

UC Santa Cruz  
EARTH SCIENCES 109



# Elements of Field Geology

Fall, 2018

## Course Personnel

### Instructor

**Hilde Schwartz**

*email:* [hilde@ucsc.edu](mailto:hilde@ucsc.edu)

Office: **A347**; office hours **Mon. and Wed., 1:30-3:30 p.m.** and *by appointment*

Office phone: 459-5429

Cell phone (for field trip emergency contact only): (831) 345-6201

### Teaching Assistants and TAAs (Offices and office hours TBA)

**Kellen Martin (TA)**

*email:* [knmartin@ucsc.edu](mailto:knmartin@ucsc.edu)

**Nick Mason (TA)**

*email:* [niamason@ucsc.edu](mailto:niamason@ucsc.edu)

**Sara Ray (TAA)**

**Lena Tokmakoff (TAA)**

### Department Equipment Manager/'Fixer'

**Brandon Cheney**

*email:* [bcheney@ucsc.edu](mailto:bcheney@ucsc.edu)

Office: **C276**

## **Class schedule** (Reduced version - see following pages for unabridged & annotated schedules)

LECTURES: Tuesday-Thursday, 9:50-11:25 p.m., EMS D258

### LABS:

Section 01: Wednesday, 10:30 p.m. – 1:30 p.m., EMS D258

Section 02: Wednesday, 4:00 p.m. – 7:00 p.m., EMS D258

### FIELD TRIPS:

#1: Saturday, Oct. 6 - UCSC Campus (locating positions on topographic maps)

#2: Friday-Sunday, Oct. 19-21 – El Adobe Ranch (stratigraphy, geologic mapping)

#3: Saturday, Oct. 27 - Pt. Año Nuevo (outcrop interpretation, field notes)

#4: Friday-Sunday, Nov. 2-4 – El Adobe Ranch (geologic mapping)

#5: Saturday, Nov. 17/Sunday Nov. 18 – Mystery site (geologic mapping)

**\*Note that the field trips #2 and #4 are 3-day trips, so you will miss your Friday classes on 10/19 and 11/2. They are also *camping* trips (two overnights each weekend), so you will need *camping gear*.**

## **Required text + field materials**

- ❖ 109 Reader - Available for purchase from the Bay Tree Bookstore (digital or hard copy formats)
- ❖ Various papers and maps available on the course website (see below)
- ❖ Materials *provided* by EPS:

Map board fixins'

Various base maps

Whistle/lanyard

Field book

Protractor rulers (2)

Grain size card

Brunton compass\*

(\*on loan for the quarter; \$400 replacement fee)



Then



Now

**Course website:** <https://people.ucsc.edu/~hilde/migrated/eart109/>  
Login: **eart109** Password: **mybruntonrocks**



## Recommended texts

*The Elements of Style*, Strunk and White

*The Craft of Scientific Writing*, 3<sup>rd</sup> edition, Michael Alley, 1998, Springer-Verlag

*The Natural History of the UC Santa Cruz Campus*, 2<sup>nd</sup> edition, Haff, Brown and Tyler (editors), 2008

*Dictionary of Geological Terms*, Bates and Jackson (editors), 1984, Anchor Books

(Note: There is a 109 copy of Bates and Jackson available in D258 for in-class use)

*Field Geology Illustrated*, Terry Maley, 1994 or a newer edition, Mineral Land Publications

*Procedures in Field Geology*, Tom Freeman, 1999, Blackwell Science

*Introduction to Field Geology*, Mary Lou Bevier, 2005, McGraw Hill

## Required field/lab/office equipment (not provided by EPS)

Hand lens

Hammer

Mechanical or drafting pencils (0.5 and 0.3, H and HB)

White-out pens and exacto-knife

Prismacolor pencils (at minimum: green, blue, yellow, orange, brown, purple, pink)

White and clear rubber erasers

Micron (or equivalent) drafting pens:

