Fall 2022 | GEOL 1110 | Structural Geology

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Class time: MWF 9:00-11:50 AM
Lab time: W 2:00-4:50 PM
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Class Room: Krebs B52
Lab Room: Krebs B52

Welcome to Structural Geology!

COURSE DESCRIPTION:

Structural Geology is a sub-discipline of geology which addresses stress, strain, and the deformation of rocks by examining and interpreting the spatial relationships of rocks and layers. Structural Geology is an upper-level geology course intended for junior or senior geology majors. The primary goals of this course are to teach the skills to: describe rock structures with proper terminology; understand the kinematic and mechanical processes that allow rocks to deform; and the ability to conduct detailed analysis of rock deformation. This class builds upon primary knowledge of geologic structures (folds, faults, etc.) taught in lower-level courses (*Prereq: GEOL 0061 Historical Geology or GEOL 0200 Geodynamics*) and expands upon these topics focusing on the three-dimensional nature of structural features, how these features fit into tectonic settings, and the basic mechanical development of such features. To develop these skills the lecture and laboratory aspects of this course are heavily integrated.

My lectures in Structural Geology are a combination of powerpoint presentations with notes written out on the chalk board. One of the most important skills learned in Structural Geology is the three-dimensional visualization of geologic structures, however, this can also be one of the more challenging aspects of the course. To achieve comprehension and skill strength, various in-class examples and exercises are provided and methodically walked through with the students. After fundamental examples are given in lecture, students complete homework assignments to reinforce material. Lab sessions apply skills learned in lecture with more in-depth problems geared toward practical application (i.e., drill-hole interpretation, geologic mapping, oil/gas exploration, etc.). Nearly all problems are approached visually as well as derived mathematically. Students are taken on several field trips to both local and regional geologic structures to study the geologic features discussed in class. Field trips and field work are an important teaching tool in Structural Geology and there are virtually no substitutes for reinforcing the theoretical elements discussed in class.

GOALS

- The primary purpose of this class is to help you conceptualize the principles of structural geology, the study of deformation in rocks. By the end of the course, you should be able to:
  - Describe rock structures with proper terminology
  - Understand the kinematic and mechanical processes that allow rocks to deform
  - Be able to conduct detailed analyses of rock deformation

Required Texts:

Structural Geology by Haakon Fossen, 2nd edition, 2011, Wiley, ISBN-10: 1107057647, ISBN-13: 978-1107057647 (~$50 new, ~$55 used)

Structural Analysis and Synthesis: A Laboratory Course in Structural Geology by Rowland, Duebendorfer, and Schiefelbein, 3rd Edition, 2007, Wiley, ISBN-13: 978-3642008641, ISBN-10: 364200864X (~$60 new – buy it new, students have had issues with used purchases)

Additional resources:
This text (*Structural Geology* by Haakon Fossen) has a variety of online resources that we will utilize throughout the semester. To use the e-modules, you will need an up-to-date web browser with a flash player. All campus computer labs should be capable of playing the e-learning modules correctly (if not, notify the lab manager).

Text E-Modules: http://folk.uib.no/nglhe/StructuralGeoBookEmodules.html
Text Problems: http://folk.uib.no/nglhe/Additional%20Problems.pdf

Additional readings and class exercises will be posted and made available for use, if necessary. All readings (textbook, e-learning modules, and other postings) should be read prior to our in-class discussion of the material to help reinforce learned concepts. I will elaborate on the most important points of the chapter readings as the course progresses.

Other required materials:
Protractor, ruler, 360° compass, colored pencils, tracing paper, graph paper (white, not green), scientific calculator, and Field book (all should be available at the bookstore).

Evaluation of the Course
Exercises and other course materials will be provided in class. It will be hard to "make up" missed classes. Reading and e-module assignments are designed to give more detail on many topics than time allows for in class presentation. These additional assignments are an important part of the course and do not just reiterate lecture material. Some topics in the reading and e-modules will not be covered in class but will appear on exams. The points of individual labs, quizzes, and exams may vary. However, your points will be weighted such that your final grade will be calculated as follows:

20% **Lecture Quizzes**
10% **Lecture Exercises**
10% **Laboratory Exercises**
5% **Laboratory Final**
5% **Term Project**
50% **Exams,** which is subdivided into three parts:
15% Exam I
15% Exam II
20% Final Exam

Please do not ask for extra credit or extra assignments to get extra credit.

LECTURES:
Lectures will be posted to Canvas each week. Students are expected to have watched the lectures and completed notes on those lectures. Each Lecture will begin with a quiz. You are permitted to use your notes on the five question multiple-choice quizzes. The lectures are intended to provide background for the in-class exercises, and therefore, it is extremely important the lectures are consumed prior to class.

CLASS EXERCISES:
The class exercises will be based off the assigned reading, lectures, and labs. Questions are designed to make sure that you have learned the material and are prepared for the next class (i.e., have completed the reading/online lectures). They will be posted to Canvas prior to class meetings so remote students can access them.

