GEOL 3411: STRUCTURAL GEOLOGY, SPRING 2021
MWF 9:00 – 9:50, Lab: T 2:00 – 4:50

Professor: Dr. Joe Satterfield
Office: VIN 122
Office phone: 325-486-6766
Physics and Geosciences Department Office: 325-942-2242
E-mail: joseph.satterfield@angelo.edu

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: April 15). 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. Each person will sit at their own table to maintain social distancing. You will sit at the same table each class. 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. Most Fridays we will meet outside for a review discussion followed by a short quiz.

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

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)
6. Ruler
Grading
- 10 Weekly Quizzes (1% each)
- 2 exams (11% each)
- Comprehensive final exam (13%)
- 11 graded lab projects, including weekend 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, we will step outside)
- Monday, Wednesday: 8:00 – 9:00 am, 2:00 – 3:00 pm
- Tuesday, 9:00 – 11:00 am
- Thursday: 10:00 – 11:00, 2:00 – 4:00 pm
- Or contact me to set up a convenient time to meet

Virtual Office Hours via Blackboard Collaborate (use guest link on Blackboard in Office Hours tab)
- Monday, Wednesday: 1:00 – 2:00 pm

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 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 or Indiana University Field Camp, Indiana University Field Camp information.
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, stereonets, 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 Gear and Camping Gear Sources
1. Happy Trails, San Angelo, Happy Trails website
2. ASC Scientific, Geology Equipment Website
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: GEO is a Student Chapter of American Association of Petroleum Geologists\(^8\).

Late Assignment Policy
- Late assignments will not accepted after graded labs returned or key posted. These are ethics issues!
- If quarantined, accommodations will be provided for late work. Please let Dr. Joe know in writing.

Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture/Discussion Topics and Required reading</th>
<th>Lab Projects</th>
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</thead>
<tbody>
<tr>
<td>I:</td>
<td>Flipgrid Introductions</td>
<td>1: Dagger Mountain cross-section: Cross-section construction review, converting true dip to apparent dip (p. 718 – 721)</td>
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<tr>
<td>1/25, 1/27, 1/29</td>
<td>Opportunities to order field book, other equipment</td>
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<tr>
<td>Chapter 1</td>
<td>1a. Rock Description Checklist (p. 21)</td>
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<td>1b. Block project: drawing strike and dip symbols, apparent dip (p. 713-718, 721)</td>
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<td>1c. Deformation: meaning and causes (p. 7-16)</td>
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<td>1d. The time factor and the geologic time scale (p. 32-33)</td>
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<td>II:</td>
<td>1e. Primary structures, How applied as Facing Indicators (p. 706-711)</td>
<td>2: Orthographic Projections: Solving true, apparent dip problems, strike and dip problems, thickness problems (Ragan, Ch 1 and 2)</td>
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<tr>
<td>2/1, 2/3, 2/5</td>
<td>2a. Displacement Vectors vs Deformation Paths, (p. 37-43)</td>
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<tr>
<td>Chapters 1, 2</td>
<td>Hot Spot Project</td>
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<td>2b. Rigid body translation, rotation (p. 44-59)</td>
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<td>2c. Strain: distortion and dilation (p. 37)</td>
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<td>2d. Strain: Calculating changes in line length and changes in angle between lines (p. 64-71)</td>
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<td>2/5: QUIZ 1</td>
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<td>III:</td>
<td>2e. The Strain Ellipse and fundamental strain equations (p. 73-77)</td>
<td>3: Interpreting strike and dip from map patterns: The three-point problem, an introduction to geologic mapping (Ragan, Ch 3)</td>
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<tr>
<td>2/8, 2/10, 2/12</td>
<td>Strain analysis projects (Belemnites, Skolithos, Brachiopods)</td>
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<tr>
<td>Chapter 2</td>
<td>2f. Simple vs Pure Shear in the Basin and Range (p. 72, 78-81)</td>
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<td>2g. Dilation application: using stylolites to interpret stresses (p. 86-88)</td>
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<td>2/12: QUIZ 2</td>
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<td>IV:</td>
<td>3a. Plate-tectonic forces (p. 99-101)</td>
<td>3: Concluded – Constructing and Interpreting Two Structure Contour Maps</td>
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<td>2/15, 2/17, 2/19</td>
<td>3b. Calculating Traction underground (p. 101-106)</td>
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<td>Chapter 3</td>
<td>3c. Going from Traction to Stress (p. 106-108)</td>
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<td>3d. Stress Ellipse and fundamental stress equations (p. 115-118)</td>
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<td>2/19: QUIZ 3</td>
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<td>V:</td>
<td>3d. Solving problems with Mohr Circle for Stress (p. 118-120)</td>
<td>4: Basic stereonet techniques</td>
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<td>2/22, 2/24, 2/26</td>
<td>3e. Interpreting Principal Stress Directions from faults (p. 288-291)</td>
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<td>Chapter 3</td>
<td>3f. Strength/rock behavior terms (p. 120-128)</td>
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<td>3g. Evaluating Mechanical behavior during testing (p. 138-147)</td>
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<td>2/26: Review before exam</td>
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<td>VI:</td>
<td>3/1: EXAM 1 (Chapters 1, 2, 3)</td>
<td>5: More stereonet techniques</td>
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<tr>
<td>3/1, 3/3, 3/5</td>
<td>5a. Types of Joints and Shear Fractures (p. 193-199, 201-202)</td>
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<td>Chapter 5</td>
<td>5b. Joints as Paleostress Indicators</td>
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<td>5c. Practical Importance of Jointing (p. 199-201)</td>
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<td>5d. Joint Intersection Patterns (p. 212-216)</td>
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<td>5e. Joint Spacing (p. 216-225)</td>
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<td>5f. Detailed Look at Joint Surfaces (p. 204-212)</td>
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<td>5g. Examples of interpreting Regional Joint Patterns (p. 239-247)</td>
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<td>Project: mapping joints with aerial photos</td>
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<tr>
<td>Week</td>
<td>Lecture/Discussion Topics and Required reading</td>
<td>Lab Projects</td>
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</tbody>
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6b. Brittle fault rocks (p. 260-266)  
6c. Map and subsurface expression faults (p. 267-272) | 6: Geologic map 2, cross-section and stereonets |
| | Chapter 6 | |
6e. Naming and classification of faults (p. 272-277)  
Project: Advanced wood blocks | 6: Continued |
| | Chapter 6 | |
| IX: 3/22, 3/24, 3/26 | 6f. Determination of slip on faults (p. 278-281)  
6g. Thrust fault systems (p. 305-320)  
6h. Normal faulting (p. 321-333)  
Project: Interpreting Corsair Trend seismic section  
Project: Sketch cross-section of klippe, window | 7: Drawing dip isogons and plotting Ramsay fold classes  
Big Bend structure paper distributed |
| | Chapter 6 | |
| X: 3/29, 3/31 | 6i. Strike-slip faulting including Reidel Shears (p. 334-343)  
3/31: EXAM 2 (Chapters 5, 6; including net, time scale) | 8: Systematic fracture measurement and analysis, Ben Ficklin Dam outcrop.  
9: PAPER SUMMARY DUE  
Discuss paper in lab |
| | Chapter 6 | |
| XI: 4/5, 4/7, 4/9 | 7a. Describing folds (Ch 7)  
7b. Basic and strange fold terms (April Fools contest)  
7c. Fold geometry: Stereonets and dip isogons (Ch 7)  
Project: Finding big folds from S- and Z-folds in Marathon uplift  
Project: Subsurface structure contour maps (Ch 7) | 10: Geologic map 3: Polyphase folding  
10: Cross-section Due  
10: Complete work on nets, sequence of events |
| | Chapter 7 | |
| XII: 4/12, 4/14, 4/16 | 7d. Kinematic analysis of folds: buckling, flexural slip, flexural flow, passive  
Project: Folding an Ice Cream Sandwich | 11: Constructing normal profile views of folds, down-plunge method (due at end of lab) |
| | Chapter 7 | |
| XIII: 4/19, 4/21, 4/23 | 7e. Causes of Folding |  |
| | Chapter 7 | |
| XIV: 4/26, 4/28, 4/30 | 8a. Reactivated faults  
8b. Fault-fold interactions  
8c. Polyphase folding |  |
| | Chapters 8, 9 | |
| XV: 5/3, 5/5, 5/7 | Review projects  
Review field trip (on-campus!)  
Subsurface mapping project |  |
| | | |
| XVI | 5/12: FINAL EXAM, 8:00 – 10:00 AM | |