3 black, 005; 2 black, 01, 1 red, 01 or 005

Ruler (the longer the better)

Calculator

## Field/camping equipment

Swiss army knife (or equivalent pocket tool)\*

Sturdy belt\*

Hammer holster\*

Acid bottle & holster\*

Sturdy hiking shoes

Hiking gaiters\*

Hat

Sunscreen

Warm jacket(s)

Sleeping pad/cot and warm sleeping bag

Tent (with rain fly)

Durable backpack

Basic first aid supplies

Backpack containers that will hold 5 liters of water (at least)

Waterproof rain gear (for working + sleeping)

Kitchen 'kit': dish, bowl, cups, utensils

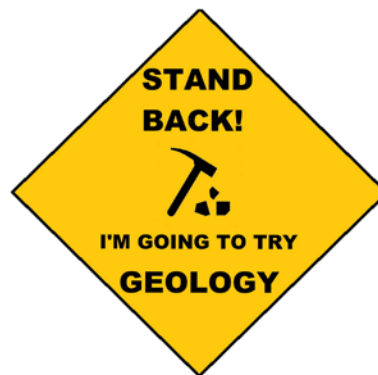
Flashlight and batteries

Camera\*

Sundries (matches, toilet paper, *deodorant*, etc...)

Binoculars\*

**Folding chair** (for New Idria campfire comfort)\*\*



\* suggested, not required

\*\* highly suggested, but still not required; but really – just bring one, OK?



# Earth Sciences 109

## ⇒ 2018 SCHEDULE ⇐



Week	Date	Class #	Topic	Lab
0.5	Th 9/27	1	Requirements, schedule, intro to maps	No lab
1	Tu 10/2 Th 10/4	2 3	Topographic and geologic maps Compasses, magnetic declination, map boards CAMPUS TOPO EXERCISE - <i>Due 10/9</i>	1: Topographic maps and profiles
	☺ Sat 10/6			
2	Tu 10/9 Th 10/11	4 5	★ More Brunton tricks, geologic maps/x-sections Q Stratigraphy, contacts	2: Map making, plotting attitudes
3	Tu 10/16 Th 10/18	6 7	Sedimentary rocks and structures El Adobe Ranch intro, rock deformation, load cargo van EL ADOBE RANCH, Part 1 – <i>Strat column due 10/30</i>	3: Sedimentary rocks
	☺ Fri-Sun 10/19-21			
4	Tu 10/23 Th 10/25	8 9	Q Structural geology Structural geology, interpreting the outcrop ★ ANO NUEVO – <i>Due 10/27</i>	4: Interpreting geologic maps I
	☺ Sat 10/27			
5	Tu 10/30 Th 11/1	10 11	★ Mass wasting Fault analysis, West-side fold belt, load cargo van EL ADOBE RANCH, Part 2 – <i>Report first drafts due 11/13, 11/20, 12/; final work due 12/14</i>	5: Landslides
	☺ Fri-Sun 11/2-11/4			
6	Tu 11/6 Th 11/8	12 13	Report sections, stereonet Q Coast Ranges geology	6: Interpreting geologic maps II
7	Tu 11/13 Th 11/15	14 15	★ Report sections, stereophotos Cross sections; set up A-A', B-B', C-C' TBA – <i>Work due 11/29</i>	7: Stereophoto mapping of Q and landslides
	☺ Sat-Sun 11/17-11/18			
8	Tu 11/20 Th 11/22	16 --	★ Coast Ranges geology NO CLASS – Give Thanks, eat <i>Meleagris gallopavo</i>	No lab
9	Tu 11/27 Th 11/29	17 18	Q Report sections ★ First draft review, more geowriting	8: Vallecitos maps
10	Tu 12/4 Th 12/6	19 20	★ El Adobe report, map, cross sections review LAST CLASS ( <b>required</b> ): turn in equipment, get awards and advice	9: NI map work

Q = quiz days

★ = field work due

★ \* Final El Adobe Ranch report due by Friday, December 14, 3:00 p.m., EPS Dept. Office \* ★

# 109 FIELD TRIP SCHEDULE

Fall, 2018



Good field geologists  
always have the right stuff.

