ACE MENTOR PROGRAM
ARCHITECTURE • CONSTRUCTION • ENGINEERING

GEOTECHNICAL ACTIVITIES
GEOTECHNICAL INVESTIGATION

DEVELOPED BY:
THE ACE MENTOR PROGRAM OF GREATER PHILADELPHIA

Geotechnical Investigation & Geotechnical Engineering

created by Tom Halliwell, with Cahill Associates, in collaboration with Laura Zale, with Lagan Engineering, for the Eastern Pennsylvania affiliate

Educational Goals Make students aware of the ground beneath them. Introduce then to geotechnical investigations and geotechnical engineering.

Description Students examine several "sites" to learn what kind of natural materials and man-made objects or structures lie beneath the ground's surface. Mentors teach students about site limitations and foundation design. This activity is divided into two parts.

Time *Part I*–75 minutes; *Part II*–30 minutes.

Materials "Sites" should be constructed before the meeting by one of the mentors. The following materials are suggested:

Part I Geotechnical Investigation

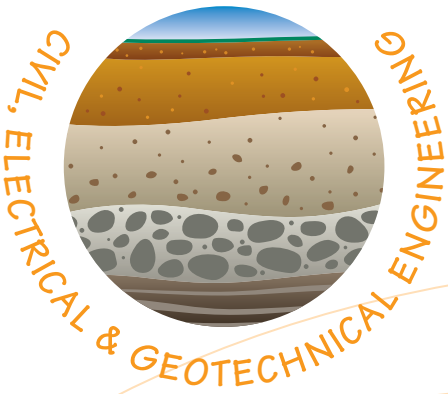
- Transparent plastic deli containers, at least 5-6 inches tall
- Sand
- Gravel
- Play-Doh
- Water
- Anything that can be used to simulate fill, construction debris, pipe, foundations, etc.
- Opaque paper or foil to cover circumference of deli containers
- Plastic spoons
- Ruler
- *Soil Investigation Worksheet* (see last page of this activity description)

Part II Geotechnical Engineering

- Paper cup
- BBs or other weights

Additional Resources

- *The Underground* by David Macaulay, available in most public libraries
- A geotechnical report, including boring logs, of any project
- Boring location plan of same project



Before the meeting, fill several deli containers with different kinds of "soil" (gravel, sand, clay (i.e., Play-Doh), and any other kind of fill, debris, or likeness of foundational structures that might be present on a hypothetical site. Place the soil in layers to simulate a natural environment. Add some water to demonstrate the presence of groundwater. Make each site different. Cover the outside of the containers with paper or foil so that students cannot see the layers of soil.

Depending on time and student interest, many other items besides the soil can be added to the sites. For example, if any students demonstrated an interest in environmental engineering in previous meetings, add one or two tablespoons of motor oil to one of the sites to simulate underground site contamination. Add a disproportionately large piece of concrete to simulate an abandoned foundation. (See *Think Green!* box at the end of this activity for a way to incorporate discussion of brownfields in this activity.)

Part I. Geotechnical Investigation

Introduction (45 minutes)
The objectives are to make the students aware of what is underground and to understand the need for geotechnical engineering. Lead the students through a simulated geotechnical investigation of one site. Remove the paper or foil around the container to allow the students to see a cross section of the site. Dig through the site to examine sections that cannot be directly observed through the container. The walk-through site investigation can lead to a discussion of types of geotechnical investigations, basic geology, and soil types.

Show the students an actual geotechnical report including boring logs and a boring location plan. Also show the students a basic free body diagram of a spread footing and pile foundation. A good supplemental text for this exercise is David Macaulay's *The Underground* which is filled with many of the author's drawings. Going through the mock site investigation and paging through this book will lead to a discussion of basements, various types of foundations, retaining walls, and tunnels. Allow the students plenty of time to ask questions about natural underground features and man-made underground struc-

tures. Continue to discuss soil types, groundwater, foundations, and soil contamination according to time constraints and student interest.

Activity (30 minutes)
Break the students into groups and have each group investigate one of the remaining sites. Students should peel the foil off the deli containers and look at the layers of soil. The students should dig through the sites using plastic spoons near each corner and in the center of the containers. Have the students record the types of soil they find and any other interesting findings on the attached worksheet. The students should record the types of soil at incremental depths at several locations.

After approximately 20 minutes, have each group describe to the larger group what the underground section of their site looks like, including any unexpected findings. Stress that as geotechnical engineers, the students would use math and science to quantify and describe the limitations of each site to determine what structures can or should be built on each site.

Part II. Geotechnical Engineering

Introduction (20 minutes)
Explain what types of foundations may be suitable for building on each site. Place a paper cup full of BBs or other weights on various different soil types on the original site that the mentors introduced to the students. Observe with the students whether and how much each cup immediately settles. Discuss why soils behave differently under similar loads. Explain that sometimes unfavorable conditions have to be improved in place or bridged with a deep foundation before construction.

Activity (10 minutes)
Have the groups of students discuss among themselves the best location for a building on each of their sites based on what they found in their test pit investigations. Students should then briefly present their conclusions to the larger group.

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THINK GREEN!

For more advanced groups introduce the concept of brown-fields. Have one container symbolize a brownfield. Provide background on what the land was previously used for and have various components in the soil to represent concrete, oils, waste, etc. As a group, discuss brownfield remediation and opportunities for reuse of the land. Discuss pros and cons of brownfield remediation versus green field development.

Questions:

1. What is the definition of a brownfield site?
2. What are the benefits of building on a brownfield site?
3. What are the drawbacks?
4. What types of projects should be built on top of a brownfield site? Which types should not?
5. What are some of the ways to remediate a brownfield site?

Developed by U.S. Green Building Council

Geotechnical Engineering
Soil Investigation Worksheet

Name:	
ACE Team:	
Date:	
Job Description:	
Location of soil investigation:	
Depth:	Describe soil
	(color, soil grain size, moisture, other findings)
0-1"	
1"-2"	
2"-3"	
3"-4"	