

**SIO 134 / BIEB 134: Introduction to Biological Oceanography
WINTER 2021**

Lectures: Tuesday/Thursday 9:30-10:50am
Final quiz Tuesday March 16 8-11am

Please note, while lectures will be given asynchronously, **quizzes will be held during scheduled lecture times, and discussion sections will be synchronous and held during their scheduled times.**

Course Instructor

Andrew Barton, Assistant Professor, UCSD and Scripps Institution of Oceanography
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Office Hours: During scheduled lecture times when no quiz is scheduled. See schedule below. Check Canvas for Zoom links.

Teaching Assistants

Quinn Montgomery	qmontgom@ucsd.edu	Office Hours: Tuesday 11-11:45am
Chase James	ccjames@ucsd.edu	Office Hours: Monday 1:30-2:15pm
Tristin Rammel	trammel@ucsd.edu	Office Hours: Tuesday 1-1:45pm
Alaina Smith	ans132@ucsd.edu	Office Hours: Thursday 10:30-11:15am

TA office hours will also be held on Zoom. Check Canvas for available times and Zoom links. You can attend office hours held by any TA.

Course Description: This course presents the basics for understanding the ecology of marine communities in the context of a dynamic and changing environment. In the first part of the course, we will take a process-oriented approach, focusing on major functional groups of marine organisms, how they interact in ocean food webs, and how communities respond to, reflect, and potentially modulate environmental forcing. We will use this foundation as a basis for considering contemporary issues in ocean ecology, including human and climate influences.

Lectures: Lectures will be pre-recorded and posted in the Media Gallery on Canvas, along with pdfs of the lecture slides. I recommend that you watch the lectures, prepare questions, and attend office hours to discuss with either me or a TA.

Assigned readings: For each lecture, including guest lectures, there is an assigned journal article, review paper, or book section to read. The readings are available as PDF files on the course website. The purpose of the readings is twofold. First, the readings reinforce and complement the material covered in lectures. The paper may explain material in a way that you understand better than the lectures. In some cases, the readings go into greater technical or methodological detail than I will cover in the lectures. While I would not add test questions on minutiae from a paper, the general concepts discussed in the readings are “fair game” for exams. Secondly, in each discussion section starting in Week 1, you will have to prepare a

written summary of the paper to be submitted for credit. See “Discussion Sections” below for more details on how to write a paper summary.

Additional background reading: Additional information on concepts covered by the course can be found in the following online books:

Biological Oceanography, C.B. Miller & P.A. Wheeler, Wiley Blackwell Publ., 2nd ed., 2013.

Available online: <https://ebookcentral.proquest.com/lib/ucsd/detail.action?docID=892193>

Biological Oceanography: An Introduction, C.M. Lalli & T.R. Parsons, 2nd ed., 1997.

Available online:

<https://ebookcentral.proquest.com/lib/ucsd/detail.action?docID=403917>

Both books are available online through the UCSD library at the links above, but you will need to have a UCSD IP address to view the books. When off campus, you’ll need to use a VPN. One way to do this is: 1) Go to vpn.ucsd.edu in a browser, 2) Enter your login credentials, 3) Paste the links above into the open field. The books are not required reading.

Discussion Sections: TA-led discussion sections will be held synchronously at scheduled times and are designed to discuss content from the lectures and exams, and also to give students the opportunity to read and digest the assigned readings. Discussion sections will have three primary components: a) creation and discussion of exam-style questions, b) preparation of summaries of the assigned reading, and c) participation. Grading for sections will be based equally upon a, b, and c.

For part a), each student should prepare no less than 5 original, written exam-style or review questions focusing on the lecture or lectures covered for each section. The student should write both the question and the answer, and submit the questions via Canvas by 8am on the day of section. 8am is the time the first section starts on Wednesday, so in fairness to all students this will be the time the assignments are due. During section, students will go into breakout rooms to discuss their questions, and may present back to the full group when the breakout room is dissolved. The submitted questions will not be graded for accuracy, so it is the students’ responsibility to make sure they understand the answers by participating in section discussion. 10 points for each section will be awarded for completion of at least 5 questions and answers, submitted prior to the deadline. You may discuss the questions with other students but must complete the submitted questions by yourself. Submitted work will be checked with Turnitin. The 5 questions need not cover both lectures covered in section, but ideally should.

