

Making Materials Stronger		Grade 3 – Strong and Stable Structures
<h2>Lesson Plan</h2>	Safety Notes	When you are testing materials by lifting, be careful not to lift the load too high off the ground. You don't want to get hurt if your material breaks and the load falls.
<p>Description</p> <p>Humans have a knack for taking simple materials and making them stronger, more durable, or more resilient, just by making simple changes to their shape. Find out how you can make changes to strengthen materials that you can find at home!</p>		
<p>Materials</p> <ul style="list-style-type: none"> ● Paper towel ● Something heavy-ish with a handle that will not make a mess if it is dropped, such as a small bucket filled with objects or a tightly closed filled jug or water bottle with a handle. ● paper (recycled office paper is fine!) ● string or ribbon 		
<p>Science Background</p> <p>Throughout history, humans have been finding ways to make materials stronger to help with building strong and stable structures.</p> <p>We can make bridges out of iron (a metal), but iron is brittle and prone to breaking without warning. By changing iron and removing impurities mixed in with the metal, we can create steel, which is easier to bend and shape (ductile). Steel is a useful bridge material because of its high strength with resisting both compression (pushing forces) and tension (pulling forces) in a structure.</p> <p>Cement is another material that has been made stronger by mixing it with water, sand and gravel to make concrete. Concrete can be shaped with molds and is really strong against compression forces, but weak against tension forces. To make concrete stronger against tension forces, we can change it again by adding steel rods to the concrete. This is called reinforced concrete.</p> <p>Steel and concrete are both examples of materials that we make strong by mixing them with other materials. There are other ways to make materials stronger without adding anything extra to them. We can make materials stronger just by changing their shape.</p>		

Activity Procedure

- The goal of this activity is to have students use inquiry-based learning to explore how to make three potentially weak materials (paper towel, paper, string or ribbon) stronger just by changing their shape.
- Challenge students to lift a filled bucket (or other container with a handle) using only a paper towel. Can they find a solution?
 - They might have other solutions, with varying success, but the tried and true solution is to twist the paper towel into a “rope” and loop it through the handle.
- A piece of paper is thin and can be torn really easily. How can we make it stronger and harder to tear?
 - One way is to fold it! Stacking works too if you have many pieces of paper — it’s really hard to tear through an entire stack of paper.
- How can you make a straight piece of string or a ribbon stronger?
 - Twisting or braiding it

Debrief

All three of the changes we made to the materials (twisting paper towel, folding or stacking paper, twisting or braiding string) added strength to the materials. These changes meant that there was more material in any given point to distribute the weight and to distribute compression and tension forces. Braiding or twisting gives the string more capacity to stretch (and the spaces between the braided sections or twists also give it more capacity to compress) without breaking or tearing.

- Can you think of any other materials that can be improved by changing their shape?
- What advantage could layering, braiding, or twisting give to building a structure?