



# SIO 162

## Structural Geology

### Instructor Info —



Dr. Vashan Wright



Office Hrs: Tue 1:30-2:30p



Munk 331



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vwright@ucsd.edu

### Course Info —



Prereq: SIO 100 (Field Methods) or permission from the professor



Mon & Wed



10a-11:20a



Vaughan 100

### Lab Info —



Fri



9a-11:50p



Vaughan 147

### Lab Instructor Info



Jharden Dasent



Office Hrs: Fri 12:00-1:00p



Ritter 300B

### Course Description

Structural geology is the study of how and why rocks change position and shape (i.e., deform). Structures, defined as the geometric configuration or arrangement of rocks, form when rocks and sediments are compressed, stretched, twisted, or otherwise displaced due to external forces (e.g., pressures related to the motion of tectonic plates). Structures may be big, such as folds in mountain belts, and small, such as repeated geometric arrangements of atoms. Structural geologists use structures to investigate the causes, timing, and implications of rock deformation events. The period of deformation events can range from 1000s of years, like with mountain building, to 10s of seconds, like with earthquakes.

This class will introduce students to concepts and terminology structural geologists use to analyze detectable structures within rocks and sediments. Students will learn the skills necessary to identify and quantify deformation structures and to communicate their observations and interpretations to other geoscientists. Students will develop an understanding of the physics that governs deformation, allowing them to interpret the structures they identify. Students will learn how to apply their newly developed structural geology skill sets to real-world problems.

Structural geology is a commonly taught undergraduate Earth science course. The materials that the professor will present will be sourced from structural geology textbooks, his understanding of the subject from years of doing structural geology research, data from his research, Kevin Brown's (former Scripps structural geology professor) lecture notes, James Kirkpatrick's (McGill University professor) lecture and lab notes, and existing photos of structures that the professor finds online.

### Learning Objectives

At the completion of this course, students should be able to:

1. Understand the basic principles of rock deformation.
2. Describe rock deformation structures.
3. Interpret the deformation history of rocks from deformation structures.
4. Develop and test geologic models of deformation structures in space and time.

### Course Material

#### Required Texts

Fossen, H. (2016). Structural geology. Cambridge University Press. [A copy of this text is on Canvas.]

#### Additional Resource

Summaries of each chapter (E-modules) on the author's website:  
<https://folk.uib.no/nglhe/StructuralGeoBookEmodules2ndEd.html>

#### Other

The textbook *Processes in Structural Geology and Tectonics* by Ben van der Pluijm and Stephen Marshak is a nice complement to the textbook by Fossen (2016). The textbook by Pluijm and Marshak is free and available online here: <http://psgt.earth.lsa.umich.edu/>. Students will need to email the authors for access to this textbook.

Any required journal articles and book chapters will be provided on Canvas.

# FAQs

? What is the policy on turning in late or missed work?

! Make-up exams or assignments will only be allowed for students who have a substantiated excuse approved by the instructor *before the due date*. Leaving a phone message or sending an e-mail without confirmation is not acceptable. Labs are mandatory. You are still responsible for completing the lab assignment if you miss a lab period.

? Are the field trips mandatory?

! Yes.

? What type of structural geology do you (the professor) do?

! The professor studies the deformation of fault zones in underwater environments using seismic-reflection profiles and sediment cores mostly.

? Are there opportunities to work in research in your lab?

! If you're interested in conducting undergraduate research, please discuss this with the professor during his office hours.

## Course Context

This classroom will be a place where students will be treated with respect. The professor will strive to create a welcoming environment for students of all ages, backgrounds, beliefs, ethnicities, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, abilities, and other visible and non-visible differences. All class members are expected to contribute to a respectful, welcoming, and inclusive environment for every other class member.

The professor's goal is to support and stimulate effective learning. This includes teaching in ways that are inclusive and accessible to all students. If a student has any situation that affects their ability to benefit from the material offered in the course, that student can request reasonable accommodations. Please inform the professor as soon as possible and contact the Office for Students with Disabilities (<https://students.ucsd.edu/well-being/disability-services/>) for additional support.

All learning happens within cultural contexts. UC San Diego is located on the unceded traditional and sacred land of the Kumeyaay people, who still occupy this land and whose history, language, culture, and traditional ways of life continue to influence the greater San Diego community. Thus, the professor acknowledges that our class, life, and work occur on the unceded territory of the Kumeyaay nation, to whom we owe honor and gratitude. The professor's research and work also acknowledge the Taino people who lived on the Jamaican island territory and from which the professor recognizes part of his ascendancy and to whose elders the professor respects through his research and actions.

## Grading Scheme

Students will receive a letter grade for the work they do in class. Grades will follow the following scale: A = 93-100; A- = 90-92; B+ = 87-89; B = 83-86; B- = 80-82; C+ = 77-79; C = 73-76; C- = 70-72; D+ = 67-69; D = 63-66; D- = 60-62; F <60. The professor will round up students' final grades to the nearest whole number — e.g., a 79.2 will be rounded up to an 80. Curving is at the discretion of the professor.

Grades in the C range represent performance that meets expectations; Grades in the B range represent performance that is substantially better than the expectations; Grades in the A range represent work that is excellent.

Grades are weighted as follows:

10%	Quizzes and In-class Exercises
15%	Class Project
15%	Midterm Exam
25%	Final Exam
35%	Lab

## Lectures

On most class days, the professor will facilitate at least one active learning exercise at the beginning of class to pique interest in the topic, get students thinking, and determine what students already know. Lectures and open discussions will follow this. Students should expect to do algebra and trigonometry problems. Electronic note recording may be important for class, so computers are allowed. Eating and drinking are allowed in class.

