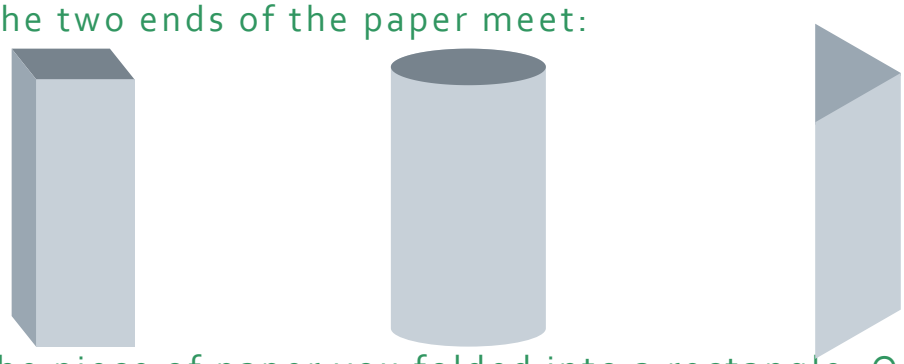
ENGINEERING OLYMPICS

USE MATERIALS FROM AROUND YOUR HOUSE TO ACCOMPLISH A SERIES OF ENGINEERING CHALLENGES! FOR YOUTH OF ALL AGES WITH ENGINEERING FACTS FOR OLDER YOUTH.

WHICH PAPER COLUMN CAN SUPPORT THE MOST WEIGHT?

The Challenge: We are going to test the strength of paper, folded in differently shaped columns, by piling books on top. This is very similar to how column are used to support buildings and other structures.
Supplies: three sheets of paper, tape, and a pile of thin books.
Steps: Fold three pieces of paper into the shapes shown below and tape where you the two ends of the paper meet:



Start with the piece of paper you folded into a rectangle. One at a time, gently pile thin books on top of your rectangle. Continue stacking them until your rectangle collapses. Make a note of which books the rectangle was able to hold. Repeat this process for the triangle and cylindrical column.

Which shape was the strongest and why?

Engineering Lessons: The cylinder can support the most books because it's walls don't have any edges. The force of the books cannot become concentrated in a particular area. The load is distributed evenly. In other words, all parts of the cylinder are sharing the load of the books. All parts of the cylinder, therefore, contribute to its overall strength until it finally collapses. The square and triangle deform more easily. They shift the weight of the books to their edges and corners, which deforms their walls and leads to a quick collapse.

Have you noticed columns in buildings and other structures? Next time you visit a parking garage, look around and notice what shape the support columns are!

WHICH AIRPLANE CAN FLY THE MOST CARGO?

The Challenge: Now our challenge is to make a paper airplane that can carry a cargo and glide more than ten feet. Our cargo today will be coins. The winner of this challenge will be the person whose plane flies the highest value of money.

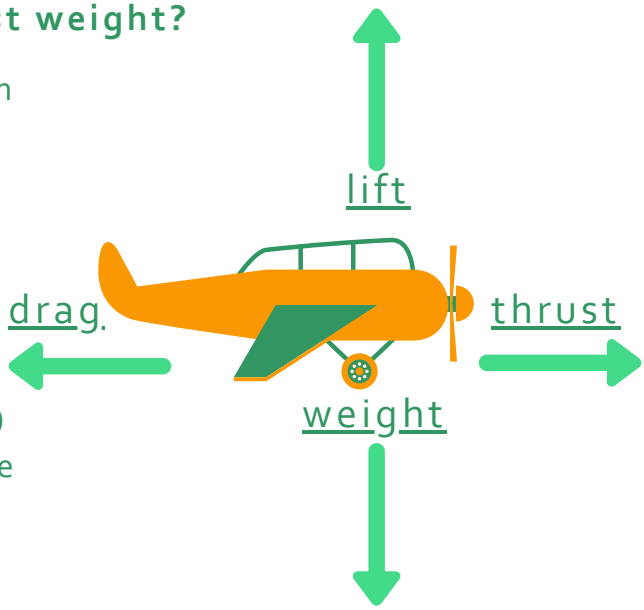
Supplies: construction paper, tape, coins, a doorway

Steps:

- First, mark a starting point for your plane throw. This will be ten feet in front of your doorway. Then use tape to make a target in the upper half of your doorway. To prove their cargo plane can fly, kids need to glide their plane through that target successfully.
- If your kids don't know how to make a paper airplane, have them watch some videos on You Tube and use this as a problem solving activity for them.
- After they are done folding, have your kids guess how much money they believe their planes will be able to fly. Using tape, have them tape that amount of coins onto their plane.
- Now it's time to fly! Have your kiddos stand behind the starting line and attempt to throw their plane through the upper half of the doorway. If they make it through, have them add more coins to their plane and fly it again. If the plane did not make it through the target, remove some coins and fly it again. Continue this process until you've found the maximum amount your plane can carry.
- Repeat these steps with multiple designs to find out which one flies the most weight!

