This package includes materials that were distributed at the

Geotechnical Engineering Faculty Teaching Strategies & Resources Workshop

Held on February 25, 2020 in Minneapolis, MN
Sponsored by the USUCGER and the National Science Foundation (Award #1936533)

For more information, contact the workshop organizers:

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Workshop Overview

Purpose of the Workshop

The primary goal of the workshop was to help geotechnical faculty at all stages become more effective and efficient teachers, so they can become better educators and improve student learning without compromising research time. Many faculty members hesitate to employ new teaching strategies due to the perceived effort required to implement them. The targeted outcome of the workshop was to help faculty teach better and teach “smarter” by incorporating existing materials and resources into their classes. A second goal of the workshop was to help faculty better develop and carry out outreach and education plans included in their research proposals.

The focus of the workshop was very specific to geotechnical engineering education and the courses that most geotechnical engineering faculty teach, such as undergraduate soil mechanics, foundation engineering, and engineering geology. Most existing engineering workshops devote significant time to pedagogical practices for effective teaching that are very general to engineering courses. Although some of this more general information was reviewed during this workshop, the bulk of the day was spent on providing specific examples, developing new instructional materials, sharing geotechnical resources, networking, and discussing challenges unique to geotechnical education. To that end, workshop sessions were centered around practical, simple strategies that faculty could apply immediately or take away to make an achievable implementation plan.

Resulting Educational Resources for the Geo-Community

One objective was to provide attendees with tools and resources that were specific, manageable, and useful for their own courses. The resources provided at the workshop generally met the following criteria:

- Free and easily accessible, such as handouts and files that were provided to the participants or were available on open websites.
- Easily adaptable so they could be used for different class sizes, class durations, and room layouts.
- Require minimal effort to implement in different courses. Many of the shared classroom activities were described as “take-and-go,” so they can be easily used in class.
- Specific to or directly usable in common geotechnical courses.

Some of these resources are included herein. A second objective was to create an exam question repository for typical undergraduate geotechnical engineering courses. Workshop participants contributed an exam problem and solution, which were compiled by the investigators and posted along with this document on the USUCGER website.
Speakers and Participants

The full-day workshop was organized by faculty from Drexel University, University of Platteville-Wisconsin, and Villanova University and included guest speakers from the National Science Foundation, the Federal Highway Administration, Arizona State University, Bucknell University, California Polytechnic Institute, Lafayette College, South Dakota School of Mines and Technology, Syracuse University, University of Southern California and Villanova University. To encourage attendance and limit additional travel costs, the workshop was scheduled in conjunction with Geo-Congress 2020 in Minneapolis, Minnesota. A total of 49 geotechnical engineering faculty, researchers, and graduate students attended (Figure 1). Attendees included 26 assistant, 11 associate and 5 full professors, along with 4 graduate students, 2 federal employees and one research center director.

Figure 1. Workshop participants and speakers.
Schedule

The workshop agenda was generally categorized into two main themes: 1) tools and resources for geotechnical courses and 2) integrating geotechnical research and education. An intentional effort was made to design the sessions with different formats, including examples of techniques faculty might employ in their own classrooms. A copy of the workshop schedule is included on the next page.

The first session focused on sharing and learning about available geotechnical teaching resources from six different speakers stationed at different locations around the room. Speakers included Dr. Gretchen Bohnhoff (University of Wisconsin-Platteville), Dr. Patricia Gallagher (Drexel University), Dr. Bret Lingwall (South Dakota School of Mines), Mr. Silas Nichols (Federal Highway Administration), Dr. Mary Roth (Lafayette College), and Dr. Claudia Zapata (Arizona State University). This session was performed as a jigsaw, an active learning technique where participants are assigned to different stations to learn about a resource and then report back to their original group to teach them about the resource and review the provided materials. The materials from the jigsaw session are provided in this document.

The second and third sessions involved speakers who shared specific novel and effective methods and examples they have used in their own geotechnical courses. In the second session, Dr. James Hanson (California Polytechnic Institute) presented “Novel Learning Strategies in the Geotechnical Classroom.” Dr. Amy Rechenmacher (University of Southern California) presented “Effective and Efficient Teaching Tips.” The third session featured Dr. Michael Malusis (Bucknell University) on “Process-Based Writing Instruction in Geotechnical Engineering” and Dr. Andrea Welker (Villanova University) on “Incorporating Entrepreneurial Minded Learning into Geotechnical Engineering Classes.”

The fourth session consisted of a group discussion and breakout groups around changes and current challenges in geotechnical education. Discussions centered around challenges faced by faculty at their institutions, the knowledge and skillsets students obtain during their educations and the future of geotechnical engineering education and educational practices.

In the afternoon, the fifth session was a special panel featuring Dr. Shobha Bhatia (Syracuse University), Dr. Mary Roth (Lafayette College), Dr. Nazli Yesiller (California Polytechnic Institute) and Dr. Claudia Zapata (Arizona State University). The panel discussed integrating education and research at all types of colleges and universities, ranging from primarily undergraduate institutions to major research universities. The panelists introduced their topics and then rotated around the room for more in-depth conversations with workshop participants. The sixth and final session was a working session for participants to identify the resources they were most interested in using, the partnerships they wanted to pursue, and the next steps required for implementation.
<table>
<thead>
<tr>
<th>Time</th>
<th>Session Topic</th>
<th>Speakers/Leaders</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 AM – 9:00 AM</td>
<td>Registration &amp; Breakfast</td>
<td>N/A</td>
</tr>
<tr>
<td>9:00 AM – 9:15 AM</td>
<td>Welcome from Organizers &amp; National Science Foundation</td>
<td>Trish Gallagher, Rick Fragaszy</td>
</tr>
<tr>
<td>9:15 AM – 10:00 AM</td>
<td>Group Jigsaw Activity: Geotechnical Resources at Your Fingertips</td>
<td>Mary Roth, Silas Nichols, Bret Lingwall, Claudia Zapata, Gretchen Bohnhoff, Trish Gallagher</td>
</tr>
<tr>
<td>10:00 AM – 10:40 AM</td>
<td>Presentations: Novel Learning Strategies in the Geotechnical Classroom &amp; Effective and Efficient Teaching Tips</td>
<td>Jim Hanson, Amy Rechenmacher</td>
</tr>
<tr>
<td>10:40 AM – 10:55 AM</td>
<td>Coffee &amp; Tea Break</td>
<td></td>
</tr>
<tr>
<td>10:55 AM – 11:35 AM</td>
<td>Presentations: Shared Examples of Enhancing Undergraduate Geotechnical Education</td>
<td>Mike Malusis, Andrea Welker</td>
</tr>
<tr>
<td>11:35 AM – 12:00 PM</td>
<td>Breakout and Discussion: Changes and Challenges in Geotechnical Education</td>
<td>Organizers</td>
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<tr>
<td>12:00 PM</td>
<td>Group Picture</td>
<td>N/A</td>
</tr>
<tr>
<td>12:00 PM – 1:15 PM</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>1:15 PM – 2:45 PM</td>
<td>Panel and Stations: Integrating Education and Research at All Levels</td>
<td>Mary Roth, Claudia Zapata, Shobha Bhatia, Nazli Yesiller</td>
</tr>
<tr>
<td>2:45 PM – 3:00 PM</td>
<td>Coffee &amp; Tea Break</td>
<td></td>
</tr>
<tr>
<td>3:00 PM – 3:40 PM</td>
<td>Group Working Session: Next Step...Implementation</td>
<td>Organizers</td>
</tr>
<tr>
<td>3:40 PM – 3:50 PM</td>
<td>Closing Remarks from NSF</td>
<td>Rick Fragaszy</td>
</tr>
<tr>
<td>3:50 PM – 4:00 PM</td>
<td>Workshop Closing Remarks &amp; Announcements</td>
<td>Gretchen Bohnhoff, Kristin Sample-Lord</td>
</tr>
</tbody>
</table>
The remainder of this document is a compilation of several resources provided to participants at the Geotechnical Engineering Faculty Teaching Strategies & Resources Workshop.

