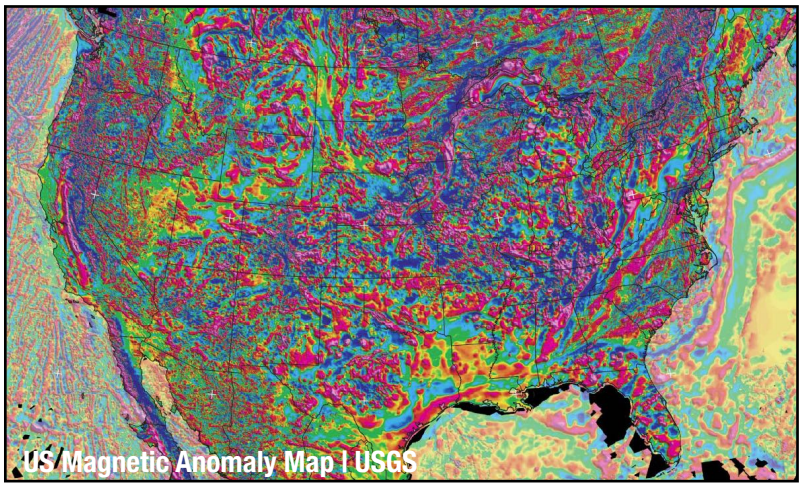
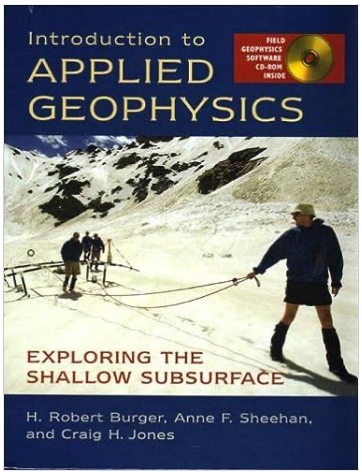
Environmental Geophysics


US Magnetic Anomaly Map | USGS

COURSE GOALS



To develop basic field geophysical skills with an emphasis on the acquisition and interpretation of data from practical field experiments/exercises. Course will include some basic foundation theory to facilitate using various geophysical techniques (e.g., seismic refraction, seismic reflection, ground penetrating radar, electrical resistivity, gravity, magnetics) to solve applied problems in the environmental, resource exploration, geotechnical, and archeology fields. Labs will consist of field experiments/exercises and applied problem sets using computer modeling and interpretation techniques.

Instructor
M. Scott Wilkerson
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http://www.depauw.edu/academics/departments-programs/envgeo/

Class (Julian 222)
2:50-3:50 pm MWF (lecture)
2:00-3:50 pm TH (lab)
sometimes later for field experiments

Office Hours
1:00-2:00 pm MWF
other times: stop in or by appt.

Text
Introduction to Applied Geophysics,
Burger, Sheehan, & Jones,
(2006, Norton).

Lab Fee
A **$20 course fee** will be charged to your student account after the adjustment period.

Suggested Materials
Pencil (e.g., mech. pencil, 0.5mm, 2H or 2), eraser, scientific calculator, ruler, protractor, small stapler, & USB drive.

Colored pencils, a pen, and a C-Thru™ 6" ruler/protractor combo also might be useful.

This syllabus is meant to provide an outline for the general flow of the course. At my discretion, I will add or omit topics and/or modify the timetable.

Upon completion of this course, **students will be able to…**

- demonstrate competency with varied forms of data analysis including organizing, interpreting, and drawing conclusions from quantitative and qualitative information.
- demonstrate application of field methods & observations to acquire, analyze, and interpret data for scientific inquiry (e.g., select the appropriate geophysical technique(s) for a specific problem, understand some of the strengths & limitations of each geophysical technique).
- demonstrate application of technology for scientific inquiry (e.g., develop and implement a basic field survey using instrumentation and software to acquire geophysical data for some of the most common geophysical techniques).
- demonstrate application of quantitative and qualitative data analysis for scientific inquiry (e.g., interpret geophysical data using spreadsheets/calculations/software to address applied problems involving the shallow subsurface).

DESCRIPTION

This course employs a variety of teaching approaches to maximize student learning of geoscience content in a classroom where different students optimally learn material in different ways. Specifically, this course will involve Apple Keynote computer-based lectures, field experiments/ exercises, applied homework problem sets, and/or simulations using computer software that accompanies our text. The distinction between "lecture" and "lab" will become blurred throughout the semester (in terms of both content and class times; especially dependent on weather and knowledge of background concepts).

