EARTHSYS/ESS 8: The Oceans

An introduction to the marine environment

Overview:

Instructors: Courtney Payne (cmpayne@stanford.edu)
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Prof. Kevin Arrigo (arrigo@stanford.edu)
Lecture: M/W 1:30-3:00, Y2E2 101
Office hours: Stephanie – W 3-4, Y2E2 101
Courtney – F 1:30-2:30, Mitchell B025
Textbook: *Investigating Oceanography* (1st or 2nd Ed) by Keith Sverdrup & Raphael Kudela
Available on Amazon (1st Ed here, 2nd Ed here), at the Branner Earth Sciences library, and PDF copies will be provided.

Assignments and Grading:

In order to receive a Satisfactory (S) grade in the class, students need to receive a 70% or higher on assignments in the course. Students who receive less than 70% will receive a No Credit (NC) grade in the class.

Grade breakdown:

Reading feedback	15%
Participation	15%
Activities	20%
Midterm 1	10%
Midterm 2	10%
Final Paper	30%

Reading feedback (15%)
Submitting 'Reading Feedback' ensures that students read the assigned chapters thoroughly and helps the instructors identify elements of the reading that are challenging or confusing to address in more detail during the class lecture. Questions should consider concepts or synthesis, rather than simple definitions or answers that can be easily searched online. To get full credit for each day's reading feedback, students must submit 1-3 thoughtful questions and 1 practice midterm question with answer (multiple choice or short answer) by 5 pm PST the day before the lecture through Canvas (under "Assignments" or "Discussion"). If there are multiple assigned chapters, students only need to submit 1-3 thoughtful questions and 1 midterm question total. Reading feedback is worth 15% of the final grade. We will have 10 lectures throughout the course; therefore, each reading feedback is worth 1.5% of the final grade.

Participation (15%)
We expect that students are invested in their learning, and attending each class session and participating in group activities is the best way to fully learn the material in this course. That said,

we understand the uncertainty of an ongoing global pandemic, and we will try to be empathetic to each other as we tackle this new course format together. If you cannot make certain parts of the course as scheduled, please notify the instructors so that we can adjust, or find other arrangements to help you make up missed material.

Activities (20%)
There are four activities to reinforce lecture and reading materials. Activities are designed to be completed during allotted class time, but in some cases groups will finish the activity outside of class. Students work in small groups (3-4 students) to complete the activities and turn in a single document (listing all group member's names) on Gradescope before the start of the next class session. All students must contribute equally and work through all parts of the assignment together. All students are held accountable for all of the material covered during activities, and concepts covered in the activities will be assessed on the midterms. Materials for activities will be posted on Canvas prior to class.

Midterms (10% each; 20% total)
The two midterms (April 20 and May 16) are a combination of multiple choice (assessing content-based learning goals) and short answer questions (assessing both skill-based and content-based learning goals). Midterm 1 (April 20) will cover chapters 2-7 (content-based learning goals 1-6; skill-based learning goals 1 and 3) and Midterm 2 (May 16) will cover chapters 8-13 (content-based learning goals 7-12; skill-based learning goals 1 and 3).

Final research paper (30%)
The goal of the final research paper is to provide an in-depth analysis of a relevant oceanography topic (chosen by the student) that incorporates recent research as well as fundamental concepts from class material. Details of the final paper proposal and assignment will be discussed further during class time (April 27). The proposed topics will be presented and discussed in class (May 2) and the 'Research Paper Workshops' (May 11 and May 23) are aimed to help students incorporate primary literature and current research into their analysis papers, as well as improve the student's ability to communicate science in written form. Skill-based learning goals 1-3 will be assessed on the final paper. Students are also recommended to meet remotely with a Hume Center tutor to discuss their paper (https://undergrad.stanford.edu/tutoring-support/hume-center/see-tutor) before the final paper is turned in (June 1).

Submitting Assignments & Late Policy
All assignments are due through Gradescope before the start of class on the day that it is due (with the exception of the 'Reading Feedback,' which is due at 5 pm the day before class). Any late assignment loses 10% off the final grade for every class period (for example, if the assignment is due Monday but is turned in Wednesday before class, the assignment will lose 10%; if the assignment is due Monday and turned in after class on Wednesday, the assignment will lose 20%). Late 'Reading feedback' will receive half credit if submitted before the class period after which the chapter was covered, and no credit following that.

Activities are group assignments that are designed to be finished within the class period. If your group does not finish the activity by the end class, the activity is due before the next lecture period.

Any students who register for class late have 2 weeks after the date they join class to make up all assignments for full credit. Please communicate with Courtney and Stephanie about joining the class and making up assignments and lecture material.

Learning goals:

Skill-based learning goals
The overall goal of this course is to engage students in scientific arguments, logical reasoning, and science communication. This course will enable students to achieve the following specific skill-based learning goals:

1. Follow a scientific argument through logical reasoning.
2. Critically evaluate scientific arguments.
3. Communicate scientific concepts in both written and spoken form.