## **Trip #1: UCSC: Campus topographic map exercise**

**When:** Saturday, October 6, **9:00 a.m. – 4:00 p.m.**

**Where:** Meet in classroom (D258), work on campus

**What to bring:** Field equipment, lunch, water, field shoes & hat, appropriate clothes

**Why:** To learn how to a) interpret topographic maps in the wild, b) locate your position on a topographic map, and c) take bearings with a Brunton compass and plot them on a topo map

## **Trip #2: El Adobe Ranch, New Idria (San Benito County): stratigraphy and geologic mapping**

**When:** Friday - Sunday, October 19-21; beginning at **7:30 a.m.**

on Friday, ending approx. **9:30 p.m.** on Sunday

**Where:** Meet at and return to *EMS loading dock*; drive to field site takes ~5 hours

**What to bring:** As above, PLUS sleeping bag, tent, toiletries, rain and cold gear, extra water and food, \$, 'kit', insect repellent, etc...

**Why:** To learn how to describe sedimentary rocks, measure a stratigraphic section, make a large scale geologic map, and identify/interpret geologic contacts, features and structures.

## **Trip #3: Point Ano Nuevo: field observation, interpretation, and note-taking exercise**

**When:** Saturday, October 27, **8:00 a.m. – 7:30 p.m.**

**Where:** Meet at Parking Lot #116 (lower campus) or loading dock (more in class)

**What to bring:** As listed above

**Why:** To learn how to a) describe and interpret rocks/outcrops in the field and b) take accurate, meaningful, and intelligible field notes

## **Trip #4: El Adobe Ranch, New Idria: geologic mapping**

**When:** Friday through Sunday, November 2-4; beginning at **7:30 a.m.** on Friday, ending approx. **9:30 p.m.** on Sunday

**Where:** Meet at and return to EMS loading dock

**What to bring:** As listed above

**Why:** To make you, faster, stronger, better...

## **Trip #5: TBA geologic mapping exercise**

**When:** Saturday, November 17 and Sunday, November 18, **7:30 a.m. – 7:30 p.m.** (returning to UCSC Saturday and Sunday evenings)

**Where:** Meet each day at Parking Lot #116 (lower campus) or loading dock (more in class)

**What to bring:** As listed above

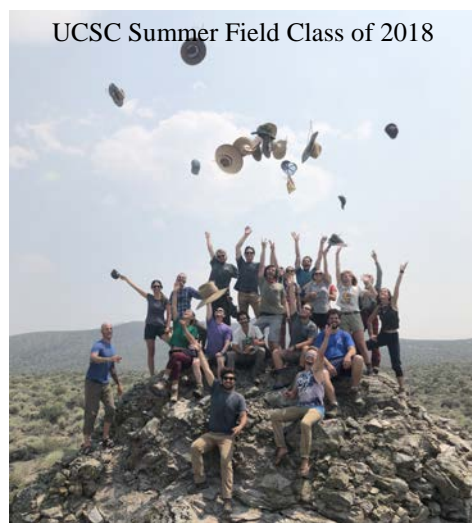
**Why:** To show your 'fold and fault mapping' stuff

**\*\*NOTE:** Earth Sciences 109 is a field course, hence the 109 field exercises are essential and required. You *must* attend each field trip, arrive for each trip promptly and arrive prepared\*. If you have social or academic conflicts with the field trip dates you must resolve them. If attendance, promptness or preparedness seem impossible, you should not take 109 at this time. If illness or injury prevent you from completing the course, you will receive an 'incomplete' pending your completion of all missed work in a subsequent quarter.