I purposively provide my slides as PDFs on Moodle, so that students can print them out before class and annotate them with notes during class. That way, students aren't scrambling to write down every single word on a slide, allowing them to focus on the content and to participate in the discussion. To facilitate discussion and effective use of our time in the field, students must "R&R" before class (no, this is not "rest & relaxation", but rather "read & retain" the assigned materials).

The material in this course is fairly math-intensive, so we will be using Excel spreadsheets throughout the course *(please familiarize yourself with basic Excel operations and its user interface…fyi…I use Microsoft Excel for Mac 16.76)*. We also will be working with the geophysical software provided with your textbook, and probably Google Earth and Adobe Illustrator to a lesser degree. Any assigned report(s) describing our field work will be written following EPA style and format guidelines. Such guidelines not only will help hone your writing skills as a scientist, but also will provide you with applied experience in organizing and preparing reports in the standard format most commonly used in the environmental field. The Geoscience Computational Laboratory (Julian 201) should be open from ~8:00 am-5:00 pm weekdays (except when classes are being conducted in the room) to work on your assignments.

Exams will focus on hands-on problems involving geophysical data, very much like the homework and field exercises. Please note that I will not post my detailed solutions to homework/lab assignments (as it is important for you to work on the assignments yourself), but I am certainly available for you to ask questions while you work on them.

Dynamic Excel Tables

Shaded boxes in the chapters provide instructions about working with dynamic tables in Excel in order to develop a deeper understanding of the concepts being covered in that chapter. Please use them while you are reading the chapters.

GRADES

The basis for final grades is described in the table below. *Extensions/make-ups for exams/assignments/quizzes will not be given unless there is a documented emergency or unless we have made arrangements in advance because of exceptional circumstances.*

All materials to be turned in for a grade must be turned in on time, clearly written (or typed), stapled in order, and following prescribed guidelines (e.g., 1 problem per page, boxed answers, etc. see guidelines on Moodle). Work that fails to meet these criteria will not be accepted and will receive a "0". Quizzes may be announced/unannounced and may cover material from assigned readings, lecture, and/or lab *(I may have you turn in labs/assignments for a quiz grade to show that you worked the problems, but not for an explicit check of your answer(s)*). I will drop 3 assignments/quizzes because there may be absences that are unavoidable and because "unannounced" quizzes can't be made up without disadvantaging those who were present originally.

Participation. Participation/engagement grades for this course will be based on a "standard" - "sub-standard" system. Everyone starts out with a "standard" grade, and I expect that most of you will finish the semester with this grade. A "standard" grade means you are attending class consistently, and you are participating in a reasonable way during most class sessions. If I judge your participation to be falling into the "sub-standard" range (e.g., excessive absences/tardiness, consistent lack of preparation or participation in activities, electronic distraction, sleeping/lack of attention, frequently getting up in class, etc.), I will explain the issue to you without penalty and will work with you to develop a plan for improvement. If an issue persists, I will explain the issue again and will assign a sub-standard participation grade. Each such sub-standard grade will result in lowering your final course grade by one percentage point.

Percent of Final Grade		Grading Scale*
Exams (1-3)	75%	88% 100% = A- to A
Field Report(s)	10%	78% 87% = B- to B+
(must be present in field; no generative AI text allowed)		68% 77% = C- to C+
Assignments/Quizzes	15%	58% 67% = D- to D+
(lowest 3 will be dropped..so no make-ups if missed for any reason)		00% 57% = F
		**I reserve the right to adjust the grading scale up slightly (benefitting you!), if warranted by the class grade distribution.*