Which airplane carried the most weight? How much did it carry?
Why do you think this plane carried the most weight?

Engineering Lessons: There are 4 forces acting on a plane in flight: thrust, lift, drag, and weight. Thrust results from when you throw the plane forward, weight comes from gravity pushing the plane toward the ground, drag comes from the resistance the plane encounters due to encountering air particles, and lift is created by the wings. Thrust (usually provided by an engine) moves a plane forward, while lift (provided by the wings) moves a plane upward.



HOW STRONG IS SPAGHETTI?

The Challenge: Test the tension and compression abilities of spaghetti through a series of challenges. If you have time, try putting your skills to the test and engineer your own pasta bridge!

Supplies: 1 package of spaghetti, 2 sheets of styrofoam, books, wooden blocks, glue, other assorted supplies

Steps:

- Start out by investigating how much weight spaghetti can hold when it's vertical. Try this by lodging one spaghetti strand in the styrofoam and gently pressing down on the top of the strand with your pointer finer. You may discover that it bends and breaks easily!
- What if you used multiple strands? Try sticking A BUNCH of spaghetti into your piece of styrofoam. Place your second piece of styrofoam on top of your vertical spaghetti. Start adding thin books on top of your styrofoam. How many books can you add before your spaghetti collapses?
- Now let's test out how much weight spaghetti can hold when it's horizontal! Grab a handful of spaghetti and two wooden blocks (or two similarly shaped objects). Span the spaghetti across the blocks so that the spaghetti is like a bridge. Pile more wooden blocks on top of the spaghetti until it collapses. Compare your pile of blocks from your vertical strength experiment to your pile of blocks from this exercise. How did the horizontal strength of your spaghetti compare?
- Looking for a bonus activity? Now try building your own bridge using craft glue and spaghetti! Simply cut pieces of spaghetti to the size you desire, glue them together into rows, columns, or other shapes, and then glue your spaghetti shapes in the form of a bridge. Use other bridges you've seen before as examples. Once finished, let your bridge dry overnight. The next day, pile items from your cabinets on the bridge to see how much weight it can hold. Great items to use for this are soda cans or canned food.

How much weight could your spaghetti support? Would you want to walk across a spaghetti bridge?

Engineering Lessons: When we are applying weight to the spaghetti, we are testing it's ability for tension and compression. These abilities are very important when it comes to bridge building. When we applied weight to the vertical spaghetti, we were testing its compression, which is a decrease in volume resulting from an applied stress (things become more compact as more weight is applied). When we applied weight to the horizontal spaghetti, we were more testing its ability to withstand tension (pulling apart). When things are tensed, the material elongates and eventually breaks if strained enough.

WILL YOUR BOAT FLOAT?

The Challenge: Build an aluminum foil boat that will hold at least 25 pennies for 10 seconds before sinking.

Supplies: 2 feet of aluminum foil, pennies

Steps:

- Cut a piece of foil that is 2 feet long.
- Folding, crumpling, or curving your foil however you please, shape it into a boat.
- Place your boat into a bucket of water (a full sink or bath tub will work as well).
- One at a time, add pennies to your boat. See how many pennies your boat will carry before it sinks.
- Try different ways to distribute the weight of the pennies or try out several different boat designs to see which will carry the maximum number.

How many pennies could your boat hold?
Why do you think your boat began to sink when you reached your maximum amount of pennies?

Engineering Lessons: There are two primary forces acting on this science experiment. The first force is gravity. Gravity is trying to pull the tin foil and pennies downward. The force of buoyancy is pushing the boat up toward the surface. The gravitational force is determined by the weight of the tinfoil and the weight of the pennies in the boat. The force of buoyancy is the weight of the water displaced by the boat. Your boat will continue to float as long as the force of buoyancy is greater than the force of gravity and you do not overload the boat so it will tip over or leak.