How Strong is a Piece of Paper?

Post a picture of yourself with your columns on Facebook and tag Worlds UNBound to be entered into a draw for a FREE week of camp. Let us know how your experiment turned out!

Materials

3 x sheets of paper
Tape
Books

Have you ever seen a building with *columns* holding it up? Maybe outside a fancy old building or inside a parking garage? Today, your job is to design the columns for a new building using models made of paper. You'll test three designs—a column with a triangle, a square, and a circle for a base—by adding books to the top of your column. Which design do you think will be the best? How strong *is* a piece of paper?

1. Time to build your designs!
    a. *Triangular base* Fold a sheet of paper into three even folds, and tape the ends together to form a triangular base.
    b. *Square base* Fold a sheet of paper in half. Now open it up again, and fold the edges in to meet the crease in the middle. Tape them together to form a square base.
    c. *Circular base* Pull the two long ends of a sheet of paper around in a circle, and tape them together to form a circular base.

    Q1: Can you identify each of the three-dimensional (3D) shapes you just built?

2. Time to test your designs out!
    a. A good scientist makes a prediction before they start an experiment. Which column design do you think will hold the most books before collapsing?

    Q2: What is the scientific word for a prediction or a starting-point explanation?

    b. You'll need to keep track of how many books each column design can hold before collapsing. We suggest using a table like this:

How Strong is a Piece of Paper?

Post a picture of yourself with your columns on Facebook and tag Worlds UNBound to be entered into a draw for a FREE week of camp. Let us know how your experiment turned out!

Base	Triangle	Square	Circle
# of Books			

a. Start with the column with the triangular base. Slowly and carefully place books on top of the column until it collapses. Record the number of books you could place on the column before it collapsed in your table.
b. Repeat step c. with the columns with the square base and the circular base.

2. Time to review your results!

a. Which column held the most books before collapsing?

Q3: Without peeking below, can you explain why this particular column worked best? Why did the others not work as well?

Hint: A *vertex* is an angular point in some shape, kind of like a corner or tip. How many vertices (plural) does each column have?

Advanced Add-ons

Forces cause objects to move faster, move slower, or change directions. The weight of the books on the columns is a kind of force. Try placing your hand against a wall and pushing as hard as you can. Forces cause objects to move…but did you move? Did the wall move? Why do you think that is?

How Strong is a Piece of Paper?
(Answers)

Post a picture of yourself with your columns on Facebook and tag Worlds UNBound to be entered into a draw for a FREE week of camp. Let us know how your experiment turned out!

Answers

A1: a. triangular prism b. rectangular prism c. cylinder

A2: The scientific word for a prediction or starting-point explanation is *hypothesis*.

A3: The cylinder should have worked best. A square has four vertices and a triangle has three. The weight of the books is not spread out evenly. It is supported *just by those tips*. Eventually the column gets wobbly—think about trying to balance on one foot…it's not as easy as standing on two feet, is it? Meanwhile, a circle does not have *any* vertices (tips). That means that the weight of the books is evenly spread out, and the cylinder can hold more books without collapsing!

AA: When you push on the wall, the wall actually pushes back on you! This force is called the *normal* force. If you don't move and the wall doesn't move, that means that the forces are balanced: the wall pushes back on you as hard as you push on it, but in the opposite direction. The columns will stay standing as long as the column can push back with as much force as the weight of the books pushes down. As soon as the weight of the books pushes down harder than the paper pushes back up, the column collapses.

Thank you for participating!
We hope you enjoyed this activity.
Check out our next activity of WEDNESDAY!