Compression and Tension	Grade 5 – Structures and Mechanisms

Lesson Plan

Safety Notes Be careful when stacking heavy objects.

Description

For a structure to stand the test of time, it has to be able to resist internal forces that act upon it. Investigate compression and tension forces and test how they affect building materials.

Materials

- 6-7 Books (try to choose books that are similar in size)
- A ruler
- A pen or pencil
- Clay or play-dough

How to make homemade no-bake play-dough (if you don't have clay or play-dough at home):

- 2 cups flour
- ½ cup salt
- 1 ¾ cups of warm water
- A bowl
- A wooden spoon

1. Mix 2 cups of flour and ½ cup of salt in a large bowl.
2. Add 1 and ¾ cups of warm water to the flour/salt mixture. You can use a wooden spoon or you can mix with your hands. It may not seem like you have enough water, but you do.
3. Take the dough out of the bowl and knead it on a flat surface. It might take up to 10 minutes of kneading until your dough feels right.

Science Background

These days, the most popular materials used to build bridges are steel and concrete. Other materials can be used, but the reason why steel and concrete are popular is because of their ability to withstand internal forces, such as tension (pulling forces) and compression(pushing forces). Concrete and steel are especially stable against these forces when they are combined to form reinforced concrete.. If we build using materials that are weak against these forces, our structure may be at risk of collapsing, making it dangerous for humans to use.

It's important for engineers to test and measure the strength of their materials so that they can properly design and build structures that can withstand the forces that will affect them.

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Today we're going to be testing the strength of clay or playdough against tension and compression forces.

Activity Procedure

The goal of this activity is to measure how well your dough will withstand compression (pushing) forces and tension (pulling) forces.

Testing compression:

1. Make a 2.5 cm x 2.5 cm x 7.6 cm rectangle using your dough.
2. Stand your dough on a flat surface like a table so that it's standing tall like a tower.
3. Measure the initial height of your dough tower with a ruler and record on your worksheet
4. Place 1 book on top of your dough tower and leave it there for about 5 seconds. What happens? Measure the new height and record on your worksheet.
5. Repeat with 2-7 books or until your tower crumbles or falls over. Make sure to always use the same books from the previous measurement when adding more books. Don't forget to record the new height of your tower on your worksheet every time you add a book.

Testing Tension:

1. Make another 2.5 cm x 2.5 cm x 7.6 cm rectangle of dough.
2. Use a ruler to measure your initial length of your rectangle and record on your worksheet.
3. Lay the rectangle down flat on a table next to a ruler.
4. Slowly stretch your rectangle along the side of the ruler by pulling on one end of the dough. You might have to hold down the other end of your dough rectangle so it doesn't move. Pay attention to the ruler measurements as you pull.
5. Keep pulling until the dough breaks. Measure the length you reached when it broke and record it on your worksheet.

Debrief

What happened when you tested the compressibility of your dough? As books are added, you are increasing the compression forces on your tower. Eventually, the dough cannot support the load and begins compressing (getting squished). The force on top of the clay creates strain or stress on the material. This is similar to what happens if a bridge or building is trying to support a load that is too heavy for the material's strength. It will break or collapse,

What happened when you tested the dough's ability to stretch? As you pulled on the dough, you were adding tension forces. This caused stress or strain on the material. When the material could no longer withstand the tension, it broke. Likewise, if a bridge or building has too much tension acting upon it, it will pull apart and break.

If you have more than one type of clay or play-dough at home, you can repeat the compression and tension tests with different types of dough to see which material can better withstand compression and tension.

Handout

TESTING COMPRESSION

Initial Height of Clay Tower (cm): _____

How many books do you predict the clay will be able to support? _____

Number of Books	**Height of Clay Tower (cm)**	**Did the Clay Tower Break?**

How many books could your clay support before breaking or falling over? _____

TESTING TENSION

Initial Length of Clay Rectangle (cm) _____

How long (cm) do you predict your clay will stretch before breaking? _____

Actual Length of Clay After Stretching (cm) _____

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