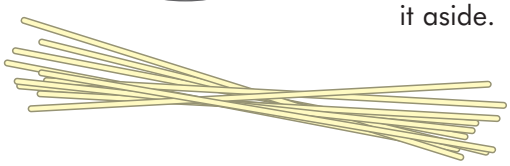
Spaghetti Strength

Can you think of an example of a polymer that is a strong building material? Yes you can! Wood is a naturally occurring polymer found in the lumber used to build the frame of a home or in the plywood placed on the outside part of the frame. One of the reasons why it is strong is because of the strength of its chemical bonds. Imagine standing side-by-side in a line with your friends. Each of your arms is hooked so that you are sturdily linked to each other. Your linked arms are like the wood's chemical bonds. Chemical bonds may be broken by a force, like someone pulling really hard on one side of the line with your friends. If the force is strong enough, the bonds will break. Strong chemical bonds are important for building materials, like lumber, because it has to be sturdy enough to hold the weight of a home or building. Scientists test how much force is required to break a sample of material to make sure that it is safe and strong enough to use for building. In this activity, you will see how scientists examine building materials by testing the strength of spaghetti and how the number of strands effects its strength.

Materials

- Small paper cup (4 oz.)
- String
- Pencil
- Raw spaghetti
- Other uncooked pasta (one thinner and one thicker than spaghetti; e.g. angel hair and fettuccini)
- Masking tape
- Metric ruler
- Pennies



NOTE: To more closely mimic the layers within a piece of plywood, it is suggested that the pasta strands be dipped in water and stuck together by running the thumb and index finger over the length of the water-dipped pasta until they stick to one another. Pasta prepared this way will need to dry overnight before conducting the activity.

If done in a large group, groups can be given one type of pasta each and may be asked to share data.

ADAPTATION *The cup can be suspended using a pipe cleaner as the handle instead of string. Larger coins or identical steel washers could be used instead of pennies.*

SAFETY! *Be sure to follow Milli's Safety Tips and do this activity with an adult! Do not eat or drink any of the materials in this activity!*

To read Milli's Safety Tips click here!

Procedure

1. Make a "penny bucket" from the paper cup and string. First use the pencil to carefully poke a hole in the side of the cup, just below the rim. Poke a second hole directly across from the first one. Your adult partner may help you make the holes.

2. Tie one end of the string to each hole to make a handle for your penny bucket as shown, and set it aside.

3. Place one piece of spaghetti on the table and use the ruler to measure so that 12 centimeters of spaghetti hang off the edge of the table.

4. Tape the spaghetti in place.

5. Place a small piece of masking tape on the end of the spaghetti that hangs off the table by folding the tape in half over the end.

6. Hang the empty penny bucket on the spaghetti up against the tape.

7. GENTLY place pennies one at a time into the penny bucket.

8. Continue to add pennies until the spaghetti breaks.

9. Record the number of pennies in the "What Did You Observe?" section.

10. Repeat steps 3 through 9 for 2, 3, and 4 strands of spaghetti. When you tape the ends, make sure the spaghetti strands are touching one another.

11. Repeat steps 3 through 10 for thinner and thicker pasta.

12. Throw away the empty penny bucket and broken spaghetti pieces. Return the pennies to their owner. Thoroughly clean the work area and wash your hands.

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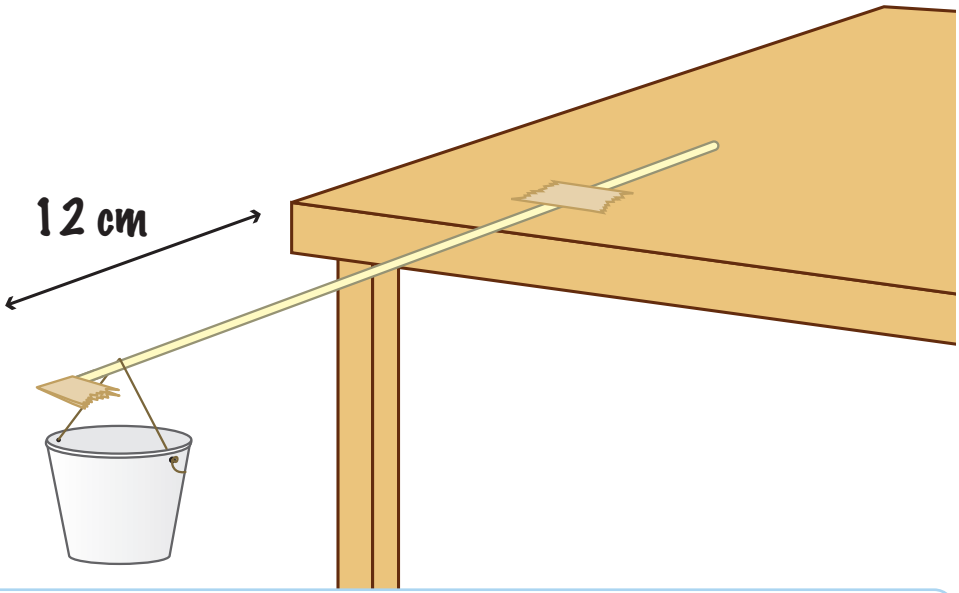
Try this...

Graph the data for this experiment, with the number of strands of pasta on the x-axis and the number of pennies on the y-axis.

Try putting the pasta strands at different distances from the edge of the table.



What Did You Observe?

Number of strands of pasta	Number of pennies held before breaking		
	Regular spaghetti	Thin pasta	Thick pasta
1			
2			
3			
4			

Which number of strands was the first to break? _____ the last? _____

Which type of pasta held the most pennies overall?

Why do you think this is so?

Where's the Chemistry?

Spaghetti is a type of polymer called a carbohydrate. Its bonds are strong; however it could only support a certain number of pennies. When there was too much strain on the spaghetti strands, it caused the chemical bonds to break. There is strength in having several strands of spaghetti stuck together. This allows more pennies to be supported.

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