Please attribute credit to the contributors when using these materials.

The Exam Question Repository compiled from this workshop is in a separate document.
Partial List of Available Geotechnical Engineering Teaching Resources

(as of 02/20/2020; if you can add others, please contact the workshop organizers with details)

Websites and Links:

- **USUCGER website**: [http://research.engr.oregonstate.edu/usucger/teaching_aids.htm](http://research.engr.oregonstate.edu/usucger/teaching_aids.htm)
  - *Educational Materials on Biogeotechnics* developed by Center for Bio-mediated and Bio-inspired Geotechnics
  - *Library of Group Activities that Promote Active Learning in the Undergraduate Soil Mechanics Classroom* developed by Dr. Kristin Sample-Lord (Villanova University) and Dr. Gretchen Bohnhoff (University of Wisconsin-Platteville)
  - *Development of a geotechnical engineering software package in R* developed by Dr. James Kaklamanos (Merrimack College)
  - *Drilled Shaft Concepts and Construction* YouTube video developed by Pierresearch
  - *Complete Landfill Course Notes* developed by David Elton (retired) and John Bowders (University of Missouri)
  - *A Brief Overview of Geosynthetics and Their Major Applications* developed by Bob Koerner
  - *Geotechnical Engineering Photo Album* developed by Ross Boulanger (University of California, Davis) and Mike Duncan (Virginia Tech)
  - *Geoengineering Photo Gallery* developed by Dimitris P. Zekkos (University of California, Berkeley)
  - *An Introduction to Drilling and Sampling in Engineering Practice* developed by Jason DeJong and Ross Boulanger, University of California, Davis
  - *Instructional centrifuge* (University of Colorado at Boulder)
  - *Alaska Earthquake Photos*
  - *Earth Science World Image Bank*
  - *Ground Modification Photos* developed by Hayward Baker
  - *Comments on seepage programs for undergraduate courses* compiled by Isao Ishibashi

- **Case Western Database**: [https://engineering.case.edu/eciv/geodatabase/](https://engineering.case.edu/eciv/geodatabase/)
  The Case Western Data Base contains over 234 tests conducted on three different sands, in dense and loose conditions, with a wide variety of stress paths. More than half of the tests are on hollow cylinders, the rest on cubical samples. In addition, the Data Base contains the results of 18 tests on Edga Plastic Kaolin clay and the results of 8 tests on Hydrite121 clay; both series conducted on thin hollow cylinders. Researchers can use the data base to validate their constitutive relations.

- **Science Education Resource Center (Carleton College)**: [http://serc.carleton.edu/index.html](http://serc.carleton.edu/index.html)
  SERC has an extensive collection of on-line teaching resources and peer-reviewed activities that can be incorporated into a variety of geotechnical engineering, geology, geohazards, and earthquake engineering courses. Materials typical include a description, teaching materials, teaching notes and tips, the context for use, learning outcomes, assessment guidance, and references. Some activities are stand-alone, while others are integrated modules that can be used individually or in sequence.

- **Engineering Geology and Site Characterization Educational Resources Developed by Committee Members**: [http://www.asce-egsc.org/educational_resources.html](http://www.asce-egsc.org/educational_resources.html)
  - *Educational Modules on Engineering Geology*: 6 modules on engineering geology, rock properties and engineering characterization, site characterization, geologic mapping, and geologic hazards developed by Thomas Oommen, Sajin Kumar Kochappi Sathyan, Nick Hudyma, Roch Player, Mala Ciancia, and Anna Shidlovskaya
  - *Training Materials on In Situ Testing*: SPT video and Power Point slides developed by Paul Mayne

- **Check ASCE technical committee webpages for other resources**: [https://www.geoinstitute.org/index.php/committees/technical-committees](https://www.geoinstitute.org/index.php/committees/technical-committees)
• International Society for Soil Mechanics and Geotechnical Engineering Education Resources
  https://www.issmge.org/education
  o Virtual University https://www.issmge.org/education/virtual-university
  o Videotaped Honour Lectures https://www.issmge.org/education/videotaped-honor-lectures
  o Recorded Webinars https://www.issmge.org/education/recorded-webinars
  o Presentations https://www.issmge.org/education/presentations
• Geoengineer: https://www.geoengineer.org/education
  o Assorted resources on a variety of topics
• American Society of Engineering Education (ASEE): https://www.asee.org
  o Hundreds of education-related papers
• National Center for Case Study Teaching in Science https://sciencecases.lib.buffalo.edu/
  o Some case studies (especially one on sinkholes) related to civil engineering and geology –
    requires a membership fee for access
• Case studies course developed by Jean-Louis Briaud, Texas A & M University (available on Teaching
  Strategies and Resources Workshop resources page or contact Professor Briaud directly)

Teaching Resources Videos:
• YouTube Channels with Soil Mechanics, Geology, Seismology and Earthquake Engineering Content
  o John Burland’s Essentials of Soil Mechanics: - 5 videos from 3 to 6 minutes
    https://www.youtube.com/watch?v=ZuofAC9rq58&list=PLKVvJWYS08Ye9WBPs3ET8eYqR1nTbu9Qc
  o Seismology/Earthquake Engineering: IRIS Consortium (Incorporated Research Institutions for Seismology) - https://www.youtube.com/watch?v=HeYo0eXQrMg
    Content varies from 5 to 10 minute seismology content videos (e.g. earthquake magnitude, building resonance) to full length in-depth content (e.g. recorded webinars by seismologists)
  o GeoScience Videos: https://www.youtube.com/channel/UCtQfVk8PDyHU6e9q_1cEY0Q
    Short (~6 minute) videos on basic geoscience topics (including some related to soil mechanics such as porosity and permeability, aquifers, water table)
  o Practical Engineering: https://www.youtube.com/channel/UCMoqf8ab-42UUQldVoKwJQ
    Grady Hillhouse, P.E. created 7 soil mechanics videos from 4 to 9 minutes (e.g. reinforced earth, rock bolts, expansive soils, groundwater flow, sinkhole formation, coffer dams)
• YouTube Channels with Recorded Geotechnical Engineering Lectures
  o Elementary Soil Mechanics, William Kitch
    https://www.youtube.com/channel/UCyt3w3SogxUSJ7RSxQusXXA
    ▪ Introductory Geotechnical Engineering – videos align with Coduto, Yeung & Kitch (2011)
    ▪ Graduate Classes
      https://www.youtube.com/channel/UCNgJ4si9cavXU3DrSA4thnw/playlists
    ▪ Advanced Soil Mechanics – 40 videos ranging from 8 to 70 minutes
    ▪ Earth Retaining Structures – 28 videos ranging from 15 to 100 minutes
  o Office Hours by Kevin Franke, Brigham Young University
    https://www.youtube.com/channel/UClSu6oTBCMyJ7Xzy-3UJ4kw
    ▪ Elementary Soil Mechanics – 23 videos ranging from 20 to 60 minutes
    ▪ Advanced Soil Mechanics – 2 videos on clay chemistry and effective stress and seepage
    ▪ Geotechnical Earthquake Engineering – 27 videos ranging from 20 to 90 minutes
• Soil and water pressure videos by Wayne Broadland: https://www.youtube.com/watch?v=mpV8-YaJ2p4
Elementary Engineering videos: https://www.youtube.com/channel/UC1A_poM_ksoafQJLc3lu_Bg/videos
Activities and Videos to Aid Active Learning in Geotechnical Engineering & Geology

