



Soils and Settlement

**2025 NSF NHERI Center for Geotechnical Modeling at the University of California,
Davis**

Camille Gaz, Edmund Cain, Flynn Jacobowitz, and Troy Olson

- **Summary-**

For this project, students will learn the basics of earthquake principles by testing buildings made of Lincoln logs in different settings. Different “soils” (sand, gravel, clay) will be placed underneath the buildings and students will test their buildings by shaking them. The goal of the project is to see how by shaking structures in different environments, they will settle by different amounts.

- **Engineering Connection-**

When earthquakes occur, structures undergo settlement. This increases the risk of these structures falling. Different types of soils have different properties that affect how much settlement occurs, especially during an earthquake which causes some soil particles to shift and act like a liquid. Understanding the different soil types and where you can find them helps determine how susceptible the buildings are to settlement and collapse.

- **Audience-**

6-8th grade

- **Lesson Objectives-**

- Students will understand the meaning of settlement due to earthquake.
- Students will understand why structures settle differently on different soils.
- Students will create different structures to demonstrate how different types of structures settle with different soils
- Students will explore how shaking the cart at different speeds will impact building settlement due to different accelerations.

- **Educational Standards-**

- MS-PS2-2 Motion and Stability: Forces and Interactions
- MS-PS2-4 Motion and Stability: Forces and Interactions
- MS-ESS3-2 Earth and Human Activity

- **Material List-**

- Lincoln log structure
- Sand (1lb to 5lbs worth)
- Gravel (1lb to 5lbs worth)
- Clay (1lb to 5lbs worth)
- 3 baking tins of at least 2 inch depth
- Cart on wheels

- **Introduction-**

The motivation behind this lesson is to understand how different soils affect settlement of structures due to earthquakes. Students will start by discussing their various hypotheses about what will happen and which materials will cause more settlement. Then they will start their various models.

- **Procedure-**

Explain how someone else can implement your lesson plan by creating a list of instructions separated by the secondary titles below. [\[RN10\]](#)

- Background knowledge
 - There are different types of soils
 - Engineers build structures on the soil
- Before the activity (10 minutes)
 - Teacher Preparation
 - Prepare 3 trays of different types of soils
 - A tray of sand
 - A tray of clay (dry)
 - A tray of gravel
 - Put all three trays on a rolling cart
 - Sort Lincoln Logs into piles of 20-30 Logs per pile
 - One pile for each group of students
 - Student Discussion (15 minutes)
 - Discuss the different types of soils
 - Clay - fine soil
 - Sand - medium soil
 - Gravel - coarse soil (rough)
 - Discuss the different types of structures
 - Housing vs commercial
 - Big vs small
 - Tall vs short

- Discuss what is settlement
 - Your structure moves down into the earth a very little bit
 - Is a big building more likely to settle than a small building?
 - Is a tall building more likely to settle than a short building?
 - During the activity
 - (15 minutes) In groups of four, have students build a building out of Lincoln Logs logs
 - Students may be as creative as they want
 - Some groups may get more Lincoln Logs than others
 - (30 minutes)
 - One at a time test each Lincoln Log
 - Break groups into three sections (for each soil)
 - Measure height of building
 - Shake the cart back and forth for 30 seconds after placing building in tray
 - Measure height of building
 - After the activity
 - Create chart comparing soil type, building size, height difference for each test
- **Assessment-**
 - Have each of the students write why they think the buildings settle differently and what soil characteristics might have led to the differences.
 - Students may discuss the correlation between building settlement and the type of soil.
 - This will help students understand the importance of understanding soils when building on a certain area.
- **Wrap-up-**
 - Have a group conversation talking about the three different aspects of the test (soil type, building size, shaking amount) and inquire as to why each student thinks these are important.
 - Have each student share why these aspects matter when dealing with a real building full of people