



# Learning Objective

We are learning to make a pneumatic scoop for our space buggy.

**KL: Making a pneumatic scoop**





Today we are...





# Design & Technology

In Design and Technology, we develop a range of creative and practical skills using our imagination and creativity.

## Designers:

- Invent solutions to problems in life
- Create better ways of living
- Express themselves in a unique way





This term, our learning will be focused on:

## Textiles



## Mechanisms



## Structures



## Cooking & Nutrition



## Electrical Systems



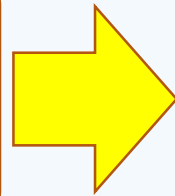
## Multi-aspect Projects



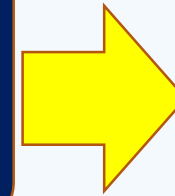


## Mechanisms: Space Buggies

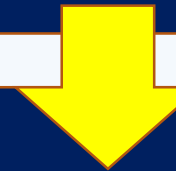
1. Identify the problem & research existing ideas



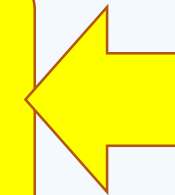
2. Ideas: Design space buggies & create list of equipment



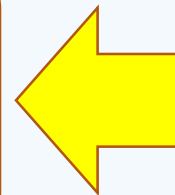
3. Make the chassis



4. Create scissor-mechanism arm



5. Make a mechanism for a scoop



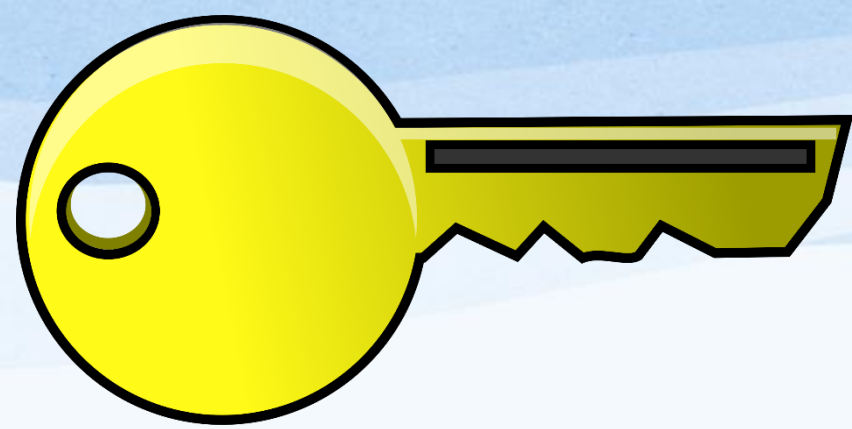
6. Make and attach the wheels



7. Test and Evaluate

### Our outcome:

We will research, design, make, test and evaluate a buggy to explore planets in our solar system