Resource #1: Science Education Resource Center (SERC), Carleton College

Website: http://serc.carleton.edu

Description: SERC has an extensive collection of on-line teaching resources and peer-reviewed activities that can be incorporated into a variety of geotechnical engineering, geology, geohazards, and earthquake engineering courses. Materials typical include a description, teaching materials, teaching notes and tips, the context for use, learning outcomes, assessment guidance, and references. Some activities are stand-alone, while others are integrated modules that can be used individually or in sequence.

Examples: Stand-Alone Activities

- Soils as Construction Materials (2 parts): Students classify soils, creating soil profiles, calculate cut and fill quantities. (Douglas Kowalewski, Worcester State University)
- Seismic Evaluation of Buildings: Students do a simplified seismic evaluation of a building. (Dr. G.P. Ganapathy, VIT University, Vellore 632014, India)

Examples: Modules

- GPS, Strain, and Earthquakes (6 units): Students analyze GPS data to calculate local crustal strain and tie it to regional geology. (Vince Cronin, Baylor University and Phillip Resor, Wesleyan University)
- Imaging Active Tectonics with InSAR and Lidar (5 units): Students use InSAR and lidar to understand the earthquake cycle and the vulnerability of lifelines to earthquake hazards. (Bruce Douglas, Indiana University-Bloomington and Gareth Funning, University of California-Riverside)
- Living on the Edge: Building resilient societies on active plate margins (6 units): Considers geologic hazards and associated risks at transform, divergent and convergent plate boundaries. (Laurel Goodell, Princeton University, Peter Selkin, University of Washington, Tacoma, and Rachel Teasdale, California State University, Chico)
- Surface Process Hazards (5 units): Students analyze landscape characteristics and use them as indicators of mass-wasting events. (Sarah Hall, College of the Atlantic and Becca Walker, Mt. San Antonio College)
- Humans' Dependence on Earth's Mineral Resources (6 units): Connects human use of mineral resources with rock and mineral identification, resource discovery and extraction, and impacts of resource extraction. (Prajukti Bhattacharyya, University of Wisconsin, Whitewater, Joy Branlund, Southwestern Illinois College and Leah Joseph, Ursinus College)
Resource #2: Existing videos with soil mechanics, geology, seismology and earthquake engineering content.

Description: There are many existing high-quality resources available to help you experiment with an inverted (flipped) classroom. By delivering some content online before class, it frees up class time for interactive activities. Links to videos can be posted in an online learning system or an app like Clip Grab (https://clipgrab.org/) can be used to download the videos from YouTube.

Examples: YouTube Channels with Soil Mechanics, Geology, Seismology and Earthquake Engineering Content

- John Burland’s Essentials of Soil Mechanics: - 5 videos from 3 to 6 minutes [https://www.youtube.com/watch?v=ZuofAC9rq58&list=PLKVVvJWYS08Ye9WBP3ET8eYqR1nTbu9Qc]
- Seismology/Earthquake Engineering: IRIS Consortium (Incorporated Research Institutions for Seismology) - [https://www.youtube.com/watch?v=HeYo0eXQrMg](https://www.youtube.com/watch?v=HeYo0eXQrMg) Content varies from 5 to 10 minute seismology content videos (e.g. earthquake magnitude, building resonance) to full length in-depth content (e.g. recorded webinars by seismologists)
- GeoScience Videos:  [https://www.youtube.com/channel/UCtQfVk8PDyHU6e9q_1cEY0Q](https://www.youtube.com/channel/UCtQfVk8PDyHU6e9q_1cEY0Q) Short (~6 minute) videos on basic geoscience topics (including some related to soil mechanics such as porosity and permeability, aquifers, water table)
- Practical Engineering:  [https://www.youtube.com/channel/UCMOqf8ab-42UUQIdVoKwjIQ](https://www.youtube.com/channel/UCMOqf8ab-42UUQIdVoKwjIQ) Grady Hillhouse, P.E. created 7 soil mechanics videos from 4 to 9 minutes (e.g. reinforced earth, rock bolts, expansive soils, groundwater flow, sinkhole formation, coffer dams)

Resource #3: Recorded geotechnical engineering lectures.

Description: If you need to miss a class due to a conference or inclement weather, you may be able to assign a lecture from these collections.

Examples: YouTube Channels with Recorded Geotechnical Engineering Lectures

- Elementary Soil Mechanics, William Kitch [https://www.youtube.com/channel/UCyt3w3SogxUSJ7RSxQusXXA](https://www.youtube.com/channel/UCyt3w3SogxUSJ7RSxQusXXA)
  - Graduate Classes [https://www.youtube.com/channel/UCNgJ4si9cavXU3DrSA4thnw/playlists](https://www.youtube.com/channel/UCNgJ4si9cavXU3DrSA4thnw/playlists)
    - Advanced Soil Mechanics – 40 videos ranging from 8 to 70 minutes
    - Earth Retaining Structures – 28 videos ranging from 15 to 100 minutes
- Office Hours by Kevin Franke, Brigham Young University [https://www.youtube.com/channel/UCTSu6oTBCMyJ7Xzy-3UJ4kw](https://www.youtube.com/channel/UCTSu6oTBCMyJ7Xzy-3UJ4kw)
  - Elementary Soil Mechanics – 23 videos ranging from 20 to 60 minutes
  - Advanced Soil Mechanics – 2 videos on clay chemistry and effective stress and seepage
  - Geotechnical Earthquake Engineering – 27 videos ranging from 20 to 90 minutes

Points of Contact: Patricia Gallagher, pmg24@drexel.edu
Ungraded Classroom Approach for “Introduction to Geotechnical Engineering”

**Resource:** Ungraded Syllabus for “Introduction to Geotechnical Engineering”

**Point of Contact:** Bret Lingwall, Bret.Lingwall@sdsmt.edu

**Description:** In professional practice, engineers submit their work, receive comments from supervisors, and revise their work based on the comments. An ungraded classroom provides students with the opportunity to model engineering practice by submitting their work for review, receiving comments, and resubmitting their work until it is correct.
Ungraded Course Syllabus

Instructor: Bret Lingwall, PhD, PE

E-Mail: bret.lingwall@sdsmt.edu

Class Time: MW 12:00 to 12:50, Room CB-204W

Discussion (optional): F 12:00 to 12:50, Room CB-204W

Office Hours: MWF 10:00 to 12:00, Room CM-313

Primary Text: "An Introduction to Geotechnical Engineering" by Holtz, Kovacs, and Sheehan. 1st or 2nd Editions.