LABS:

Labs are designed such that a student who is current with the class material should be able to complete the lab in the time allotted. However, some labs will at times be more difficult and require work outside of class time. Most lab exercises will involve graphical and analytical solutions to geometric problems, whereas other labs may emphasize the study and interpretation of geologic maps, since these offer the best alternative to visiting structures in the field. We will also explore hand sample and thin-section observation, structural analytical techniques, and other methods. Lab topics will parallel those covered in concurrent lectures as closely as possible, but there may not always be a perfect overlap. At times, materials will be made available for use. Out of courtesy to others, please do not remove any materials from the lab.

You are expected to use all of the resources at your disposal, including your wits, the internet, each other (when acceptable), as well as the instructor. You are responsible for turning in *your own* work. Working with other students is encouraged, however, blatantly copying another student's work is unacceptable.

Please take care in preparing lab reports, since your grade will in part depend on the presentation of your reports. Write clearly, draw clearly and carefully what you see, and annotate captions with strings of words that make sense. If you feel your handwriting will be a hindrance to the professionalism of your reports, **type**. Please, thoroughly read the questions posed so that you answer all that is being asked of you. Labs are due at the start of lab the following week after they are assigned, unless stated otherwise. Late assignments will lose 10% of their value for each day that they are late, this includes weekend days.

EXAMS:

The best way to study for the exams will be discussed in class. They will attempt to have you apply the knowledge, both forward and backwards through examples and exercises discussed. I really don't know exactly how I am going to do these, we're going to have to talk about it.

FIELD TRIP:

Fieldwork is at the core of structural geology and it is in this environment that students link learned course concepts to the observation of natural phenomena around them. Consequently, we will have one full weekend fieldtrip for this course tentatively scheduled for **October 1st and October 2nd (Sat and Sun)**. We will be camping one night and as the date approaches we will coordinate needed equipment. There will be an assignment connected with the fieldtrip. Students unable to attend the fieldtrip will miss a great deal, and will need to do a substantial make-up assignment. Attendance on the fieldtrips is required, I will discuss everyone's schedule the first week of class and determine if people have conflicts. Additional details will be provided regarding the field trip so that students can plan accordingly.

EXPECTATIONS:

The study of structural geology is both challenging and fun. You will have the chance to learn in a hands-on way in class and lab, and I hope you find this class both enjoyable and challenging. A few things to keep in mind will maximize your potential success in this course:

Attendance: I do not take attendance, but you are expected to attend each class and lab. Much of the learning takes place in the classroom and laboratory, and often cannot be made up or reproduced, so be in class. Attendance is also a great predictor of grades! It is your responsibility if you miss a class and you will be held accountable for any reading assignments, exams, and any deadlines or changes announced. If you do miss a class, see your classmates to make up for what you have missed. Please contact me if you have any further questions or a scheduled absence.

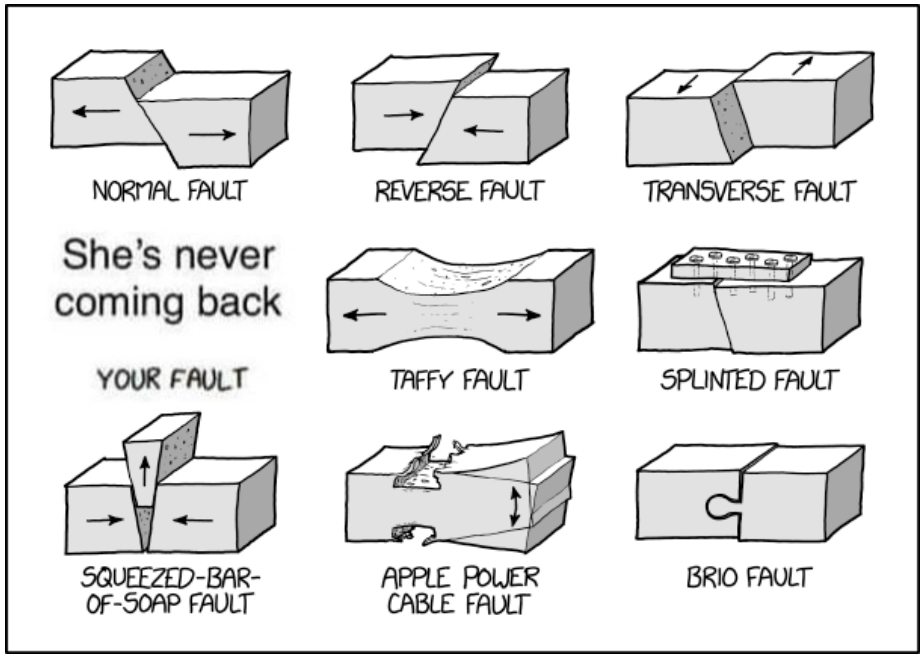
Prerequisites: I assume a basic understanding of physical and historical geology, including elementary nomenclature for such topics as rock classification, geologic time, and stratigraphy. A working knowledge of trigonometry and the manipulation of basic mathematic equations are essential.

