Summary
Students will learn about soil properties and standard soil testing practices in geotechnical engineering for a two-day camp. They will make pretest predictions of soil properties and conduct tests to confirm their predictions.

Engineering Connection
Making sure the type of soil under structures is stable for construction for the safety of the community and people inside or around the structure. A structure is nothing with a weak foundation.

Audience
6-8 grade (middle school)

Scientific Concepts
Soil properties
Standard soil testing practices

Lesson Objectives
Define soil properties
Classify and describe soils
Demonstrate different properties through feel and construction
Test standard soil practices (Sieve analysis and Atterberg limits)
**Educational Standards**
Common Core Lesson Plan for Middle School

**Material List**
Sand, Silty Sand, and Clay
Different Sieves
Grooving tools
Droppers
Water
Moisture Plates
ASTM Chart
Plasticity Index Plot
Spatulas

**Introduction**
Studying different soil properties is important to help a home stand and critical to the environment and safety of people. Understanding soil properties is vital to different industries – construction, agriculture, engineering, and many more.

**Procedure**

*Background knowledge*
- Definitions: plasticity, gravel, sand, clay, silt, water content, absorption, voids, texture, density, Liquid Limit, Plastic Limit, sieves, sieve analysis, and Atterberg limits.
- How to classify soil with ASTM and Plasticity Plot

*Before the activity*
- Mini lesson on sand, silt, and clay differences
- Vocabulary related to soil classification
- Prepare several samples of sand, silt, and clay for students in advance of lesson/camp

*During the activity*
1. Feel different soil types and make predictions on which is sand, silt, or clay after mini lesson
2. While showing students different sieves sizes and allowing volunteers to pour soil at the top of sieves, perform dry sieve analysis tests.
3. Show uniform soil in sieves and allow students to feel
4. Weigh pans and graph for grain size distribution
5. Give students prepared soil for liquid limit and plastic limit test (Atterberg Limits)
6. Allow them to feel the different soils to tell the differences
7. Continue rolling soil on moisture plate until it breaks for plastic limit, weigh, and place in oven for 24 hours
8. Wet soil for liquid limit test and perform liquid limit test. Drop till the soil closes a small groove and count the number of drops
9. Collect the soil that closed, weigh, and place in oven for 24 hours
10. After 24 hours, weigh samples and collect data.

After the activity
- Evaluate data and check student predictions
- Classify official soil type

Assessment
No need for test. Predictions and soil testing is good to master objectives.

Wrap-up
- Review soil properties and give more real world-examples where this is used
- Get student input and examples of why soil is important for engineering
- Give students their own hardened and dry clay sample, marked with camp name and date, to take home