Labs: Several lab sections are held as part of this course. A separate lab syllabus is posted which is governed by this syllabus. Group reports are the primary deliverable for the lab section. Attendance is mandatory to all labs.

Course Description: This course covers the general background material in geotechnics and soil mechanics that every civil, geologic, environmental, petroleum or mining engineer will need to be successful in their professional practice after graduation. As such, the course is not catered towards those who will specialize in geotechnics, but in broad principles and applications common across the entirety of science and engineering wherein soil is encountered. This course uses several novel and exciting pedagogical techniques and is taught as both “flipped” and “un-graded”. A separate 0-credit laboratory is associated with the course and included in the overall grade. The laboratory section is to provide a hands-on learning experience for students to reinforce the theory and concepts discussed in lectures and the classroom.

In an “un-graded” course, there is still a final grade, but no assignments, quizzes and exams are graded. Each submittal is reviewed, comments provided, and effort noted. You then have every opportunity to revise as many times as needed to get each and every problem correct. If you fail to submit or revise your solutions, you receive lower course grades than classmates who embrace the process and submit and revise. To help you understand your learning, at Mid-Term and the end of the semester, you will submit to the instructor a brief Self-Evaluation of their learning. In this Self-Evaluation you will recommend to the instructor an honest grade that you believe you deserve based on your overall learning in the course (this grade is not based on EFFORT or SCORE or TIME, but on LEARNING.) The final examination of the course is to visit with the instructor in my office with the Self-Evaluations and Exams in-hand and explain to the me what
you have learned over the semester. Students who demonstrate deep and insightful learning in this visit are awarded higher grades than those who demonstrate very little growth or learning from the semester.

Why am I 'ungrading' the structure of this class? -- because engineering professionals receive comments and input on their work and then revise. I want you to practice being an engineering professional and begin to learn like a pro. Pros have deep and broad knowledge structures from learning just like we are doing in this class.

What do I do if I’m flipping out with worry about my final grade? --review what you have done thus far, e.g., the effort you have put into the course and the work you have done then come talk to me if you are still concerned about knowing where you stand or if you are on track to earn the grade you plan to earn.

Course Objectives: Students will be able to:

- Perform well formatted and clear Engineering Design Calculations
- Write engineering laboratory reports with technicality and sophistication
- Identify different soil types and their Engineering Use
- Demonstrate the use of geosynthetics in infrastructure engineering
- Perform Soil Classifications
- Explain Soil Phase Relationships
- Specify Soil Compaction and quality control measures in design recommendations
- Identify soils susceptible to Capillarity, Expansive Soils, and Frost Action and select remedial alternatives
- Perform Permeability and Seepage analysis calculations in support of the design of dams and levees
- Evaluate Stress Distributions into the Earth and impacts to the design of structures
- Read boring logs and geologic sections (i.e. lithology)
- Recommend appropriate subsurface exploration means and methods for a given design problem
- Work efficiently and effectively in groups and build strong teams
- Resolve conflicts in group work
- Reflect on their own learning and progress in becoming an engineer

Exams: There will be two exams in this course. One exam is in-class and at midterm. The other exam is take-home and will be administered beginning Thanksgiving Break with a date of the last day of classes. The exams are both cumulative in nature. In-class exams will be open book/notes. No electronics of any kind are allowed in an in-class exam aside from a conventional calculator which may be used during the exam.
The mid-term exam will be reviewed by the instructor, and level of learning noted. You will then have opportunity to revise your exams based on my feedback. If you take advantage of opportunities to revise your work by making your initial submission purposefully weak, thin, disappointing, and/or devoid of effort so you can “improve” it quickly and impressively, this trick will not be lost on me. I will note this in my review comments and pulling this trick may lower your final grade.

The final exam for the course is a brief 1-on-1 visit with the instructor during finals week to show and discuss your Self-Evaluation of Learning, mid-term exam and final exam.

Quizzes: Multiple in-class quizzes are planned. Additional quizzes may be added as needed to encourage attendance, reading of textbook, and utilization of video lectures. Quizzes only cover material in the textbook and online course content. Quizzes are closed book and closed note with no electronics allowed of any kind aside from a conventional calculator. Quiz makeup for approved absence is determined by the instructor on a case-by-case basis. Any individuals caught cheating in any manner on quizzes will receive an F for the course. Quizzes will only be considered complete when you have revised your quiz and resubmitted based on my comments on your quiz. If you take advantage of opportunities to revise your work by making your initial submission purposefully weak, thin, disappointing, and devoid of effort so you can “improve” it quickly and impressively, this trick will not be lost on me. I will note this in my review comments and pulling this trick may lower your final grade.

Homework: Homework problem solutions must follow acceptable formatting requirements (to be discussed later in this syllabus), and assignments that do not follow formatting rules will not be counted in the student’s final grade. Homework assignments will be due at end-of-day on Fridays, submitted as a single .pdf document. Homework assignments submitted late will not receive a penalty. Despite the lack of a penalty for late submissions, I strongly encourage everyone to keep up on homework submission dates. If you fall behind in the homework, learning will be difficult, quizzes and exams will suffer, and the revisions process may become unsurmountable as the semester ages. Keeping up on assignments and following due dates is the best practice.

Homework assignments will be reviewed by the grader and you will receive detailed feedback. You must then revise and re-submit the homework to the grader, correcting everything noted by the grader. The homework does not “count” until the revisions are complete. If you fail to submit fully completed homework assignments or do not complete the revisions process, you will receive lower grades at the end of the semester. All homework must be submitted, and revisions submitted by the last day of classes. Homework problems may cover material not covered in class. It is your responsibility to
use the textbook to learn how to solve those problems. No homework will be accepted after the last day of classes per University policy.

Working on homework assignments with friends, the TAs, the instructor, mentors, and groups is encouraged. Group work is excellent for learning. However, these methods of study should be collaborative in nature. Do not simply copy a friend or the TA! Do not simply tag along and replicate another’s work! Use collaborative work correctly to enhance learning rather than a vehicle for cheating. Cheating is not tolerated, collaboration is.