For part b), each student must write a short summary of one assigned reading for each section. If there is more than one assigned reading for a given week, select only one paper to summarize. The paper summary must be submitted to Canvas by 8am on the day of section. The summary must include the following, but not more, components (a template will be provided):

Main theme: State the main objectives and questions from the reading in 1-2 sentences.

Background information: Describe in 1-2 sentences any necessary background information to understand key aspects of the reading. These details can be technical or factual.

Methods: Describe in 1-2 sentences the method or methods used in the study. If the paper is a review paper, you may skip this part.

Results: Describe the main results of the study in 1-2 sentences.

Conclusions and Implications: Describe the conclusions and implications of the results in 1-2 sentences.

The purpose of this weekly summary assignment is to gain practice reading and synthesizing scientific papers. Please do not feel compelled to write a lengthy summary; instead, provide crisp text filling only the categories outlined above. Up to 10 points for each section will be awarded for completion of your paper summary, submitted prior to the deadline. Your TA will grade only for completeness. You may discuss the papers with other students but must complete the summary by yourself. Submitted work will be checked with Turnitin. During section, you will discuss the paper or papers after going over your study questions.

For part c), you will receive a grade for participation in the section. Attendance in sections may be recorded through Zoom polls, so it's important that the email you use to register for the session is your UCSD email and matches your Canvas login (one at the start of the 50 minute section and one at the end, participation in the full section is required for credit). 10 points will be awarded for each section for participation.

In addition, prior to and after exams, students can ask questions related to the exams. For detailed week-by-week schedule of sections, see the schedule below. There are two weeks where section will not be held (see the schedule).

You may attend a different section if you cannot attend the one you are enrolled in, but to receive credit for the weekly assignments, full answers to the questions and your paper summary must be submitted prior to the section start time for the section in which a student is enrolled. Please note that I prefer you to attend a consistent section each week. If you do attend an alternative section, it is easiest to attend one run by your same TA.

Note: if consistent participation in a section is impossible for you this quarter due to a time zone difference or other significant barrier, please contact me during the first week of classes, and your Discussion section grade will be based solely on the weekly questions and paper summaries. This policy ensures students are not disadvantaged if they cannot participate synchronously in the sections.

Academic integrity: My expectations for this course are as follows: You may discuss discussion section questions with other students, but you must write the answers in your own words (your

responses will be monitored by Turnitin plagiarism software). Similarly, you may discuss the assigned readings with other students, but the summary must be completed in your own words (and will be assessed by Turnitin). You may not use any resources (online, book, notes, collaboration with other students) during your Canvas quizzes, including the final quiz. **Any student caught cheating will fail the course.** For information on academic integrity at UCSD: <http://senate.ucsd.edu/Operating-Procedures/Senate-Manual/Appendices/2>

Grading: Grading will be based proportionally on the following assessments:

70% Quizzes

There will be 9 total quizzes during the quarter, including 8 quizzes and a final quiz. The quizzes will consist of multiple choice and/or short-answer questions. The quizzes will be available at the start of class time, for a 40 minute window (contact me if you are in a time zone that is not conducive to testing during this window). Students will have a time limit of 30 minutes once they start the quiz. The quizzes are “closed book.” **I will drop the lowest 2 scores among the quizzes and final quiz**, such that the remaining 7 assessments are each worth 10% of your final grade. This is to account for events that could cause you to miss a quiz, or impact your performance, such as illness, power outages, internet outages, social unrest, an extra busy week, etc. If you are happy with the average of your best 7 quizzes, you are not required to take the final quiz. The final quiz will be comprehensive but focus on the big ideas covered repeatedly during the quarter.

30% Discussion Sections

As described above, for each section you will earn up to 10 points each for completing at least 5 study questions, completing a paper summary, and participating in section. Assignment turned in after the due date and time will not receive credit.

I will use the following grading scale this quarter:

A+	100% to 98%
A	<98% to 92%
A-	<92% to 90%
B+	<90% to 88%
B	<88% to 82%
B-	<82% to 80%
C+	<80% to 78%
C	<78% to 72%
C-	<72% to 65%
D	<65% to 60%
F	<60%

Make-up Policy: Please note that there will be no make-up quizzes or final exam. If you miss a quiz or the final exam, you will be assigned zero points for that assessment (remember you can drop the lowest two grades). If you miss a quiz due to a serious illness, emergency or unavoidable absence we recommend you provide documentation to the faculty within 5 days of

the assessment, because it allows faculty to advise you on how best to stay current with the material, and ensure you're on track to do well with your remaining assessments. In the unusual event that you miss more than two assessments due to these kinds of serious, unavoidable issues, your grade will be calculated on the basis of the remaining assessments.

