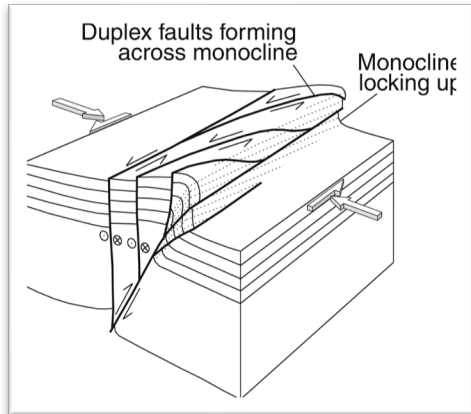


GEOL 3411: STRUCTURAL GEOLOGY, SPRING 2022

Lecture: TR 11:00 – 12:15, Lab: T 2:00 – 4:50



Professor: Dr. Joe Satterfield

Office: VIN 122

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Course Description

A study of ways rocks and continents deform by faulting and folding, methods of picturing geologic structures in three dimensions, and causes of deformation. Includes a weekend field trip project (tentative date: March 3-6). Prerequisite: Physical Geology or Historical Geology

Course Delivery Style: On-campus class and lab

Structural Geology lecture and lab will be run as face-to-face classes in Vincent 146. Short videos made by your professor coupled with required reading in our two textbooks will introduce terms and basic concepts. We will spend much time in class and lab applying terms and concepts to solve problems.

Please refer to this [Health and Safety web page](#)¹ for updated information about campus guidelines as they relate to the COVID-19 pandemic.

Required Textbook

- ***Structural geology of rocks and regions, Third Edition***, by George H. Davis, Stephen J. Reynolds, and Charles F. Kluth. No lab manual needed!

Required Lab and Field Equipment

1. Geology field book (I will place an order for all interested and pay shipping)
2. Pad of Tracing paper, 8.5 in x 11 in or 9 in x 12 in (Buy at Hobby Lobby or Michaels)
3. Graph paper pad, 5-squares-per-inch grid
4. Set of colored pencils (Buy good ones at Hobby Lobby or Michaels)
5. Small protractor (4-inch) and ruler

Field Geology Gear and Camping Gear Sources

1. Happy Trails, San Angelo, [Happy Trails website](#)²
2. ASC Scientific, [Geology Equipment Website](#)³

Grading

- 10 Weekly Quizzes, 1% each (10% total)
- 2 exams, 11% each (22% total)
- Comprehensive final exam (13%)
- 11 graded lab projects, including required field trip and paper summary, 5% each (55% total)
- Each student will schedule a brief individual meeting with Dr. Joe after Exam 1.

On-campus Face-to-face Office hours (meet in my office, VIN 122)

- Tuesday: 1:00 – 2:00 pm
- Wednesday: 10:00 am – 1:00 pm, 2:00 – 5:00 pm
- Or contact me to set up a convenient time to meet

Course Expectations

- 1) You will attend and participate in every class and lab and view and take notes on every course video.
- 2) You will not distract yourself or others with electronic devices in lecture or lab. You will put your phone away during class and lab. During lab, you will step outside the room if you must text or take a call.
- 3) Take the next big step: let's talk outside of class about almost anything. Topics I like to discuss: geology, hiking and backpacking trails, productive ways of learning geology, racquetball, Lord of the Rings, future careers, lame jokes, and more. You will schedule a brief meeting after Exam 1; I will buy the coffee!

Course Webpages

The [Angelo State Blackboard site](#)⁴ contains PowerPoint slides, course videos, web links to scenic areas mentioned in class, practice problems, answers to lab assignments, and your official grades.

Student learning outcomes

1. To learn and practice skills needed for summer field camp, GEOL 3600, a 5- or 6-week field geology course. Look at Sul Ross State University Field Camp, [Sul Ross Field Camp information](#)⁵ or Indiana University Field Camp, [Indiana University Field Camp information](#)⁶
2. To recognize and measure linear and planar structural features in rocks, folds, and faults. You will learn how to use a Brunton compass to measure structures in the field.
3. To describe and visualize three-dimensional orientations of folds and faults by constructing cross-sections, stereonet, and orthographic projections.
4. To make interpretations about the forces that deform rocks (dynamic analysis) and the history of deformation (kinematic analysis).
5. To make interpretations about the details of plate tectonics, especially aspects related to the Marathon-Ouachita, Cordilleran, and Basin and Range orogens exposed in West Texas mountains.