Content-based learning goals
Broadly, the goal of this course is to introduce students to an integrated perspective of biological (marine organisms), physical (circulation, tides, waves), chemical (constituents of seawater), and geological (plate tectonics, seafloor) oceanography. Throughout the course we consider the impacts of human activities on the ocean, including discussions on global climate change, marine pollution, overfishing and eutrophication. This course will enable students to achieve the following specific content-based learning goals:

1. Describe Earth's internal structure, explain plate tectonics, and differentiate among the lithosphere, asthenosphere, and mesosphere. (Ch. 2)
2. Identify the main elements of the seafloor and understand the formation and classifications of ocean sediments. (Ch. 3)
3. Understand the physical properties of water, predict how temperature, pressure, and salinity impact density, and describe how energy is transmitted through seawater. (Ch. 4)
4. Describe the chemical composition of seawater by understanding salinity, the major constituents of seawater, residence times, nutrients, and dissolved gases. (Ch. 5)
5. Explain how the ocean and atmosphere interact by understanding Earth's heat budget and atmospheric circulation. (Ch. 6)
6. Distinguish between thermohaline circulation and surface currents in order to describe oceanic circulation patterns and features. (Ch. 7)
7. Predict the formation and dispersion of waves and quantify wave characteristics. (Ch. 8)
8. Model the Earth-moon-sun system, compare and contrast tidal patterns, and describe resultant tidal currents. (Ch. 9)
9. Recognize the major types of coastal zones and beaches and describe how human impacts (dams, breakwaters, jetties) may interfere with the equilibrium of beaches. (Ch. 10)
10. Differentiate the major environmental zones of the oceans and understand the flow of energy through trophic levels in food webs. (Ch. 11)
11. Identify key planktonic organisms and, after working directly with satellite and in situ data, understand top-down and bottom-up controls on global patterns of productivity. (Ch. 12)
12. Describe evolutionary adaptations of marine nekton, including invertebrates, fish, marine mammals, reptiles and birds. (Ch. 13)
13. Characterize different benthic environments, including intertidal zone, coral reefs, hydrothermal vents and deep-sea floor, to predict the zonation of marine organisms. (Ch. 14)

14. Evaluate the environmental problems posed by various human activities including pollution, eutrophication, oil spills and overfishing. (Ch. 15)
15. Understand the role of the oceans in global climate change and predict what the oceans might look like in a warmer world. (Ch. 16)

Course schedule:

Week	Date	In class	Reading *
1	March 28	Introduction	
	March 30	Earth Structure and Plate Tectonics & The Seafloor and its Sediments;	2, 3 **
		Physical Properties of Water	4 **
2	April 4	Activity 1 – Shape of ocean basins and bathymetry of the seafloor	
	April 6	The Chemistry of Seawater; The Atmosphere and Oceans	5, 6 **
3	April 1	Activity 2 – Seafloor sediments	
	April 13	Ocean Structure and Circulation; Guest – Noah Gluschankoff	7 **
4	April 18	Activity 3 – Surface ocean currents and ocean-atmosphere interactions	
	April 20	**Midterm 1**; Blue Planet – Seasonal Seas;	
5	April 25	*Tide pooling field trip to Pillar Point*	
	April 27	The Waves; The Tides; Research paper discussion	8, 9
6	May 2	Coasts, Beaches, and Estuaries;	10
		Research paper mini presentations – final paper topics due	
	May 4	The Living Ocean; The Plankton, Productivity, and Food Webs	11, 12
7	May 9	Activity 4 – Primary productivity in the ocean	
	May 11	The Nekton: Swimmers of the Ocean; Blue Planet – Open Ocean	13
		Research paper workshop – outlines due	
8	May 16	**Midterm 2**; Blue Planet – Coral Seas	
	May 18	The Oceans and Climate Disruption	16
9	May 23	Blue Planet – Deep Seas	
		Research paper workshop – drafts due	
	May 25	Environmental Issues; Guest – Bianca Santos	15
10	May 30	*Holiday (no class)*	
	June 1	The Benthos: Living on the Seafloor (+ possibly Blue Planet – Frozen Seas)	14
		Final paper due	

* The assigned reading is to be read for the class period listed and the reading feedback form is due by 5 pm the day before the lecture. For example, on March 30 the lecture covers chapters 2,3 & 4, so the reading feedback form is due by March 29 at 5 pm.

**Sections to read:
Ch. 2 & 3: read 2.1 – 2.5, can skip "Diving In" and "Evidence for Crustal Motion"; 3.1 – 3.3, can skip "Sampling Methods" and "Sediments as Historical Records";
Ch. 4: read all sections, can skip "Diving In"

Ch. 5: read 5.1-5.4, can skip "Diving In"
Ch. 7: skip sections 7.10-7.11, "Diving In"

Students with documented disabilities

Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk; Phone: 650-723-1066; Web site: http://studentaffairs.stanford.edu/oae.

If you are a student with a documented disability who needs special accommodations for exams, please talk to the instructors as soon as possible.

Stanford Honor Code

Students must follow Stanford University's Honor Code and the Fundamental Standard: https://communitystandards.stanford.edu/student-conduct-process/honor-code-and-fundamental-standard