*\*with all materials and equipment necessary for the trip (see image above)*

## *EPS FIELD TRIP RULES*

1. Do not bring illegal substances or 'hard' alcohol on field trips. Do not consume such substances directly before field trips. Period. Students deemed incapacitated will be sent home and dropped from the class.
2. Alcohol consumption is not allowed before or during working hours, and designated drivers must not drink alcohol before they drive (in addition to not drinking during the drive).
3. No open alcohol containers or drugs in university vehicles. If instructors or fleet services or department personnel find any type of open/discarded alcoholic beverage container or the remnants of banned substances in a university van, everyone who rode in that van will be held responsible and be subject to expulsion from the university. The situation will be out of the hands of the instructors and the students will have to deal directly with the department chair and the Dean of Physical and Biological Sciences.
4. No smoking in university vehicles or while doing field work (due to fire, littering, and pollution hazards). If you must smoke, please do so only around the campfire ring or in a paved area, and only with the consent of nearby classmates. Do not leave a mess behind.
5. Drive university vehicles safely. Speeding, tailgating and other irresponsible behavior will result in loss of driving privileges and/or dismissal from the class. *Riders as well as drivers will be held accountable.*
6. Those riding 'shotgun' are expected to remain attentive and engaged. Your job is to keep the driver awake and alert them to possible hazards.
7. Return university vehicles *immediately* after field trips unless otherwise instructed.
8. When returning a vehicle you must fill it with fuel and record the ending mileage. Give mileage and key(s) to an instructor.
9. All vehicles must be cleaned and swept upon return. *All trash and personal belongings must be removed.*
10. When on the road, in the field, or in our campground you will be expected to behave responsibly and respectfully at all times. You must obey both the rules of the instructor, and those established by the property owners at each of our field sites. Any actions that could impugn the reputation of or result in litigation towards the university will not be tolerated. Likewise, any behavior that disrupts the mission of the class, results in your inability to work, and/or interferes with the well-being of others will be grounds for dismissal. I consider our field areas to be extensions of my classroom, and expect you to behave accordingly.
11. Wildlife, livestock and private property must be respected. For example, take care not to damage fences when crossing them and do not harass livestock. Likewise, you may not catch or harm wild animals, unless you are defending yourself from serious harm. If you open gates, be sure to close them behind you. If gates are open, leave them open.



*"Geologists are very pleasant companions, especially for other geologists. It's their art, to stop at every stone, and carry out an investigation at every layer of earth!"*  
- "La vallée de Trient" by Swiss author Rodolphe Toepffer (1799-1846)



## 109 GRADES

You will receive separate grades for Earth Sciences 109 (lecture and field) and Earth Sciences 109L (lab). Your final grades will reflect your performance on the assignments described below.

### EARTH SCIENCES 109 (LECTURE + FIELD TRIPS)

FIELD ASSIGNMENTS	POINT VALUE
Campus topographic map exercise	100 points
Ano Nuevo exercise	100 points
Mystery exercise	150 points
El Adobe Ranch project*	990 points (!)
(*Strat column, cross sections, report, geologic map)	
CLASS QUIZZES	
Three of four quizzes (Your lowest score will be dropped)	75 points (total)
	<hr/>
	<b>1415 points total</b>

\*\*\*Note #1: In order to pass Earth Sciences 109 you MUST:

- 1) Accumulate sufficient total points
- 2) Pass the time scale quiz (Quiz #1)
- 3) Attend all field trips and complete all field exercises satisfactorily

### EARTH SCIENCES 109L (LAB)

LAB EXERCISE	POINT VALUE
1) Topographic maps and profiles	100 points
2) Pace and compass/geologic maps	75 points
3) Sedimentary rock ID & descriptions	100 points
4) Structural geology, Part 1	100 points
5) Landslides	75 points
6) Structural geology, Part 2	100 points
7) Stereophoto mapping	25 points
8) Vallecitos maps	25 points
9) El Adobe map work	0 points

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**600 points total**



*If Crusty can do it,  
you can do it...*

\*\*\*Note #2: Punctual submission of work is key to your success in Earth Sciences 109. Labs will be due one week after they are assigned, unless otherwise noted by your TA. Field exercises will be due on the dates specified on the syllabus. Lab (and field) exercises will be docked 10% of the total points per day for late submission. Late submission of your final (New Idria) project is unacceptable, and will result in a failing grade.