FIELD TRIP

1. **Lab 11: El Solitario, Big Bend Ranch State Park:** NEW DATES: Thursday – Sunday, March 3 – 6, departing 11:00 am. We will camp three nights in the South Leyva Campground and drive into El Solitario (4WD required!) to describe outcrop-scale folds, map-scale folds, thrust faults, and pluton-caused structures. Last trip to El Solitario was in 2019! Those in 2021 Structure class invited to join us!

Schedule

Week	Lecture/Discussion Topics and Required reading	Lab Projects
I: 1/18, 1/20 Chapter 1	Flipgrid Introductions Opportunities to order field book, other equipment 1a. Rock Description Checklist (p. 21) 1b. Block project: drawing strike and dip symbols, apparent dip (p. 713-718, 721) 1c. Deformation: meaning and causes (p. 7-16) 1d. The time factor and the geologic time scale (p. 32-33) 1/20: QUIZ 1: Chapter 1 (subject to change)	No lab meeting
II: 1/25, 1/27 Chapters 1, 2	1e. Primary structures, How applied as Facing Indicators (p. 706-711) 2a. Displacement Vectors vs Deformation Paths, (p. 37-43) 2b. Hot Spot Project 2c. Rigid body translation, rotation (p. 44-59) 2d. Strain: distortion and dilation (p. 37) 1/27: QUIZ 2: Orthographic Projection Problem	1: Dagger Mountain cross-section: Cross-section construction review, converting true dip to apparent dip (p. 718 – 721)
III: 2/1, 2/3 Chapter 2	2d. Strain: Calculating changes in line length and changes in angle between lines (p. 64-71) 2e. Strain analysis projects (Belemnites, Brachiopods, Skolithos) 2f. The Strain Ellipse, fundamental strain equations (video, p. 73-77) 2/3: QUIZ 3: Chapter 2, Displacement and Strain	2: Orthographic Projections: Solving true, apparent dip problems, strike and dip problems, thickness problems (Ragan, Ch 1 and 2)
IV: 2/8, 2/10 Chapter 3	3a. Calculating Traction underground (p. 101-106) 3b. Going from Traction to Stress (p. 106-108) 3c. Interpreting Principal Stress Directions from faults, stylolites (p. 288-291) 2/10: QUIZ 4: Chapter 3, Traction, Principal Stresses	3: Interpreting strike and dip from map patterns: The three-point problem, an introduction to geologic mapping (Ragan, Ch 3)
V: 2/15, 2/17 Chapter 3	3d. Strength/rock behavior terms (p. 120-128, Video) 3e. Evaluating Mechanical behavior during testing (p. 138-147) 2/17: EXAM 1: Chapters 1, 2, and 3	4: Basic stereonet techniques
VI: 2/22, 2/24 Chapter 5	5a. Types of Joints and Shear Fractures (p. 193-199, 201-202) 5b. Practical Importance of Jointing (p. 199-201) Project: mapping joints with aerial photos 2/24: DEPART ON EL SOLITARIO FIELD TRIP	5: El Solitario Field Trip
VII: 3/1, 3/3 Chapter 5	5c. Joints as Paleostress Indicators 5d. Detailed Look at Joint Surfaces (p. 204-212) 5e. Video: Examples of Regional Joint Patterns (p. 239-247) 5f. Joint Intersection Patterns reveal relative timing (p. 212-216) 5g. Joint Spacing (p. 216-225) 3/3: QUIZ 5, Review Chapter 5	6: Introduction to Geologic Mapping using Google Earth. Bring Laptop to lab
VIII: 3/8, 3/10 Chapter 6	6a. Recognizing faults (p. 251-260) 6b. Video: Brittle fault rocks (p. 260-266) 6c. Map and subsurface expressions faults (p. 267-272) 6d. Fault Slip versus Fault Separation 6e. Naming and classification of faults (p. 272-277) 3/10: Projects: Mapping Backbone R. faults, Advanced Wood blocks 3/10: QUIZ 6 GRADE: Turn in fault Projects, plus fault naming quiz	7: More stereonet techniques
3/14 – 3/18	SPRING BREAK: GET OUTSIDE!	