If you have a serious and unavoidable issue that causes you to miss the due date for the weekly review questions, or such an issue makes it impossible for you to attend any discussion that week (serious illness, emergency or unavoidable absence), you must submit documentation to your IA, as well as submit your review questions within five days of the missed section to have full credit. Note that IAs keep track of discussion section points.

Lecture and Section Schedule

Note that these modules do not exactly follow weeks of the course. Modules may overlap a bit to give you time to prepare for quizzes. The lecture dates are shown mainly for planning, but the lectures themselves will be available online prior to this day/time. Make sure to plan ahead to complete discussion section assignments by the deadline.

Module 1

- Jan 5 **Lecture 1:** Overview - habitats, major themes and issues, historical perspective
Jan 6 **Section 1:** Covering Lectures 1 and 2
 Readings: Lecture 1 → Anderson and Rice (2006)
 Lecture 2 → Behrenfeld and Boss (2014), pages 167-176
Jan 7 **Lecture 2:** Why plankton “bloom” – the dynamics of ocean biology
Jan 14 **Quiz 1: Covering Lectures 1 and 2**

Module 2

- Jan 12 **Lecture 3:** Phytoplankton - diversity and environmental relationships
Jan 13 **Section 2:** Covering Lectures 3 and 4
 Readings: Lecture 3 → de Vargas et al. (2015)
 Lecture 4 → Hansen and Calado (1999)
Jan 14 **Lecture 4:** Zooplankton - diversity and adaptations of planktonic consumers
Jan 21 **Quiz 2: Covering Lectures 3 and 4**

Break! No Section on January 20.

Module 3

- Jan 19 **Lecture 5:** Upper ocean circulation, biogeography, biomes
Jan 26 **Lecture 6:** Secondary production processes and relationships
Jan 27 **Section 3:** Covering Lectures 5 and 6
 Readings: Lecture 5 → Follows et al. (2007)
 Lecture 6 → Shurin et al. (2006)
Jan 28 **Quiz 3: Covering Lectures 5 and 6**

Module 4

- Jan 28 **Lecture 7:** Organization of pelagic food webs

- Feb 2 **Lecture 8:** Vertical migrations and life in the twilight zone (Professor Anela Choy)
 Feb 3 **Section 4:** Covering Lectures 7 and 8
 Readings: Lecture 7 → Steinberg & Landry (2017), pages 413-426
 Lecture 8 → Choy et al. (2017)
 Feb 4 **Quiz 4: Covering Lectures 7 and 8**

Module 5

- Feb 4 **Lecture 9:** Ocean biogeochemical cycles I: carbon cycle
 Feb 9 **Lecture 10:** Ocean biogeochemical cycles II: nitrogen, phosphorus
 Feb 10 **Section 5:** Covering Lectures 9 and 10
 Readings: Lecture 9 → Henson et al. (2012)
 Lecture 10 → Zehr (2011)
 Feb 11 **Quiz 5: Covering Lectures 9 and 10**

Module 6

- Feb 11 **Lecture 11:** Trait based ecology of marine microbes
 Feb 16 **Lecture 12:** Larval ecology and recruitment of ocean fishes & Natural climate cycles
 and the ups and downs of ocean fisheries
 Feb 17 **Section 6:** Covering Lectures 11 and 12
 Readings: Lecture 11 → Barton et al. (2013)
 Lecture 12 → Chavez et al. (2003)
 Feb 18 **Quiz 6: Covering Lectures 11 and 12**

Module 7

- Feb 23 **Lecture 13:** Ecology of marine mammals (Dr. Simone Baumann-Pickering)
 Feb 24 **Section 7:** Covering Lectures 13 and 14
 Readings: Lecture 13 → Ballance (2006)
 Lecture 14 → Edwards & Richardson (2004)
 Feb 25 **Lecture 14:** Impacts of anthropogenic climate change on marine ecosystems
 Mar 2 **Quiz 7: Covering Lectures 13 and 14**

Module 8

- Mar 2 **Lecture 15:** Coral reef ecology (Professor Jennifer Smith)
 Mar 3 **Section 8:** Covering Lectures 15 and 16
 Readings: Lecture 15 → Hoegh-Guldberg (1999)
 Lecture 16 → Ducklow et al. (2013)
 Mar 4 **Lecture 16:** Sea ice, climate change, and the ecology of polar regions
 Mar 9 **Quiz 8: Covering Lectures 15 and 16**

Break! No Section on March 10.

