

Lecturer's Guide – Sandcastle

Activity Objectives

- Demonstrate in a simple way how moisture content influences soil stability.
- Relate the observed behaviour to geotechnical concepts of unsaturated soils.

Suggested Total Time

60 to 90 minutes

Required Materials

- Disposable cups (200 ml): 3 per group of 3 to 5 students
- Spoon: 1 per group of 3 to 5 students
- Ruler or tape measure: 1 per group of 3 to 5 students
- A base for building the sandcastles to keep the mess contained, such as a flexible plastic board: 1 per group of 3 to 5 students
- Container with dry sand: for all groups
- Container with moist sand: for all groups
- Container with very wet sand (almost saturated): for all groups
- Paper towels, a large bucket, broom, and dustpan for cleanup: for all groups

Activity Outline

1. Introduction (20 – 30 min)

- Brief introduction to unsaturated soil mechanics and its relevance in geotechnics and infrastructure works.
- Brief explanation of the activity.

2. Sandcastle Building (20 min)

Each group:

- Receives 3 cups.
- Fills the cups, moulding the sand into a mini sandcastle.
- Measures the castle height after removing the cups.
- Evaluates: Stability, Ease of construction, Maximum height achieved.
- Completes the Observation Table during the activity.

Discussion and Reflection (20 – 40 min)

- A set of guiding questions is available for download.

Practical Tips

- Bring containers with pre-prepared sand at the right moisture levels to save time.
- Encourage students to take photos to document the process.

SANDCASTLE EXPERIMENT PRE-ACTIVITY

1. What is the primary difference between saturated and unsaturated soils in geotechnical engineering?

2. In practical geotechnical situations, does an increase in the presence of water typically lead to an increase or decrease in the stability of soil? Explain your reasoning.

3. Can you think of any environmental factors that influence the moisture content of soils over time?

4. Why is it crucial for geotechnical engineers to study and understand unsaturated soils?

5. What changes do you anticipate will occur to a sandcastle as you gradually add water to initially dry sand, progressing from dry to very wet conditions?

ACTIVITY: REFLECTING ON THE SANDCASTLE EXPERIMENT

1. As we reflect on our sandcastle-building experience, let's organize our observations in a table format. For each situation encountered during the activity, please describe the stability and ease of construction you observed. Use the table below to record your findings.

Situation	Stability Observed (High, Medium, Low)	Ease of Construction (Easy, Moderate, Difficult)	Height achieved
Dry sand			
Partially wet sand			
Very wet sand			

2. Did your initial predictions regarding the behaviour of the sandcastle according to the water content, align with the actual outcomes?

3. Describe a stage during the sandcastle-building process where you observed the sandcastle to be relatively stable. Explain the characteristics of both the sand and the structure during this stage.

4. How did the addition of a small amount of water impact the sandcastle-building process? What changes did you observe in terms of sandcastle stability, and ease of construction?

5. What happened when you added enough water to the sandcastle? Explain the consequences in terms of stability and ease of construction.

6. Describe a stage of the sandcastle building process in which you observed that the castle was relatively stable. Explain the characteristics of the sand and the structure at that moment.

7. How does your sandcastle-building experience relate to the concept of unsaturated soils in geotechnical engineering? Discuss the parallels between your sandcastle and real-world soil behaviour.

Additional reflection questions

8. How might climate change impact the behaviour of unsaturated soils in geotechnical engineering projects, and what challenges could this pose?

9. What geotechnical engineering strategies or innovations can help mitigate the risks associated with unsaturated soils in a changing climate?