KEYS TO SUCCESS IN THIS COURSE

1. **Read the Assigned Material** in a distraction-free environment and in advance of lecture over that material (errata for the text and geophysical software are at http://cires1.colorado.edu/people/jones.craig/GSSH/). As you are reading, carefully note any questions that you have. Use the dynamic tables in the textbook.
2. **Take Good Notes**. Students with complete notes seem to do better in class. If possible, print out the lecture slides before class and annotate them from the lecture/discussion (including sketches from the whiteboard). Rewriting your notes will make them more legible and orderly, plus it will help you focus on areas that are still unclear. Be careful of falling into "TV-watching mode", as it is easy to look at the pictures and not take down any notes.
3. **Ask Questions**. The only "bad" question is one that is unasked. It is essential to ask questions to clarify any concepts that you do not understand. If I forget to call on you while I am in the middle of explaining something in lecture, PLEASE raise your hand again to remind me as I most certainly want to answer your questions!
4. **Check out the Internet**. There is a world of information on geophysical techniques out on the internet (you might use a search engine to find web sites of interest). We also may use Google Earth (https://www.google.com/earth/versions/) for plotting map data throughout the semester.
5. **Use the library**. There are many excellent books & articles that pertain to geophysical techniques (see list on the next page; we have a great interlibrary loan system for materials that our library does not carry).
6. **Create your own Study Aids**. Some people like to highlight text in the chapter, others like to make flash cards, and still others like to study in groups and discuss the material. Feel free to experiment with what works for you. In addition, The Learning Commons in Roy O. West Library (https://depauw.mywconline.com/) has Q tutors and trained people available to help you refine and improve your study habits and techniques.
7. **Study the Material on a Regular Basis**. It is important that everyone maintain good study habits by regularly working with the assigned material. Procrastination and cramming just don't work for most of us...it is best to get comfortable with the material as we go along so that you don't fall behind.
8. **Study for the Exam** as an individual and then as a group. Again, different people study in different ways. I've found that it helps to study as an individual first (thinking about what important concepts were emphasized in each chapter & lecture), then get together with others and study as a group (e.g., asking each other questions, brainstorming about what will be on the test, etc.).
9. **"Success is where opportunity meets preparation." -Zig Zigler**. Preparation in this context means applying a strong work ethic to practice your craft so that you are prepared when the opportunity (e.g., exam, homework/lab assignment, report, etc.) presents itself.

Feedback:
I usually need at minimum of a week to return work (perhaps longer for exams/large assignments). While I might not always write detailed explanations on graded work, I will orally go over the answers or work the problems in class (usually based on student requests). Please ask questions in class or stop by my office if a concept is not clear or if you have a question on how I graded your work.

Additionally, you need to give me feedback about how the course is going. It is important that you "rein me in" if I go too fast or if I haven't explained something well enough. **Ask questions!!!**

FAQ:
Are lecture notes from the slides provided? PDF's of the lecture notes will be available in Moodle. Please bring printouts to class, so that you can annotate them. Please note that if I post notes from the last time the course was offered, I will post any revised PDF's of the lecture notes before the next corresponding exam.

Should we copy all the text on the slides? There shouldn't be a need with access to PDF's of the lecture notes. However, it is *far better* to listen to me/our discussion and take notes than to copy the slides. Sometimes text on slides is really just to trigger me on a topic and not something to be committed to your notes. In addition, I commonly go more in-depth than what is on the slides, and you will want to learn that detail.

Can we have an exam review sheet? I commonly do oral Q&A reviews before every exam to clarify geoscience concepts.

ORDER OF TOPICS

Week Starting	Lecture & Lab Topics (Last Day to Withdraw 10/27)	Reading
01: 08/21 *(no class W)*	Syllabus/Course Organization Introduction to Geophysics/Seismic Waves	Chapter 1 & 2
02: 08/28	Seismic Waves	Chapter 2
03: 09/04 *(no class M)*	Seismic Refraction	Chapter 3
04: 09/11	Seismic Refraction	Chapter 3
05: 09/18	Seismic Refraction	Chapter 3
06: 09/25	Seismic Reflection **Lecture Exam #1 (est)**	Chapter 4
07: 10/02	Seismic Reflection	Chapter 4
08: 10/09	Ground Penetrating Radar	Chapter 4
09: 10/16	**Fall Break** (10/14-10/22)	
10: 10/23	Ground Penetrating Radar	Chapter 8
11: 10/30	Magnetics **Lecture Exam #2 (est)**	Chapter 7
12: 11/06	Magnetics	Chapter 7
13: 11/13	Electrical Resistivity	Chapter 5
14: 11/20 *(no class W, R, F)*	Electrical Resistivity **Thanksgiving Break** (11/22-11/24)	Chapter 5
15: 11/27	Gravity	Chapter 6
16: 12/04	Gravity	Chapter 6
Lecture Exam #3: Wed, Dec 13, 1:00-4:00 pm, Julian 226		
Note: These topics and times are subject to change *(especially wrt weather conditions, understanding of basic theory, and equipment availability).* *Students willing to become certified for driving University vehicles should visit http://www.depauw.edu/studentlife/campus-safety/publicsafety/education-and-awareness/drivers-safety/ to find out about driver certification.*		

Useful Resources

Anstey, N.A., 1982, Simple Seismics, International Human Resources Development Corp, 168 pages.