Week	Lecture/Discussion Topics and Required reading	Lab Projects
IX: 3/22, 3/24 Chapter 6	6f. Determination of fault slip: 5 ways (p. 278-281) 6g. Measuring slickenline rake on fault surface, plotting on stereonet 3/24: QUIZ 7, Fault Slip Indicators Gallery Walk Review	8: Geologic map 2, cross-section and stereonets
X: 3/29, 3/31 Chapter 6	Thrust faults (p. 305-320) 6g. Plate-tectonic settings of thrust belts (3) 6h. Thrust fault terms: allochthon, autochthons, window, klippe Project: Sketch cross-section of klippe, window 3/31: QUIZ 8, Thrust faults	8: Cross-section Due 8: Complete work on stereonets, sequence of events
XI: 4/5, 4/7 Chapter 6	6i. Wedge thrust belt model: piggyback thrusts on basal decollement 6j. Thrust belt: ramps, flats, horses, duplexes, tear faults Normal faulting (p. 321-333) 6k. Plate-tectonic settings of normal faults (2) 6l. Growth faults 6m. Normal fault zones: ramps, flats, synthetic vs antithetic faults 6n. Low-angle normal faults: metamorphic core complexes vs Yerington domino model Project: Interpreting Corsair Trend seismic section 6o. Strike-slip faulting including Reidel Shears (p. 334-343) 4/7: No formal class meeting. Watch, take notes on course videos (Dr. Joe and Field Methods Class at Indio Ranch)	Lab open, but no formal meeting: Field Methods Class at Indio Ranch
XII: 4/12, 4/14 Chapter 7	4/12: EXAM 2 (Chapters 5, 6; including net, time scale, cross-section) 7a. Geometric analysis of folds (p. 358-364) 7b. Basic and strange fold names (p. 351-357; April Fools contest) 7c. Describing shape and size of a folded surface (p. 375-378) 7d. Classifying folds using layer thickness changes (p. 380-383) 7e. Stereographic determination of fold orientations (p. 366-368) 7f. Project: Finding big folds from parasitic S-, Z-folds, (p. 347-348)	9: Systematic fracture measurement and analysis, Ben Ficklin Dam outcrop.
XIII: 4/19, 4/21 Chapter 7	7g. Project: Subsurface structure contour maps (p. 726-728) 7h. Fold dynamics: buckling, flexural slip, flexural flow, passive (p. 383-403) Project: Folding an Ice Cream Sandwich 7i. Causes of Folding 4/21: QUIZ 9: Folds, Chapter 7 topics	10: Geologic map 3: Cross-section displaying Polyphase folding
XIV: 4/26, 4/28 Chapters 8, 9	8a. Structural Inversion and Reactivated faults (p. 443-447) 8b. Fault Propagation Folds (p. 414-426) 8c. Axial-planar cleavage / foliation (p. 463-486) 8d. Geometric relationship of cleavage to folding (p. 487-488) 8d. Polyphase folding (p. 512-518) 4/28: QUIZ 10: Folds, Chapter 8, 9 topics	10: Cross-section Due 10: Complete work on nets, sequence of events 11: Scientific papers passed out, Introduction to how to read scientific papers
XV: 5/3, 5/5	Review projects Review field trip (on-campus!) Subsurface mapping project	10: Remainder of lab due 11: PAPER SUMMARY DUE Discuss paper in lab
XVI 5/10	5/10: FINAL EXAM, Tuesday, 10:30 AM – 12:30 PM	

Your future career in Geology

The [US Department of Labor Occupational Handbook](#)⁷ contains information on geology careers, salaries, education needed, and future job outlook in geology.

GEO, the student organization for all interested in geology, meets twice a month, Wednesdays at 6:00 pm. The first meeting will be: GEO is a Student Chapter of [American Association of Petroleum Geologists](#)⁸.

Late Assignment Policy

- Ten-point penalty assessed if turned in after due date stated on lab handout
- Late assignments will not be accepted after graded labs returned or key posted (generally one week after lab is due). These are ethics and project management issues!
- If quarantined, accommodations will be provided for late work. Please let Dr. Joe know in writing.

Academic Integrity

Students are expected to maintain complete honesty and integrity in all work. Any student found guilty of any form of dishonesty in academic work is subject of disciplinary action and possible expulsion from ASU.

The College of Science and Engineering adheres to the university's [Statement of Academic Integrity](#)⁹.

Policy for this course: first offense- zero for exam or assignment, second offense- F in course

Plagiarism

Plagiarism is a serious topic covered in ASU's Academic Integrity policy in the Student Handbook. Plagiarism is the action or practice of taking someone else's work, idea, etc., and passing it off as one's own. Plagiarism is literary theft.

In your discussions and/or your papers, it is unacceptable to copy word-for-word without quotation marks and the source of the quotation. It is expected that you will summarize or paraphrase ideas giving appropriate credit to the source both in the body of your paper and the reference list.