Letter Grade Scale: The grades for this “un-graded class” will be on a set scale:

<table>
<thead>
<tr>
<th>Category</th>
<th>3pts</th>
<th>2pts</th>
<th>1pt</th>
<th>0pts</th>
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</thead>
<tbody>
<tr>
<td>Homework Submittal and Revision Rate</td>
<td>100%</td>
<td>90%</td>
<td>80%</td>
<td>&lt;80%</td>
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<tr>
<td>Group Laboratory Reports</td>
<td>100%</td>
<td></td>
<td></td>
<td>&lt;100%</td>
</tr>
<tr>
<td>Laboratory Attendance And Participation</td>
<td>100%</td>
<td></td>
<td></td>
<td>&lt;100%</td>
</tr>
<tr>
<td>In-Class Participation</td>
<td>Frequent</td>
<td>Occasional</td>
<td>Infrequent</td>
<td>Rarely</td>
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<tr>
<td>Minute Papers Submittals</td>
<td>100%</td>
<td>90%</td>
<td>80%</td>
<td>&lt;80%</td>
</tr>
<tr>
<td>Quiz Submittals and Revisions</td>
<td>100%</td>
<td>90%</td>
<td>80%</td>
<td>&lt;80%</td>
</tr>
<tr>
<td>Mid-Term Exam and Revision</td>
<td>Done</td>
<td></td>
<td></td>
<td>Not Done</td>
</tr>
<tr>
<td>Student Does not Submit Earnestly and Completely in Initial Submittal</td>
<td>Reduction in Points Based on Severity and Frequency of the Indiscretions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End-of-Semester Exam</td>
<td>Scored by Instructor and Student</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid-Term Learning Reflection</td>
<td>Scored by Instructor and Student</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of Term Learning Reflection and Self-Assessment</td>
<td>Scored by Instructor and Student</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2 – Approximate Letter Grade Metrics

<table>
<thead>
<tr>
<th>Grade</th>
<th>Points</th>
<th>Student and Instructor Assessment of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>27-30</td>
<td>Can move the grade down if low levels of learning are demonstrated in the final exam or issues with submittal earnestness occur</td>
</tr>
<tr>
<td>B</td>
<td>24-26</td>
<td>Can move the grade up or down</td>
</tr>
<tr>
<td>C</td>
<td>21-23</td>
<td>Can move the grade up or down</td>
</tr>
<tr>
<td>D</td>
<td>18-20</td>
<td>Can move the grade up or down</td>
</tr>
<tr>
<td>F</td>
<td>&lt;18</td>
<td>Can move the grade up if significant learning is demonstrated in the final exam</td>
</tr>
</tbody>
</table>

Table 4 – Evaluation Rubric for Numerical Problems

<table>
<thead>
<tr>
<th>Desired Outcome</th>
<th>Missing 0 %</th>
<th>Inadequate 5%</th>
<th>Adequate 15%</th>
<th>Good 20% pts</th>
<th>Exceptional 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engineering Process</td>
<td>No attempt at an engineering problem solving process.</td>
<td>No clear engineering problem solving process.</td>
<td>An engineering process has been attempted, but is of poor quality.</td>
<td>An adequate and clear engineering process has been utilized.</td>
<td>The engineering problem solving process is clear, concise, shows assumptions, and includes sufficient detail that the flow of thoughts are simple and well presented.</td>
</tr>
<tr>
<td>2. Calculations and Equations</td>
<td>No calculations are included.</td>
<td>Only minimal calculations are included even if the wrong equations.</td>
<td>Most Calculations are included, but a few are missing even if the wrong equations.</td>
<td>All calculations are included, but lack organization or some wrong equations have been used.</td>
<td>All calculations are included and all of the correct equations have been used.</td>
</tr>
<tr>
<td>3. Results</td>
<td>No Results are included.</td>
<td>Only a part of the required results are included.</td>
<td>The required results are included, but the results are entirely incorrect.</td>
<td>The required results are present in the report, but only partially correct.</td>
<td>All of the required results are present, results are correct</td>
</tr>
<tr>
<td>4. Formatting</td>
<td>No attempt at formatting made.</td>
<td>Some required sections missing, general non-compliance with formatting standards.</td>
<td>All of the sections are included with partial non-compliance with formatting standards.</td>
<td>All required sections are included, and most other formatting standards have been followed. Items such as</td>
<td>All required sections are included and all formatting standards have been included.</td>
</tr>
</tbody>
</table>
Table 5 – Evaluation Rubric for Abstracts, Essay or Writing Problems

<table>
<thead>
<tr>
<th>Desired Outcome</th>
<th>Missing 0 %</th>
<th>Inadequate 5%</th>
<th>Adequate 15%</th>
<th>Good 20% pts</th>
<th>Exceptional 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Results</td>
<td>No Results are included.</td>
<td>Only a part of the required results are included.</td>
<td>The required results are included, but the results are entirely incorrect</td>
<td>The required results are present in the solution, but only partially correct</td>
<td>All of the required results are present, results are correct</td>
</tr>
<tr>
<td>2. Formatting</td>
<td>No attempt at formatting made.</td>
<td>Some required sections missing, general non-compliance with formatting standards.</td>
<td>All of the sections are included with partial non-compliance with formatting standards.</td>
<td>All required sections are included, and most other formatting standards have been followed.</td>
<td>All required sections are included and all formatting standards have been included.</td>
</tr>
<tr>
<td>3. Writing</td>
<td>Spelling, grammar, tense, and voice errors throughout the solution.</td>
<td>Spelling, grammar, tense, and voice errors common in the solution.</td>
<td>Writing is free from most spelling, grammar, tense and voice errors. Language is not concise or insufficient to make clear engineering points.</td>
<td>Writing is free from almost all errors, but lacks technicality, sophistication and/or clarity.</td>
<td>Writing is completely free from errors and is concise, descriptive, and technical.</td>
</tr>
<tr>
<td>4. Discussion</td>
<td>No required discussion made.</td>
<td>An attempt at a discussion has been made, but lacks critical content, conclusions, and/or clarity.</td>
<td>The discussion includes minimal or excessive wording which clouds the content, conclusions and/or clarity.</td>
<td>The discussion has all of the required content, covers issues with accuracy and precision, and conclusions are clear. Writing is concise but complete.</td>
<td>The writer shows particular insight into the topic, issue, or problem showing original thought synthesizing with information from lecture and the engineering profession.</td>
</tr>
</tbody>
</table>
Center for Bio-mediated and Bio-inspired Geotechnics

Resources Available

Web link: https://cbbg.engineering.asu.edu/education/curriculum/

Our collection of teaching modules, lesson plans, and other resources have been categorized into grade-level appropriate pages for pre-college audiences, undergraduate and graduate students, as well as practicing engineers. Examples of modules that have been vetted by our Curriculum Committee for pre-college and graduate levels are:

Pre-College Level: https://cbbg.engineering.asu.edu/education/curriculum/pre-college/
(27 lessons available)