Badley, M.E., 1985, Practical Seismic Interpretation, International Human Resources Development Corp, 266 pages.

Bolt, B.A., 1982, Inside the Earth, W.H. Freeman & Company, 191 pages.

Dobrin, M.B., 1952, Introduction to Geophysical Prospecting, McGraw-Hill, 435 pages.

Ferguson, J, 1987, Mathematics in Geology, Allen & Unwin, 299 pages.

Haeni, F.P., 1988, Chapter D2: Application of Seismic-Refraction Techniques to Hydrologic Studies, Techniques of Water-Resources Investigations of the USGS, 86 pages.

Kearey, P., and Brooks, M., 1984, An Introduction to Geophysical Exploration, Blackwell Scientific Publications, 296 pages.

Sharma, P.V., 1986, Geophysical Methods in Geology, Elsevier, 442 pages.

Sjögren, B., 1984, Shallow Refraction Seismics, Chapman & Hall, 268 pages.

Slotnick, M. M., 1959, Lessons in Seismic Computing, SEG, 268 pages.

Stover, C.W., and Coffman, J.L., 1993, Seismicity of the United States, 1568-1989 (Revised), USGS Professional Paper 1527.

Robinson, E.S. & Coruh, C., 1988, Basic Exploration Geophysics, Wiley, 562 pages. (excellent resource)

Waltham, D., 1994, Mathematics: A Simple Tool for Geologists, Chapman & Hall, 189 pages.

Waters, K.H., 1981, Reflection Seismology: A Tool for Energy Resource Exploration, John Wiley, 453 pages.

Wheeler, R.L., Rhea, S, and Tarr, A.C., 1994, Elements of Infrastructure and Seismic Hazard in the Central United States, USGS Professional Paper 1538-M.

Books on geologic report writing

Copeland, P., 2012, Communicating Rocks, Pearson, 149 pages. (excellent resource)

Policy Page

ADA STATEMENT

It is the policy and practice of DePauw University to provide reasonable accommodations for students with properly documented disabilities. Written notification from Student Accessibility Services is required. If you are eligible to receive an accommodation and would like to request it for this course, please contact Student Accessibility Services. Allow one week advance notice to ensure enough time for reasonable accommodations to be made. Otherwise, it is not guaranteed that the accommodation can be provided on a timely basis. Accommodations are not retroactive. Students who have questions about Student Accessibility Services or who have, or think they may have, a disability (psychiatric, attentional, learning, vision, hearing, physical, medical, etc.) are invited to contact Student Accessibility Services for a confidential discussion. Student Accessibility Services can be reached by phone at 765-658-6267 or studentaccessibility@depauw.edu.

ATTENDANCE

Regular and on-time attendance is expected and monitored (see the Student Handbook https://www.depauw.edu/handbooks/academic/). As stated in the Student Handbook, excessive absences can be grounds for being dismissed from the course. In addition, it has been my experience that learning comprehension improves dramatically when students are present to listen to lectures, to ask questions, and to discuss the material in the classroom setting. In addition, some activities (e.g., field work) require attendance to receive credit. Should you know that you will be absent (e.g., health issue regarding yourself or immediate family, athletic obligation, etc), please contact me in advance (or ASAP afterwards) to make arrangements about assignments.

ACADEMIC INTEGRITY

Any attempt to gain an unfair advantage over other students in the class will be handled in accordance with established University procedures as described in the Academic Handbook section http://www.depauw.edu/handbooks/academic/ on Academic Integrity.

DePauw Academic Resources on Academic Integrity

http://www.depauw.edu/academics/academic-resources/academic-integrity/

Writing Center Information on Plagiarism:

Plagiarism. Using the words or ideas of another writer, including AI-generated text, without attribution, so that they seem as if they are your own. Plagiarism ranges from copying work not written by the person taking credit for it, to rewriting such work with only minor word changes (mosaic plagiarism), to summarizing work (including that done by AI) without acknowledging the source. See the Writing Center Guide to Avoiding Plagiarism for further information on plagiarism: http://www.depauw.edu/academics/academic-resources/academic-resource-center/w-center/w-center-handouts/

CELL PHONE/COMPUTER/SMART DEVICE USE

Before class begins, turn off your cell phone (or set it to vibrate) and put it away in your book bag (not in the desk/table). Do not check or send voicemail or text messages during class, and do not leave class to check or send messages unless 1) you have an emergency (inform your instructor prior to class starting of special circumstances involving a personal emergency situation that would require you to use your phone when class is in session) or 2) are on an instructor-designated break. In other words, do not use your cell phone in class for any reason at any time unless you have consulted with the course instructor.