Papers are subject to be evaluated for originality. Resources to help you understand this policy are available at the [ASU Writing Center](#)¹⁰

Accommodations for Students with Disabilities

ASU is committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs or activities of the university, or be subjected to discrimination by the university, as provided by the Americans with Disabilities Act of 1990 (ADA), the Americans with Disabilities Act Amendments of 2008 (ADAAA), and subsequent legislation.

Student Disability Services is located in the Office of Student Affairs, and is the designated campus department charged with the responsibility of reviewing and authorizing requests for reasonable accommodations based on a disability. It is the student's responsibility to initiate such a request by contacting an employee of the Office of Student Affairs, in the Houston Harte University Center, Room 112, or contacting the department via email at ADA@angelo.edu. For more information about the application process and requirements, visit the [Student Disability Services website](#).¹¹ The employee charged with the responsibility of reviewing and authorizing accommodation requests is:

Dallas Swafford, Director of Student Disability Services
Office of Student Affairs, Houston Harte University Center, Room 112
325-942-2047
dallas.swafford@angelo.edu

Title IX

The University prohibits discrimination based on sex, which includes pregnancy, sexual orientation, gender identity, and other types of Sexual Misconduct. Sexual Misconduct is a broad term encompassing all forms of gender-based harassment or discrimination including: sexual assault, sex-based discrimination, sexual exploitation, sexual harassment, public indecency, interpersonal violence (domestic violence and/or dating violence), and stalking. As a faculty member, I am a Responsible Employee meaning that I am obligated by law and ASU policy to report any allegations I am notified of to the Office of Title IX Compliance.

Students are encouraged to report any incidents of sexual misconduct directly to ASU's Office of Title IX Compliance and the Director of Title IX Compliance/Title IX Coordinator at:

Michelle Miller, J.D.

Special Assistant to the President and Title IX Coordinator

Mayer Administration Building, Room 210

325-486-6357

325-942-2022, michelle.boone@angelo.edu

You may also [file a report online](#)¹² 24/7.

If you are wishing to speak to someone about an incident in confidence you may contact the University Health Clinic and Counseling Center at 325-942-2173 or the ASU Crisis Helpline at 325-486-6345.

For more information, visit [Title IX website](#)¹³.

Student Absence for Observance of Religious Holy Days

A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. See [ASU Operating Policy 10.19 Student Absence for Observance of Religious Holy Day](#)¹⁴ for more information

Incomplete Grade Policy

It is policy that incomplete grades be reserved for student illness or personal misfortune. Please contact faculty if you have serious illness or a personal misfortune that would keep you from completing course work. Documentation may be required. See [ASU Operating Policy 10.11 Grading Procedures](#)¹⁵ for more information.

General Policies Related to This Course

All students are required to follow the policies and procedures presented in these documents:

- [Angelo State University Student Handbook](#)¹⁶
- [Angelo State University Catalog](#)¹⁷

Modifications to the Syllabus

This syllabus, including grade evaluation and course schedule, is subject to modification. In particular, the COVID-19 pandemic may require significant changes in course delivery and content on potentially short notice.

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- ¹ <https://www.angelo.edu/covid-19/returning-to-campus/health-and-safety.php>
 - ² <http://www.happytrailsshop.com/>
 - ³ <http://www.ascscientific.com/>
 - ⁴ <https://blackboard.angelo.edu>
 - ⁵ <http://www.sulross.edu/geology-field-camp>
 - ⁶ <http://www.indiana.edu/~iugfs/>
 - ⁷ <https://www.bls.gov/ooh/life-physical-and-social-science/print/geoscientists.htm>
 - ⁸ <https://www.aapg.org/about/membership/types/student>
 - ⁹ <https://www.angelo.edu/student-handbook/community-policies/academic-integrity.php>
 - ¹⁰ https://www.angelo.edu/dept/writing_center/academic_honesty.php
 - ¹¹ <https://www.angelo.edu/services/disability-services/>
 - ¹² <http://www.angelo.edu/incident-form>
 - ¹³ www.angelo.edu/title-ix
 - ¹⁴ <https://www.angelo.edu/content/files/14206-op-1019-student-absence-for-observance-of>
 - ¹⁵ <https://www.angelo.edu/content/files/14197-op-1011-grading-procedures>
 - ¹⁶ <https://www.angelo.edu/student-handbook/>
 - ¹⁷ <https://www.angelo.edu/catalogs/>