**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 to disciplinary action and possible expulsion from ASU. The College of Science and Engineering adheres to the university’s [Statement of Academic Integrity](#). 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.

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. 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 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\textsuperscript{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\textsuperscript{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\textsuperscript{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\textsuperscript{16}
- Angelo State University Catalog\textsuperscript{17}

**Required Use of Masks/Facial Coverings by Students**
As a member of the Texas Tech University System, Angelo State University has adopted the mandatory Facial Covering Policy\textsuperscript{18} to ensure a safe and healthy classroom experience. Current research on the COVID-19 virus suggests there is a significant reduction in the potential for transmission of the virus from person to person by wearing a mask/facial covering that covers the nose and mouth areas. Therefore, in compliance with the university policy students in this class are required to wear a mask/facial covering before, during, and after class. Faculty members may also ask you to display your daily screening badge as a prerequisite to enter the classroom. You are also asked to maintain safe distancing practices to the best of your ability. For the safety of everyone, any student not appropriately wearing a mask/facial covering will be asked to leave the classroom immediately. The student will be responsible to make up any missed class content or work. Continued non-compliance with the Texas Tech University System Policy may result in disciplinary action through the Office of Student Conduct.

**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.

\textsuperscript{1} https://www.angelo.edu/covid-19/returning-to-campus/health-and-safety.php
\textsuperscript{2} https://blackboard.angelo.edu
\textsuperscript{3} http://www.sulross.edu/geology-field-camp
\textsuperscript{4} http://www.indiana.edu/~iugfs/
\textsuperscript{5} http://www.happytrailsshop.com/
\textsuperscript{6} http://www.ascscientific.com/
\textsuperscript{7} https://www.bls.gov/ooh/life-physical-and-social-science/print/geoscientists.htm
\textsuperscript{8} https://www.aapg.org/about/membership/types/student
\textsuperscript{9} https://www.angelo.edu/student-handbook/community-policies/academic-integrity.php
\textsuperscript{10} https://www.angelo.edu/dept/writing_center/academic_honesty.php
\textsuperscript{11} https://www.angelo.edu/services/disability-services/
\textsuperscript{12} http://www.angelo.edu/incident-form