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Grade</th>
<th>Lesson Plan</th>
<th>Other Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>Ashley, Martina</td>
<td>Middle School</td>
<td>Winogradsky Columns: Microbial Ecosystems</td>
<td>Presentation</td>
</tr>
<tr>
<td>2019</td>
<td>Callhoun, Mark</td>
<td>High School</td>
<td>Structural Analysis of BiCP Treated 3D Printed Concrete</td>
<td>Presentation</td>
</tr>
<tr>
<td>2019</td>
<td>Carrier, Scott</td>
<td>Elementary School</td>
<td>Enzyme-Induced Cementation in Soil (Enzymatic Precipitation)</td>
<td>Presentation</td>
</tr>
<tr>
<td>2019</td>
<td>Hood, Daniel</td>
<td>High School</td>
<td>Exploring Bioremediation Through Cellulase Respiration</td>
<td>Presentation</td>
</tr>
<tr>
<td>2019</td>
<td>Johnson, Jasmine</td>
<td>Elementary School</td>
<td>Using Jack Bean Enzyme to Increase the Rate of Cementation in Soil (Enzymatic Precipitation)</td>
<td>Presentation</td>
</tr>
<tr>
<td>2018</td>
<td>Collver, Wendy</td>
<td>High School</td>
<td>Reducing Surface Porosity of Concrete</td>
<td>Presentation</td>
</tr>
<tr>
<td>2018</td>
<td>Gensel, Jessica</td>
<td>Middle School</td>
<td>Exploring the Nitrogen Cycle</td>
<td>Presentation</td>
</tr>
<tr>
<td>2018</td>
<td>Hall, Jason</td>
<td>Middle School</td>
<td>Tough Stuff</td>
<td>Presentation</td>
</tr>
<tr>
<td>2018</td>
<td>Pellsbury, Finn</td>
<td>Middle School</td>
<td>A Student-Led Investigation of Ways to Reduce Soil Liquefaction</td>
<td>Presentation</td>
</tr>
<tr>
<td>2018</td>
<td>Reding, Amanda</td>
<td>Middle School</td>
<td>Amazing Anchoring Adapters and Analogs</td>
<td>Presentation</td>
</tr>
</tbody>
</table>

University Level: https://cbbg.engineering.asu.edu/education/curriculum/university/

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Level</th>
<th>Lesson Plan</th>
<th>Other Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>Dash, Sagarika</td>
<td>Community College</td>
<td>Exploring Soil Microbial Diversity for Bioremediation</td>
<td>Presentation</td>
</tr>
<tr>
<td>2017</td>
<td>Elder, Renee</td>
<td>Community College</td>
<td>Let’s Get Dirty with Soil</td>
<td>Presentation</td>
</tr>
<tr>
<td>2017</td>
<td>Thacker, Quinn</td>
<td>Community College</td>
<td>Microbes Facilitate Chain Elongation</td>
<td>Presentation</td>
</tr>
<tr>
<td>2018</td>
<td>Wood, Karrie</td>
<td>Community College</td>
<td>Geotechnics and Soil</td>
<td>Presentation</td>
</tr>
</tbody>
</table>

Level: Title

<table>
<thead>
<tr>
<th>Module</th>
<th>Handouts</th>
<th>Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td>Introduction to Biogeotechnical Engineering</td>
<td>Presentation</td>
</tr>
</tbody>
</table>
Example Activity

Topic: Freshman Module – Introduction to Biogeotechnical Engineering

Learning Objectives
This instructional module is developed to motivate and educate freshman civil engineering students to learn about, become interested in, and consider careers in, biogeotechnical engineering. The module is meant to be a teacher-led, in class, customizable lecture for a 50 to 90-minute-long session for introductory engineering courses.

Organization and Timeline
1. Pre-survey 6 to 8 minutes
2. Instructional time with in-class student activities 50 to 75 minutes
3. Post-survey 8 to 10 minutes

Assessments:
Links to the online assessment instruments are provided within the presentation. Participants may use their laptops, tablets, or smartphones to take the surveys; however, it is suggested to keep some paper copies of the assessments for backup.

Supplies Needed for the Instructional Delivery of the Module:
• Classroom equipped with computer and speakers, projector, and screen
• PowerPoint slides, pre-loaded onto a USB or shared drive
• Paper copies of pre and post assessments as backup
• Students should come prepared with paper and pencil
• Pictures of implemented applications, samples of bio-cemented sand, or other visual aid to share
• Optional demonstrations in biogeotechnical engineering (Liquefaction and Surficial Soil Stabilization)

Suggestions for Effective Delivery:
• Review instructional slides (along with notes provided below each slide) ahead of time
• To view notes during instructional delivery, either start PowerPoint in presentation mode, presenter view, or print out the notes before class
• Modify slide 35 to include elective course numbers specific to your institution
• If short on time, skip slides 29 to 34
• If there is extra time in the class period, show the following video created by Geoengineer.org: Fascinating Geotechnical Engineering News that Happened in 2016 - https://www.youtube.com/watch?v=eOBwkdB4rU0
• Contact Dr. Jean Larson at jean.larson@asu.edu or (480) 965-7804, or Claudia Zapata at czapata@asu.edu if you have any questions or concerns.

Material Provided
• Power Point presentation
• Instructor handout
• Pre- and post-surveys
**GeoTech Tools**

**Resource:** GeoTechTools Toolkit for Infrastructure Projects

**Website:** [https://geotechtools.geoinstitute.org/](https://geotechtools.geoinstitute.org/)

**Point of Contact:** Silas Nichols, Silas.Nichols@dot.gov

**Description:** GeoTechTools disseminates research results from the second Strategic Highway Research Program Project Number R02 (SHRP 2 R02) *Geotechnical Solutions for Soil Improvement, Rapid Embankment Construction, and Stabilization of the Pavement Working Platform.* GeoTechTools is a toolkit of geotechnical information to address all phases of decision making for infrastructure projects.
TEACHING STRATEGIES AND RESOURCES WORKSHOP: GEOTECHTOOLS

Presented at Geo-Congress
Minneapolis MN; 02/25/2020

DEEP MIXING METHODS

AGGREGATE COLUMNS AND LIGHTWEIGHT FILL

COLUMN SUPPORTED EMBANKMENTS

TECHNOLOGIES ADDRESSED (CONT.)

- Drilled/Grouted & Hollow Bar Soil Nailing
- Electro-Osmosis
- Excavation & Replacement
- Fiber Reinforcement in Pavement Systems
- Geocell Confinement in Pavement Systems
- Geosynthetic Reinforced Construction Platforms
- Geosynthetic Reinforced Embankments
- Geosynthetic Reinforcement in Pavement Systems
- Geosynthetic Separation in Pavement Systems
- Geosynthetics in Pavement Drainage
- Geotextile Encased Columns
- High-Energy Impact Rollers
- Hydraulic Fill + Vacuum Consolidation + PVDs
- Injected Lightweight Foam Fill

TECHNOLOGIES ADDRESSED

- Aggregate Columns
- Beneficial Reuse of Waste Materials
- Bio-Treatment for Subgrade Stabilization
- Blast Densification
- Bulk-Infill Grouting
- Chemical Grouting/Injection Systems
- Chemical Stabilization of Subgrades & Bases
- Column-Supported Embankments
- Combined Soil Stabilization with Vertical Columns
- Compaction Grouting
- Continuous Flight Auger Piles
- Deep Dynamic Compaction
- Deep Mixing Methods

Credit: Silas Nichols
TECHNOLOGIES ADDRESSED (CONT.)

