nanogirl's LAB

SUPER POWER: Pivots and Levers!

EXTENDABLE ARM

BUILD TIME 15 MINS

YOU WILL NEED

- Thick cardboard
- Scissors
- Pencil
- Ruler
- 9 x Paper clip
- Tape
- 1 x Wooden skewer
- 2 x Plain paper
- 2 x Elastic band
- Blue tack

LAB NOTES...

TO MAKE YOUR EXTENDABLE ARM...

1. Measure and cut out six 16cm x 4cm and two 10cm x 4cm rectangles from your card.
2. Put the two smaller rectangles to the side for now.
3. Lay one rectangle down, lay another rectangle down so that it lies at right angles to the first with one end of each rectangle overlapping. Add a third rectangle to the chain to create a zig-zag shape, this time tuck your third rectangle underneath the second rectangle.
4. Repeat with the other three pieces of card except this time, instead of laying one piece down and putting the other two pieces on top, lay two pieces down side by side and put the middle piece on top.
5. Using a sharp pencil or a skewer, make holes in the centre of the cardboard where two pieces overlap.
6. Open a paperclip at one end and push the end through the hole, making sure you go through both pieces of cardboard. Fold this end flat against the cardboard and tape in place.
7. Repeat with paperclips for the other holes to create hinges in the two zig-zags.
8. Lay the first zig-zag down and arrange the rectangles so they make a sideways "S" shape.
9. Lay the second zig-zag on top of the first so it makes three "X" shapes.
10. Take the card at the top of the top and bottom X and move so that they are underneath the card they were lying on. The X shape should stay the same.
11. Make a small hole in the centre of each X shape where the two arms cross, place and secure an opened paper clip through the hole as before. You should then have a shape which can be stretched out and squashed back in on itself, using the paper clips as joints.
12. Roll and tape a piece of paper around a skewer to make a straw. Trim to 7cm.
13. Squash your arms to their shortest arrangement. Choose what will be your bottom left arm and draw a mark 2.5cm up the right side. Connect this mark with the bottom left corner and draw a diagonal line. Tape your straw along this line
14. Push your skewer through the straw and tape the far end to where it overlays the right hand side bottom arm.
15. Now when you push the skewer through the straw the arm should extend.
16. Pull the skewer as far back through the straw as it will go to stretch out the arm as far as possible.
17. Take the two shorter pieces of cardboard you cut earlier. Overlap them on the top ends of the arm and bring their tips in so they are touching at the top.
18. To mount on an arm-guard take a fresh sheet of paper and trim so it just fits over your forearm.
19. Make hooks out of your paper clips by opening out and tape them close the one long edge of the paper.
20. Hook an elastic band around each paperclip and tape in place so they stretch and keep your arm guard secure on your arm.
21. Tape your extendable arm to the top of your arm guard - now you are ready to test it!.

Extendable arm

Your extendable arm has lots of paper clips acting as pivot points (also called fulcrums), and lots of short pieces of cardboard which act as levers, moving around the paper clips to extend (stretch out) and retract (shorten) the arm. With the levers all working together, you should be able to extend the reach of your arm! If you find that your grabber claw is not very good at gripping and lifting things, you could try adding high friction material like elastic bands around the ends

What can you pick up with your arm?

Try building or finding some different shapes to pick up, like a cylinder, a box or a ball of scrunched up paper. Which shapes are easiest to pick up, and why do you think this is?

Are some materials easier to pick up than others? What about very smooth material like plastic, or very fuzzy material like a cotton ball?

As a science superhero, you could be called into action in lots of different situations. What sort of superhero missions would you need to take your extendable arm with you on?

Can you make a loop to attach your extendable arm to your utility belt?