\*\*\*Note #3: Your final grades in Earth Sciences 109 and 109L will be based on traditional assessment standards. We do not inflate grades or grade on a curve. A 'C' grade in 109 reflects satisfactory work. It means that you have a good understanding of the material. If by the end of the class you do not demonstrate good understanding of field geology techniques, you will receive a 'D' or 'F'. 'A's and 'B's will be awarded only for truly superior work.

\*\*\*Note #4: Though you may confer with others in lab or in the field (in the spirit of cooperative learning), all finished work in Earth 109 and 109L must be original. Unoriginal work will be rejected (no points awarded; first offence) or result in your dismissal from the class and possible UC disciplinary action (second offense).

## EDUCATIONAL PHILOSOPHY

"We cannot teach others anything; we can only help them discover it within themselves."

Galileo

"Spoon feeding in the long run teaches us nothing but the shape of the spoon."

E. M. Forster

"I have never let my schooling interfere with my education."

Mark Twain



**PRIORITIES & RESPONSIBILITIES:** We the instructors have three primary obligations in this class:

- 1<sup>st</sup>: To the discipline of geology: to present geologic concepts with clarity and insight.
- 2<sup>nd</sup>: To the university: to guarantee that this is a rigorous class, that basic academic standards are upheld, and that students attain some basic level of understanding of the subject.
- 3<sup>rd</sup>: To the student: to give you guidance and support, particularly while in the field. However, you and you alone will determine what you learn in this course. The best we can do is to present ideas, data, and materials in a format that facilitates learning, and allow sufficient time for digestion of new concepts. The rest is up to you: *carpe lapidem!*

Early in this class we will spend as much time as possible with you, especially in the field. However, in the latter stages of the New Idria field exercise we will reduce the amount of student-instructor contact, leaving you to your own resources more often. Thus, you will get to do some truly independent fieldwork. During this course you will learn that field geology can be both exhilarating and frustrating, often simultaneously. Remember that the key to success is perseverance: Never give up, never surrender. As illustrated by the story below, great achievements are rarely effortless.

# If you want to succeed, try failure — again and again

BY LEONARD PITTS JR.

**L**OATH THOUGH I am to shill for a multibillion-dollar maker of overpriced athletic shoes, I must say this: You really ought to see the new Nike commercial.

It stars Michael Jordan, nine-time All-Star, four-time MVP, two-time Olympic gold medalist, once-in-a-century icon. Jordan — the man who shackled gravity and courted flight, who made the impossible seem routine and the merely difficult look easy — is seen here arriving at the game, heading to the locker room. His stride is easy, his smile secretive and knowing as he moves down the gauntlet of fans and well-wishers. He walks like a winner.

Yet in the voice-over he says: "I've missed more than 9,000 shots in my career. I've lost more than 300 games. Twenty-six times I've been trusted to take the game-winning shot — and missed. I've failed over and over and over again in my life. And that is why I succeed."

Consider that. Failure is why he succeeds.

Failure is the price of excellence.

But nowadays, we want it all immediately. Nowadays, some of us think children are too fragile to sustain the trauma of failure.

Nowadays, every mediocre singer is a superstar, every so-so athlete an all-time great.

You want to know how far greatness has fallen? A young man told me the other day that Tupac Shakur was another Martin Luther King Jr. or Malcolm X. I asked him to tell me how, exactly, Shakur changed the whole world. He, of course, could not.

Not that it matters. Nowadays, perception is stronger than truth.