- Intelligent Compaction
- Jet Grouting
- Light Weight Fills
- Mechanical Stabilization of Subgrades & Bases
- MSE Walls
- Micro-Piles
- Onsite Use of Recycled Pavement Materials
- Partial Encapsulation
- PVDs & Fill Preloading
- Rapid Impact Compaction
- Reinforced Soil Slopes
- Sand Compaction Piles
- Screw-In Soil Nailing
- Shoot-In Soil Nailing
- Shored MSE Walls
- Traditional Compaction
- Vacuum Preloading w/ & w/o PVDs
- Vibrocompaction
- Vibro-Concrete Columns

APPLICATION AREAS

- Construction over Unstable Soils
- Construction over Stable/Stabilized

LOG-IN SCREEN

HTTPS://GEOTECHTOOLS.GEOINSTITUTE.ORG

THANKS!

Log into GeoTechTools at https://geotechtools.geoinstitute.org

Silas C. Nichols, P.E.
Principal Geotechnical Engineer
Federal Highway Administration
Office of Bridges and Structures

Phone: 202-366-1554
Email: Silas.Nichols@dot.gov
Website: fhwa.dot.gov/engineering/geotech
Simple Web-Based Tools That You Can Use to Support Student Collaboration

Resource #1: Padlet: A tool to create online bulletin boards that you can share with your students

Website: Padlet.com

Point of Contact: Mary Roth, rothm@lafayette.edu

Description:
Use individual Padlets (virtual bulletin boards) to give your students spaces to share observations, ideas, drafts, or resources. This is a great tool to use in a Bring Your Own Device (BYOD) classroom; students can access it for free no matter what device they have. Students can post pictures, audio, video, websites, and documents. For each Padlet that you create, you set the access level. The site can be private and shared with just your students, made available to anyone who has a link, or you can make the Padlet public.

Example Activities:

1. For any topic discussed in class, ask students as a follow up homework to find examples of the topic and post it to a Padlet. (You can provide them a link to the Padlet in the course management system you use for the class.) During the next class meeting, you can ask students to do a number of activities based on the examples collected, e.g., report out on the example they provided, work in groups to identify the best three examples and provide a rationale for their selection, etc.

2. Create a Padlet that has a column for each student in the class. Before class, have students post drafts of their writing projects on a Padlet and during class, ask students to read and provide feedback on the drafts submitted by other students. The feedback from the other students can also be posted on the Padlet as a separate document in the column allowing you as the instructor to monitor the reviews of the students.
Simple Web-Based Tools That You Can Use to Support Student Collaboration

**Resource #2:** Flipgrid—a tool to share videos.

**Website:** Flipgrid.com

**Point of Contact:** Mary Roth, rothm@lafayette.edu

**Description:**
Flipgrid “empowers social learning in PreK to PhD classrooms around the world.” Flipgrid is an on-line space where students can post videos to share their ideas, projects, and stories. Educator accounts are free and, as the instructor, you can determine who has access to post and watch the videos. For large classes, this can also be an easy way for students to introduce themselves to you and to each other. (The “Say Hello” option is a default assignment for this purpose but you can ignore and hide that assignment if you want.) Students can create videos on their phones and then upload the video to the “grid” you have created for the class.

**Example Activities:**

1. In a senior seminar on professional issues in engineering, have students work in teams to describe some aspect of the course material to students in an introduction to engineering class. In the example on the right, students in the seminar class created and shared videos that described various leadership characteristics that we had discussed during the seminar.

2. In a senior capstone course, each student can be asked to reflect on the courses they have taken and to identify one topic they wish they had been able to learn more about during their education. Each student then researches how they might learn about that topic on their own and creates a video to share that information with the other students in the class. Watching the videos could be assigned as homework or they can be watched during class. Since all videos are located on the same site, it is easy to watch many videos during one class meeting.
Library of Group Activities for Undergraduate Soil Mechanics

Resource: Library of Group Activities that Promote Active Learning in the Undergraduate Soil Mechanics Classroom

Website: http://research.engr.oregonstate.edu/usucger/teaching_aids.htm

Points of Contact: Kristin Sample-Lord, kristin.sample-lord@villanova.edu; Gretchen Bohnhoff, bohnhoffg@uwplatt.edu

Description: A "grab-and-go" set of education geotechnical activities. Sixteen different activities were developed with the help of undergraduate students at both Villanova University and the University of Wisconsin-Platteville. The materials for each activity include: (1) a summary sheet for the instructor with learning objectives and instructions; (2) the activity handout to provide to the students; (3) the solution set; (4) an example rubric for the activity; and (5) supplemental information, if applicable. The required in-class time for the activities ranges from as short as one to two minutes to 50 minutes, to allow for flexibility in implementing the activities in existing courses. All the activities are meant for small informal groups. The recommended number of group members ranges from two to five, allowing for use in a range of class sizes. The activities vary widely in their format (e.g. "typical" quantitative problems, jigsaws, concept questions/discussion, group presentations, calculation QA/QC) to complement different teaching styles.

Table 1. Activities and associated teaching materials in the library of small group activities for the undergraduate soil mechanics classroom.

<table>
<thead>
<tr>
<th>#</th>
<th>Topic</th>
<th>Activity</th>
<th>Teaching Materials Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Soil classification</td>
<td>Failed raingarden case study</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>Site investigation</td>
<td>Boring log jigsaw</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Weight-volume relationships</td>
<td>Porosity demo &amp; activity</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>Soil compaction</td>
<td>Problem-solving horse race</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>Hydraulic conductivity &amp; 1-D seepage</td>
<td>Introductory concept questions</td>
<td>✓</td>
</tr>
<tr>
<td>6</td>
<td>2-D seepage</td>
<td>Flow nets</td>
<td>✓</td>
</tr>
<tr>
<td>7</td>
<td>Total &amp; effective stresses</td>
<td>Geotech. engineering in the news</td>
<td>✓</td>
</tr>
<tr>
<td>8</td>
<td>Load-induced stresses</td>
<td>Group Calculation</td>
<td>✓</td>
</tr>
<tr>
<td>9</td>
<td>Settlement</td>
<td>Millennium Tower case study</td>
<td>✓</td>
</tr>
<tr>
<td>10</td>
<td>Shear strength</td>
<td>Interpreting lab data</td>
<td>✓</td>
</tr>
<tr>
<td>11</td>
<td>Lateral earth pressures</td>
<td>PE practice problem</td>
<td>✓</td>
</tr>
<tr>
<td>12</td>
<td>Bearing capacity</td>
<td>Calculations &amp; Quality Control process</td>
<td>✓</td>
</tr>
<tr>
<td>13</td>
<td>Slope stability</td>
<td>Evaluation of existing slope</td>
<td>✓</td>
</tr>
<tr>
<td>14</td>
<td>Geosynthetics</td>
<td>Categorizing geosynthetic samples</td>
<td>✓</td>
</tr>
<tr>
<td>15</td>
<td>Comprehensive: site investigation, classification, compaction, geostatic &amp; load-induced stress, settlement and time-rate of consolidation, shear strength, bearing capacity</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
The primary mode of dissemination is a downloadable zip file, with sub-folders for each activity. Each sub-folder includes the individual Word/PDF/Excel files for the activity to allow for instructor editing, as well as a single PDF of the complete activity. There also is a front-matter file describing the contents of the library and acknowledging contributors. The password-protected zip folder is available for download on the USUCGER website (http://www.usucger.org), on the Teaching Aids page. The current password is:

**Example Activity**

**Topic:** Site Investigation  
**Time Required:** 30-40 min  
**Description:**
- First part of the activity, students use a summary of subsurface information to create a boring log  
- Second part of the activity, groups are reassigned (jigsaw) to create cross-sections  
**Learning Objectives:**
- Create boring logs using the subsurface information provided.  
- Construct cross-sections for the site using boring logs.  
- Investigate different areas of the site and identify potentially problematic areas.