Final Review and Quiz

- Mar 11 In class review during scheduled lecture time
 Mar 15 Final quiz (8-11am)

Reading Assignments

- Anderson, T. R., and T. Rice. 2006. Deserts on the sea floor: Edward Forbes and his azoic hypothesis for a lifeless deep ocean. **30**: 131-137. 10.1016/j.endeavour.2006.10.003
- Ballance, L. T. and others 2006. The Removal of Large Whales from the Southern Ocean Evidence for Long-Term Ecosystem Effects?, p. 215-230. *In* R. L. Brownell, J. A. Estes, D. P. Demaster, D. F. Doak and T. M. Williams [eds.], Whales, Whaling, and Ocean Ecosystems. University of California Press.
- Barton, A. D. and others 2013. The biogeography of marine plankton traits. *Ecol. Lett.* **16**: 522-534. 10.1111/ele.12063
- Behrenfeld, M. J., and E. S. Boss. 2014. Resurrecting the ecological underpinnings of ocean plankton blooms. *Ann. Rev. Mar. Sci.* **6**: 167-194. 10.1146/annurev-marine-052913-021325
- Chavez, F. P., J. Ryan, S. E. Lluch-Cota, and M. C. Niquen. 2003. From anchovies to sardines and back: multidecadal change in the Pacific Ocean. *Science* **299**: 217-221.
- Choy, C. A., S. H. D. Haddock, and B. H. Robison. 2017. Deep pelagic food web structure as revealed by in situ feeding observations. *Proceedings. Biological sciences / The Royal Society* **284**. 10.1098/rspb.2017.2116
- De Vargas, C. and others 2015. Eukaryotic plankton diversity in the sunlit ocean. *Science* **348**: 1261605. 10.1126/science.1261605
- Ducklow, H. and others 2013. West Antarctic Peninsula: An Ice-Dependent Coastal Marine Ecosystem in Transition. *Oceanogr.* **26**: 190-203. 10.5670/oceanog.2013.62
- Edwards, M., and A. J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. *Nature* **430**: 881-884.
- Follows, M. J., S. Dutkiewicz, S. Grant, and S. W. Chisholm. 2007. Emergent biogeography of microbial communities in a model ocean. *Science* **315**: 1843-1846. 10.1126/science.1138544
- Hansen, B., P. K. Bjørnsen, and P. J. Hansen. 1994. The size ration between planktonic predators and their prey. *Limnol. Oceanogr.* **39**: 395-403.
- Hansen, P. J., and A. J. Calado. 1999. Phagotrophic mechanisms and prey selection in free-living dinoflagellates. *J. Eukaryot. Microbiol.* **46**: 382-389.
- Henson, S. A., R. Sanders, and E. Madsen. 2012. Global patterns in efficiency of particulate organic carbon export and transfer to the deep ocean. *Global Biogeochem Cyc* **26**. 10.1029/2011gb004099
- Hoegh-Guldberg, O. 1999. Climate change, coral bleaching and the future of the world's coral reefs. *Mar. Freshwater. Res.* **50**: 839-866.
- Shurin, J. B., D. S. Gruner, and H. Hillebrand. 2006. All wet or dried up? Real differences between aquatic and terrestrial food webs. *Proceedings of The Royal Society Biological Sciences* **273**: 1-9. 10.1098/rspb.2005.3377
- Steinberg, D. K., and M. R. Landry. 2017. Zooplankton and the Ocean Carbon Cycle. *Ann Rev Mar Sci* **9**: 413-444. 10.1146/annurev-marine-010814-015924
- Zehr, J. P. 2011. Nitrogen fixation by marine cyanobacteria. *Trends Microbiol.* **19**: 162-173. 10.1016/j.tim.2010.12.004