That used to drive me crazy when I was a music writer. I found myself constantly amazed by the number of singers who weren't and performers who could not, the number of people who took shortcuts to success and back doors to fame.

But it's not just the entertainment arena that suffers counterfeit greatness. We seem to hear ever more these days about middle managers who arrive at the corner office ignorant and unprepared. About grade infla-

tion, where mediocre academic performances are rewarded with superior marks. About high school and college graduates who go into the world unprepared to hold down a job.

In so many fields of endeavor, it seems, it has become possible for people to reach the goal without doing the work. We forget that there is a reason to go through ordeal, some value to be found in adversity.

One becomes tougher from those things, learns that failure is not fatal, nor defeat eternal. One gains depth. One becomes ready. Perhaps one even becomes truly great.

The problem with greatness, though, is that in a society obsessed with perception, it looks too easy. Seen from the outside by those who don't know any better, greatness looks almost like magic. Looks like something anyone could do if he just understood the trick, had the ability, or intercepted the bolt of lightning from God.

How does Angelou write like that, we wonder. How does Hawking conceive such thoughts? How does De Niro act with such

conviction and soul?

And how does Jordan fly? We talk about talent, we nod to luck, but so often, we ignore the most important things. The hard work and many failures. The arriving early and staying late. The rejection of complacency, the refusal of contentment, the unceasing push to be just a little better than the day before.

The results of which were on display in a Jordan highlight clip I downloaded the other day. He fakes left, goes right, elevates to the hoop, finds a man in his path, spins in mid-air, throws the ball backward over his head and scores.

It leaves the announcers breathless, the crowd roaring. And you wonder again . . . how?

The answer is simple. That moment, seen by millions, was built on a thousand others only Jordan himself will ever know.

You have to pay some dues before you get to walk as winners do.

Leonard Pitts Jr. is a Miami Herald columnist.

5-12-97

**HONOR SYSTEM/GRADES:** Cheating, including plagiarism (the use of others' work without attribution) and copying the work of classmates or former students, will not be tolerated in Earth Sciences 109. If you feel you have to cheat in order to get through this course you should drop it. If you are caught cheating, you will be asked to leave the class and the matter will be reported to the university for appropriate action. It is difficult to fail this course if you are honest and willing to work hard. However, do not misinterpret this to mean that it is *impossible* to fail. Many have. Perfection, though always hoped for, is not required; effort and common sense *are*. If you are hoping to use 'Summer Field Geology' (189A and 189B) as your senior capstone, it is important to do well in Earth Sciences 109. Earth Sciences 189 is capped at 25 students; if more than 25 qualified students apply, the top 25 will be selected you've been on the basis of seniority and academic performance (particularly in Earth Sciences 109).

## 109 COURSE GOALS



The goal of this course is to introduce the techniques that will allow you to develop basic field geology skills, and provide a foundation for future fieldwork in other Earth Sciences classes, graduate school and your professional career. Successful completion of Earth Sciences 109 will not make you a competent field geologist - you earn that title only after years of experience, but we aim to get you started on the right foot.

What actually constitutes “fieldwork” can vary greatly depending upon the specialty of the earth scientist. Hydrologists, engineering geologists, seismologists, paleontologists, sedimentologists, and so on, study different phenomena, materials and processes. Nevertheless, all earth scientists who work in the field rely on the same basic skills essential to collecting, analyzing and presenting data, including the following:

