

Can We Make Sand Strong?

When we build, expand, and improve our towns and cities, there are many decisions to make around equitable access, resource usage, and environmental impact. These decisions are often guided by how long it will take to build something, how much it costs to construct it, and how much space it will take up. Many times, space is limited, funds are low, and something needs to be built as quickly and as safely as possible.

Imagine you are an engineer tasked with building an offramp from down on a freeway up to an interchange. The main material you have is dirt or sand, which is low-cost and abundant. Can you build a ramp out of sand that can support the weight of many cars? Let's explore the limits of sand and see what we can do to make it strong. In this lab, we will measure our observations **qualitatively**, focusing on descriptions and not on numerical values.

Supplies:

Wet sand

Tray

Small container

Spoon

Rock/weight

Reinforcing materials + scissors to cut:

- Paper

- Fabric

- Wire mesh

- Plastic

- Paper towel

1. Fill the container with the sand and pack it down. Turn it over on the tray and carefully release the sand so it keeps the form of the container. Use the rock or weight to see how strong the wet sand mixture is by itself. What happens when you press down? Record your observations in the table on page 2.

With your group, brainstorm some ways you could make the sand stronger:

One way to increase the strength of sand is by piling more sand around the area where you want the sand to be strong. This adds **pressure** to the pile of sand which increases the strength of the **friction** between each grain of sand, which makes the sand pile stronger. However, this requires more space (as well as sand), and space is often limited. Another way to add pressure that will increase the friction strength is to put layers of materials in the sand.

2. Test the materials to see which one creates the strongest sand. Start off by testing paper. Cut out 4 circles of paper so that they fit in the container. Pack some sand into the container, add a piece of paper, then pack more sand, and then a piece of paper, and so on until the container is full.

Turn over the container on the tray like you did in step 1 and use the rock or weight to see how strong the sand mixture is now. What happens if you press down? Record your observations in the table on page 2.

3. Repeat step 2 with the fabric, wire mesh, plastic, and paper towel.

Materials	Observations
Wet sand + nothing	
Wet sand + paper	
Wet sand + fabric	
Wet sand + wire mesh	
Wet sand + plastic	
Wet sand + paper towel	

4. From your qualitative observations, rank each of the six materials in order from strongest to weakest:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

5. Is there anything else you'd want to consider besides pure strength when it comes to selecting which material to use? What other materials would you be interested in testing?