Assignments / workload: It is also essential that you read the assigned pages and e-modules prior to class and participate in class. As with your other courses, you should expect to spend about 2-3 hours outside of class for each credit hour. So for this class, expect to spend a minimum of 9 hours *outside* of class each week reading, working on the quizzes, exercises, and labs.

Learning accommodations: If you require any course adaptations or accommodations, please make an appointment to discuss these or other important matters with me as soon as possible.

Ask for help: Please seek help if you are confused or in need of clarification. Also please visit me at office hours.

Academic integrity: UPJ values the academic integrity of its students and faculty. It is your responsibility to familiarize yourself with the university's policy on academic integrity (http://www.upj.pitt.edu/globalassets/documents/academics/upj-academics-integrityguidelines.pdf). Violations of academic integrity will be reported to and judged by the academic integrity committee. If you are found responsible for violating the policy, penalties may include a failing grade as well as possible probation, suspension, or expulsion, depending on the seriousness and circumstances of the violation and your history of past violations.



*This schedule will be fluid at times to adjust for the pace and comprehension of the class.

Schedule of Events				
Week	**Monday (Lec)**	**Wednesday (Lec)**	**Wednesday (Lab)**	**Friday (Lec)**
1	August 29, 2022 Intro to Structure	August 31, 2022 Strike , Dip, and Bruntons	August 31, 2022 Strike and Dip	September 2, 2022 Measuring Rocks
2	September 5, 2022 **NO CLASS** **LABOR DAY**	September 7, 2022 Review of Basic Structures I	September 7, 2022 Attitudes of lines and planes	September 9, 2022 Review of Basic Structures II
3	September 12, 2022 Deformation: Displacement & Strain	September 14, 2022 Deformation: Strain Ellipses	September 14, 2022 Outcrop Patterns and Structure Contours	September 16, 2022 Stress Normal & Shear
4	September 19, 2022 Stress: Mohr's & Coulomb Fail	September 21, 2022 Rheology: Intro Terms	September 21, 2022 Interpretation of Geologic Maps	September 23, 2022 Rheology: Confining Pressure
5	September 26, 2022 Rheology: Pressure and Fluids	September 28, 2022 Rheology: Temp & Heat	September 28, 2022 Geologic Structure Sections	September 30, 2022 Rheology: Strain Rate & Diff Press
6	October 3, 2022 Rheology: Brittle-Ductile	October 5, 2022 Review & Catch Up	October 5, 2022 Stereonets I: Lines and Planes	October 7, 2022 **EXAM I**
7	October 10, 2022 Folds: Vocab	October 12, 2022 Folds: Definitions	October 12, 2022 Stereonets II: Folds	October 14, 2022 **NO CLASS** **FALL BREAK**
8	October 17, 2022 Folds: Fold Classifying I	October 19, 2022 Folds: Classifying Folds II	October 19, 2022 Stereonets III: Restorations	October 21, 2022 Folds: Fold Mechanics

Schedule of Events

Week	Monday (Lec)	Wednesday (Lec)	Wednesday (Lab)	Friday (Lec)
9	October 24, 2022 Folds: Passive Folding	October 26, 2022 Folds: Parasitic & Cleavage	October 26, 2022 Folds: Fold interpretation	October 28, 2022 *Last day to withdraw* Joints: Definitions
10	October 31, 2022 Joints: Joint Sets	November 2, 2022 Faults: Definitions	November 2, 2022 Faults	November 4, 2022 Faults: Components & Features
11	November 7, 2022 Faults: Features & Surfaces	November 9, 2022 Faults: Rocks & Stresses	November 9, 2022 Dynamic & Kinetic Analysis of Faults	November 11, 2022 Faults: Compressional
12	November 14, 2022 Faults: Tensional	November 16, 2022 Faults: Shear	November 16, 2022 Balanced Cross Sections	November 18, 2022 **EXAM II**
13	November 21, 2022 **NO**	November 23, 2022 **CLASSES THANKSGIVING**	November 23, 2022 **THIS BREAK**	November 25, 2022 **WEEK**
14	November 28, 2022 Metamorphic Facies and Foliations	November 30, 2022 Foliations, Cleavages, and Flinn Plots	November 30, 2022 Bree Creek Quad Catch Up	December 2, 2022 Lineations, Tectonites, and Kinematic Indic.
15	December 5, 2022 Tectonics: Appalachia	December 7, 2022 **FINAL LAB EXAM**	December 7, 2022 Tectonics: Spring Break Location	December 9, 2022 Tectonics Your Choice
16	**Monday** **December 12th** *8:00 AM - 10:00 PM* **FINAL EXAM**			