If you have a cell phone/smartwatch on your person or on your desk/table during an exam without the instructor's permission, you will receive a 0 on the exam, and you will automatically be considered in violation of DePauw's academic integrity policy on cheating due to unauthorized use of a cell phone/smartwatch. You may not take your cell phone/smartwatch with you on bathroom breaks during exams.

Please read the following: http://www.insidehighered.com/blogs/just-visiting/open-letter-incoming-freshmen

Laptops, tablets, smartwatches, and other electronic devices are not allowed to be used in the classroom except for activities directly related to our course as specified by your instructor (e.g., do not check or send emails, chats, or texts, do not use your web browser except for course-sanctioned activities, do not use to view slides or take notes, etc.). Quit all programs not specifically designated by your instructor (not only reducing temptation, but also helping your computer run more efficiently).

Violating the cell phone/computer/smart device use policy is one way students may be considered not engaged/participating in course activities (see the Grades discussion on participation above).

COVID-19 PROTOCOLS

The Fall 2023 DePauw University Covid-19 policy (https://www.depauw.edu/campus-life/wellness/coronavirus/current-covid-19-guidelines-fall-2023/) will be followed in this course. Please carefully read and follow these guidelines.

Masking with KF94, KN95 or N95 masks is **required** for ANYONE who: is experiencing symptoms that could be consistent with COVID-19; tested positive in the last 5 days; or was exposed to COVID-19 in the last 10 days.

Assess your personal health daily. It is of the utmost importance that if you have symptoms of COVID-19, you should put on a mask, and contact the DePauw Health Wellness Center.

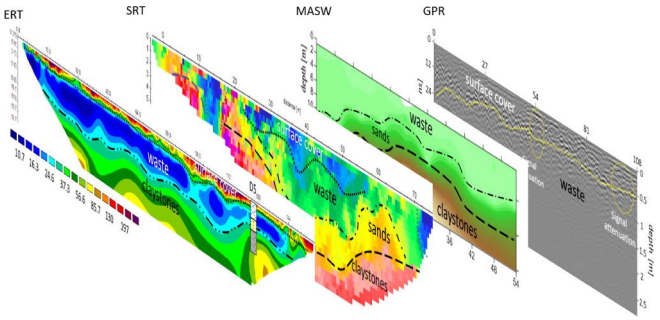
Policy Page

CLASSROOM BEHAVIOR

- **Early is on time, and on time is late.** (especially on days with field activities).
- **Respect everyone.** (yourself, your peers, and your instructor).
- **Listen and contribute.** Lecture and discussion portions of our class can quickly morph to lecture only if you are not an active and contributing participant in class.
- **Work to the best of your ability.** True learning is hard work and is constructed and nurtured by you (not simply transferred from the instructor). A strong work ethic will not only serve you well in this course, but in life in general. Do not settle for less than your best effort.
- **Be aware of consequences (positive & negative).** If you make good decisions (e.g., reading the course materials, taking notes, asking questions, working hard, etc.), you will likely experience good consequences such as enhanced understanding of geoscience processes, improved grades, and general success in life. Conversely, poor decisions (e.g., waiting to cram right before an exam or assignment, pulling an "all-nighter" and coming to class exhausted, relying on energy drinks or other substances, distracting yourself or others with cell phones or laptops, etc.) typically have negative consequences that cause your understanding of course content to suffer.
- **Consider the classroom your workplace.** Once you step inside the classroom, commit yourself to learning as much as you can during that time. Do not routinely get up during class to take care of personal needs (e.g., bathroom breaks, social networking, etc.). Please address these needs during the break between classes. If an emergency occurs, please feel free to leave the classroom to address it.

AUDIO/VISUAL POLICY

- No video, audio, or still picture recordings are allowed during class without the instructor's permission.
- No video recordings, still picture, or other means of duplication (e.g., xeroxing) of homework assignments, labs, exams, etc. are allowed without the instructor's permission.
- You are not permitted to record any of our class meetings. Student Accessibility Service accommodations pertaining to recordings of lectures for taking notes are addressed by the instructor providing handouts of lecture slides/materials on Moodle.
- Materials (or derivative materials) from this course may not be shared, replicated, or published, in whole or in part, or used for any other purpose, without my written approval.



Kondracka, M., et al., 2021, Evaluation of geophysical methods for characterizing industrial and municipal waste dumps, Waste Management, 125(15), 27-39.