1. The ability to “read” and interpret topographic maps, including:
  - a) being able to *locate yourself accurately in the field*
  - b) being able to *prepare large scale topographic and planimetric maps using tape/pace and compass techniques*
  - c) being able to *prepare topographic profiles, both in the field and from topographic maps.*
2. The ability to use a compass proficiently.
3. The ability to identify and classify rocks in the field and to write concise, accurate rock descriptions.
4. A solid, basic understanding of structural geology and stratigraphy.
5. The ability to make systematic field observations and to write clear, legible field notes.
6. The ability to prepare a geologic map (in the field), including:
  - a) being able to *record field data in the field on a topographic base map*
  - b) being able to *make logical interpretations from the map and the field data.*
7. The ability to prepare a geologic cross section.
8. The ability to accurately measure a stratigraphic section in the field and draft it in the ‘office’.
9. The ability to analyze, organize, and interpret field data, and to present that information in a written report.
10. The ability to prepare neat, clear, and precise graphics\*
11. The ability to write clear, concise English prose, in the scientific style.
12. The ability to use inductive and deductive reasoning and multiple working hypotheses in the field.
13. The ability to use widely-available technology (such as Google Earth and Visible Geology) to better analyze field data and interpret rocks and landforms.

**\*Note:** There is heavy emphasis in this class on hand-rendered graphical displays of data (stratigraphic sections, cross sections, field book sketches, etc.). This may seem quaint and/or daunting, but the rationale for adhering to the old-school, non-electronic approach (at least for now) is fourfold: 1) I want you to spend your time learning about rocks and geological processes rather than graphics software, 2) I believe you will come to understand geological phenomena better as you draw them, 3) because of scale, symbol and coloring issues, acceptable computer graphics often take longer to produce than graphics done manually, and 4) even here in Little Silicon Valley, the power sometimes goes out. Therefore, you *must* learn to draft reasonably well with your own two hands, and a significant portion of your grade will be based on the neatness and clarity of said graphics. Manual dexterity varies widely amongst *Homo sapiens*, but I believe each of you can learn to draft reasonably well by improving baseline skills through practice. This applies to written work too! If your work cannot be easily understood by others it is useless, however brilliant its essence.

*To arrive where you are, to get from where you are not,  
You must go by a way wherein there is no ecstasy.  
In order to arrive at what you do not know  
You must go by a way which is the way of ignorance...*  
(T.S. Eliot, excerpt from ‘East Coker’)







## 109 DUE DATES



### LABS

- Lab 1 Topographic maps
- Lab 2 Map making, plotting attitudes
- Lab 3 Sedimentary rocks
- Lab 4 Interpreting geologic maps and structures
- Lab 5 Landslides
- Lab 6 Interpreting geologic maps and structures, II
- Lab 7 Stereophoto mapping
- Lab 8 Vallecitos map analysis
- Lab 9 El Adobe map inking

### DUE DATE

- 10/10**, beginning of Lab 2
- 10/15**, beginning of Lab 3
- 10/24**, beginning of Lab 4
- 11/7**, beginning of Lab 6
- 11/7**, beginning of Lab 6
- 11/14**, beginning of Lab 7
- 11/14**, end of Lab 7
- 11/28**, end of Lab 8
- 12/5**, end of Lab 9

### FIELD EXERCISES

*Campus topographic map exercise* (Field Trip 1)

### DUE DATE

Maps + handout due **10/9** (Tuesday)

*El Adobe Ranch, Part 1* (Field Trip 2)

Strat column due **10/30** (Tuesday)

*Año Nuevo* (Field Trip 3)

Field book due at 6 p.m. **10/27** (Saturday)

*El Adobe Ranch, Part 2* (Field Trip 4)

- Rock Descriptions Chapter (first draft)
- Regional Geologic Setting (first draft)
- Structural geology (first draft)
- Final drafts (abstract, RGS, RD, Structure)
- Abstract (final draft)
- Geomorphology (final draft)
- Geologic History (final draft)
- Geologic map
- Cross Section A-A', B-B' and C-C'
- Final drafts (abstract, RGS, RD, Structure)
- Title page, Table of Contents, References Cited

**11/13** (Tuesday)

**11/20** (Tuesday)

**12/4** (Tuesday)

**12/14** (Friday)

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*Mystery site* (Field Trip 5)

Map/cross section due **11/29** (Thursday)