**Cover summary sheet:**
- brief description  
- learning objectives  
- logistics

**Student activity handout:**
- in word for easy editing  
- detailed instructions  
- figures and templates

---

![Group Activity 2: Site Investigation – Boring Log Jigsaw](image1.png)  
![Site Investigation](image2.png)  
![Figure 1. Boring log locations.](image3.png)
Active Learning Techniques for Efficient and Effective Teaching

Point of Contact: Amy Rechenmacher
arechenm@usc.edu

Resource: Simple Active Learning Strategies

1. “90-second pause” (or “think-pair-share”):
   - Pose a specific question for discussion. For example:
     - “Look at your lecture notes from the last X minutes. If there is anything confusing, turn to a neighbor and ask for clarification…”
     - “90 sec. from now I’m going to pick on one of you to answer the following question [state question here]. But first, turn to a neighbor to discuss possible answers…”
     - “What do you think would be the effect if we changed…”
   - Ask students to turn to a neighbor to discuss. Monitor students to make sure they are discussing and to hear what they are saying!
   - After 90-sec., reconvene, and ask for volunteers, or call upon students, for answers/discussion

2. One minute paper:
   - Stop the lecture with 1-2 min. to go and ask the students to write:
     - Define X [some concept] in your own words
     - Write one or two questions about what we covered today…
     - What are the main points of today’s lecture?
     - What are the muddiest points from today’s lecture?
   - Review the submitted papers to feel-out student understanding and identify clarity needed in future classes

3. Peer Instruction:
   - Students solve a small problem in groups in class
   - Instructor circles the class and motivates, observes, and redirects as needed
   - Regroup at the end to clarify solution and answer questions

References on Active Learning Techniques


Shared Examples of Enhancing Undergraduate Geotechnical Education

Resource: Incorporating entrepreneurially minded learning into geotechnical classes

Points of Contact: Andrea Welker, andrea.welker@villanova.edu

Description:

This is an easy to implement activity to instill the entrepreneurial mindset into any engineering class. The specific example provided was used in Geology for Engineers. The materials include the activity handout to provide to the students and additional resources. The required in-class time for this activity is about 35 minutes. This activity is meant for small informal groups. The recommended number of group members ranges from two to five, allowing for use in a range of class sizes.

Table 1. Activities and associated teaching materials in the library of small group activities for the undergraduate soil mechanics classroom.

<table>
<thead>
<tr>
<th>#</th>
<th>Topic</th>
<th>Activity</th>
<th>Teaching Materials Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Instilling curiosity and making connections</td>
<td>Geology in the News</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>Additional resources</td>
<td>-</td>
<td>✓</td>
</tr>
</tbody>
</table>

Additional Resources

Engineering Unleashed is the website for KEEN. Anyone can join. There are currently several cards related to geotechnical engineering. Since new resources are added all the time, it is best to enter the website and search for geotechnical. There are currently about 50 partner schools, at least eight are represented here.

KEEN talk (TED-style) on how to get started with EML.
Lecture #1
Activity: Geology in the News

General Directions: Form six groups with four to five people in each group. You may use any device (smartphone, laptop, etc.) to perform internet research for this activity. At least one group member should keep notes summarizing the conclusions for each step.

1. Investigate: News headlines often feature stories related to geology. As a group, investigate and discuss the stories behind the headlines shown on the next page. Each group has been assigned two headlines. (Note: You do not need to find these actual articles - just information that explains the headline.)

2. Summarize: As a group, choose one of the headlines to focus on and summarize the story/topic in 1 paragraph. Keep a list of the information sources that you used to develop the summary. You will be asked to share this summary with the class later.

3. Identify opportunities: Evaluate the information you have found for your topic to identify opportunities for improvement, to solve a problem, and/or address a common need. The following questions may be used to help guide group discussion:
   • Does this seem like a legitimate concern, founded on science?
   • If yes, are there opportunities to prevent/mitigate/solve this issue? To better prepare? To find an alternative?
   • If no, why is there this misconception? Is there an opportunity to better inform the public/media?

   As a group, identify opportunities related to your topic.

4. Brainstorm: Now that you have identified opportunities, brainstorm as many solutions as possible. Think outside the box! Keep a running list. The goal is to come up with as many ideas as possible (do not worry about how feasible they are).

   Once you have a list of at least 5 – 10 ideas, look for similarities and then pick a favorite.

5. Present & Pitch: Prepare a pitch for your idea. This should be a quick (< 2 min), verbal description that includes (a) the summary of your headline (step 2), (b) the opportunity identified (step 3), and (c) your favorite creative idea (step 4). Designate a group member to share the pitch with the class. They may use notes during the pitch. You may draw on the white board as well to help pitch your idea.

6. Discuss & Vote: After the other groups have presented their pitches, discuss among your own group which ideas you liked the best (and you would consider investing in) and why. As a group, choose a favorite and list the Group #/idea below. You may not choose your own group!

   Our group would invest in: ________________________________
7. **Identify at least one potential topic for your term paper:** As part of this course you will be required to write a 10-page term paper on any topic related to geology that interests you. During this activity, make sure to note any topics or ideas that you may be interested in learning more about, as these may help you identify a term paper topic. Next week we will have a guest speaker from Falvey Library who will demonstrate how to find reliable sources of technical information to use for your term paper.

**HEADLINES**

All these headlines are from the last one to three years.

Group 1:
A. “Yellowstone volcano eruption could spew ash for thousands of miles across U.S.”
B. “Nuclear tests in North Korea caused mountain deformation and radiation leakage”

Group 2:
A. “Beijing is sinking at an alarming rate”
B. “Siberia’s tundra is bubbling under people's feet”

Group 3:
A. “Landslide buries California's scenic highway in Big Sur”
B. “Earthquakes in Ohio triggered by fracking”

Group 4:
A. “City of Charleston starts work to brace for sea level rise”
B. “Earth’s magnetic north pole is shifting rapidly”

Group 5:
A. “Fracking contaminated groundwater in Wyoming”
B. “Kilauea volcano has destroyed 600 homes in Hawaii”

Group 6:
A. “Man-made pollutants found in the Earth's deepest ocean trenches”
B. “The Arctic is experiencing its worst wildfire season on record”

Group 7:
A. “Gurgling mud pool is creeping across California like a geologic poltergeist”
B. “Florida has more sinkholes than any other state in the nation”