## Field Trip & Research Project

There are two mandatory field trips for this course. The field trips are where you will collect data for the class project. Please see the class schedule (last page) for the field trip dates. If changes are needed, we will discuss them ahead of time.

## Remote Learning

This course may include a mix of in-class and remote learning. Remote learning can be awkward. Even though the professor and students are mostly experts by now, we should still expect glitches and issues. The professor will work hard to make students' learning experience as smooth and enjoyable as possible. This course's content and evaluation scheme may change due to extraordinary circumstances beyond the University's or professor's control.

## Attendance

Attendance is expected at all lectures. Valid excuses for absence will be accepted before class. In extenuating circumstances, valid excuses with proof will be accepted after class. Students are allowed to miss 3, unexcused classes, during the quarter without penalty. Any further absences will result in grade deductions (1 point per missed class, taken from the total of the quiz scores).

## How to do well in this course

The professors suggest that students attend all the lectures, labs, and exams. If students do this, pay keen attention in class, read for the quizzes, do most of the labs during lab time, and complete the assignments on time, they will have a better chance of doing well. Students should take good notes in class since the notes will be needed to revise for exams. Students are responsible for lectures, lab materials, and assigned reading. The professor will draw exam questions from these materials. Students should feel free to ask questions anytime – during the lectures, labs, or professor's office hours. Students may email the professor to make an appointment if visiting during office hours does not work for them. To achieve the best grades in the class, students will likely need to do the required reading, read around the subject for themselves, and demonstrate the knowledge gained from this study time by using it to answer the exam, quiz, and lab questions.

## Academic Integrity and Honesty

Students are expected to complete the course in compliance with the highest standards of academic integrity. An honest effort is expected of everyone. By continuing enrollment in this course, students pledge to abide by UC San Diego's Integrity of Scholarship Agreement (<https://academicintegrity.ucsd.edu/forms/form-scholarship-agreement.html>), which reads as follows (some modifications were made to adjust it to the present course):

1. No student shall knowingly procure, provide, or accept any materials that contain questions or answers to any examination or assignment to be given at a subsequent time.
2. No student shall complete, in part or in total, any examination or assignment for another person.
3. No student shall knowingly allow any examination or assignment to be completed, in part or in total, for themselves by another person.
4. No student shall plagiarize or copy another person's work and submit it as the student's own work.
5. No student shall employ aids excluded by the instructor in undertaking course work.
6. No student shall alter graded class assignments or examinations and then resubmit them for regrading.
7. No student shall submit substantially the same material in more than one course without prior authorization. A student acting in the capacity of an instructional assistant (IA), including but not limited to teaching assistants, readers, and tutors, has a special responsibility to safeguard the integrity of the scholarship. In these roles, the student functions as an apprentice instructor under the tutelage of the responsible instructor. An IA shall equitably grade student work in the manner agreed upon with the course instructor. An IA shall not make any unauthorized material related to tests, exams, homework, etc., available to any student.
8. No student shall provide their assignments, in part or in total, to any other student in current or future classes of this course. No student shall procure or accept assignments from any other student from current or prior classes of this course.
9. For all group assignments, each group member is responsible for the academic integrity of the entire submission.
10. Each student is responsible for knowing and abiding by UCSD's Policies on Integrity of Scholarship and Student Conduct (<https://students.ucsd.edu/sponsor/student-conduct/>).
11. Any student violating these policies will earn an 'F' in the course and will be reported to the University for the violation.

## Tentative Class Schedule

Classes begin Monday, January 8, 2024. The last class will be on Wednesday, March 13, 2023. The course begins with the fundamentals of deformation, followed by examining ductile and brittle deformation structures, and then plate tectonics. The professor hopes to end the course by bringing everything together in the last week. The topics that the professor covers weekly might change depending on the class' progress.

### Quiz and Suggested Reading Schedule

There will be a 10-minute quiz or in-class group exercise on the prior week's material during the Wednesday class for weeks 2-10 unless otherwise stated. The professor suggests reading the textbook's online E-module before lectures and reading the textbook chapter after attending lectures. This should prepare students well for the quiz/in-class exercise while enhancing the assimilation of the knowledge gained in class.

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### MODULE 1: Fundamentals of Deformation

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Week 1	Introduction to Structural Geology	Chapter 1
	Introduction to Deformation	Chapter 2
Week 2	Fundamentals of Strain	Chapter 3
	Strain in Rocks	Chapter 3
Week 3	Introduction to Stress	Chapter 4
	Stress in Rocks	Chapter 5; Field Trip: Jan 27
Week 4	Rheology	Chapter 6

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### MODULE 2: Deformation Structures

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Week 4	Shear Zones	Chapter 16
Week 5	Ductile Structures	Chapter 13-15
	Folds	Chapter 12
Week 6	EXAM	Chapters 1-6, 13-15, 16
	Mechanics of Folding	Chapter 12; Field trip: Feb 17
Week 7	Brittle Deformation	Chapter 7
	Faults and Faulting Mechanisms	Chapter 9

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### MODULE 3: Tectonics

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Week 8	Reverse Faults	Chapter 17
	Extensional Faults	Chapter 18
Week 9	Transform Faults	Chapter 19
	Convergent Boundaries	
Week 10	Divergent and Transform Boundaries	
	Plate Tectonics and Natural Hazards	
Week 11	FINAL EXAM	March 22, 2023; 8-11 am; Vaughan 100