# Vocabulary

**pneumatic**

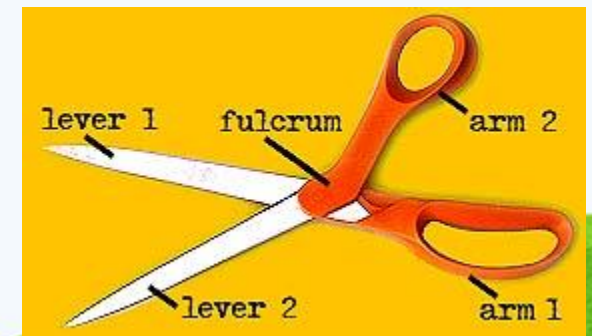
*Operated by gas or air*

**hydraulic**

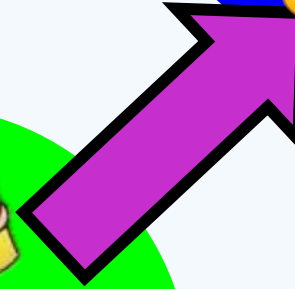
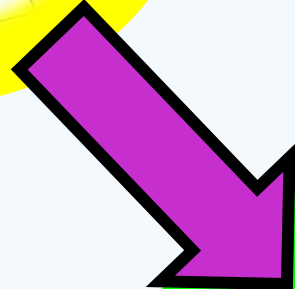
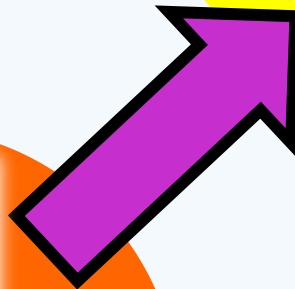
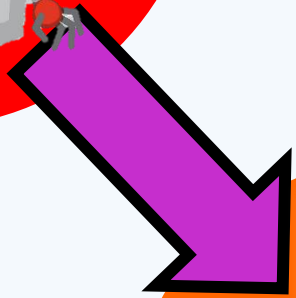
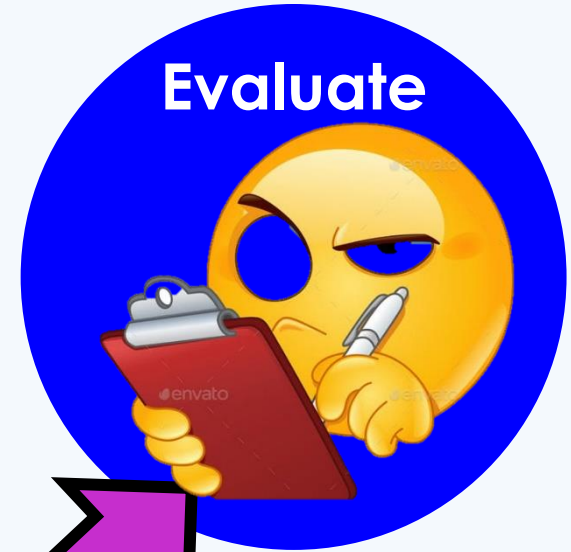
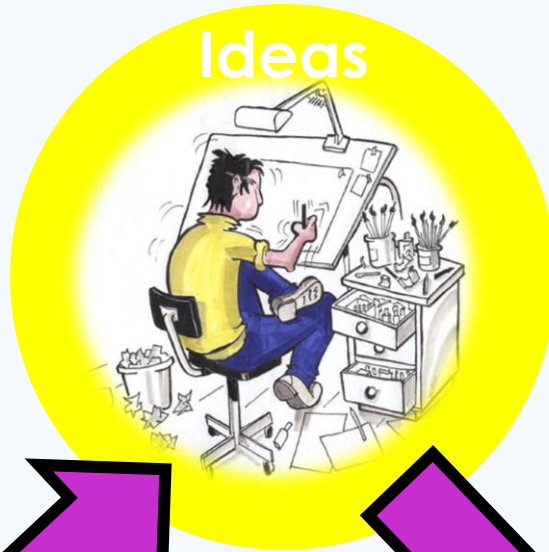
*Operated by water*

**fulcrum**

*The point against which a lever is placed to get a purchase*



# PRIME DESIGN PROCESS:

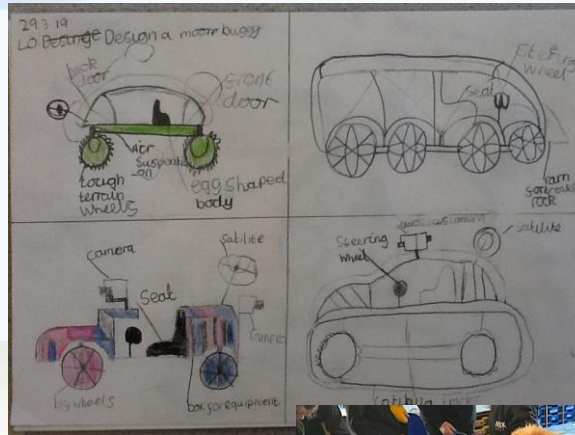


# Recap: So far...

Problem

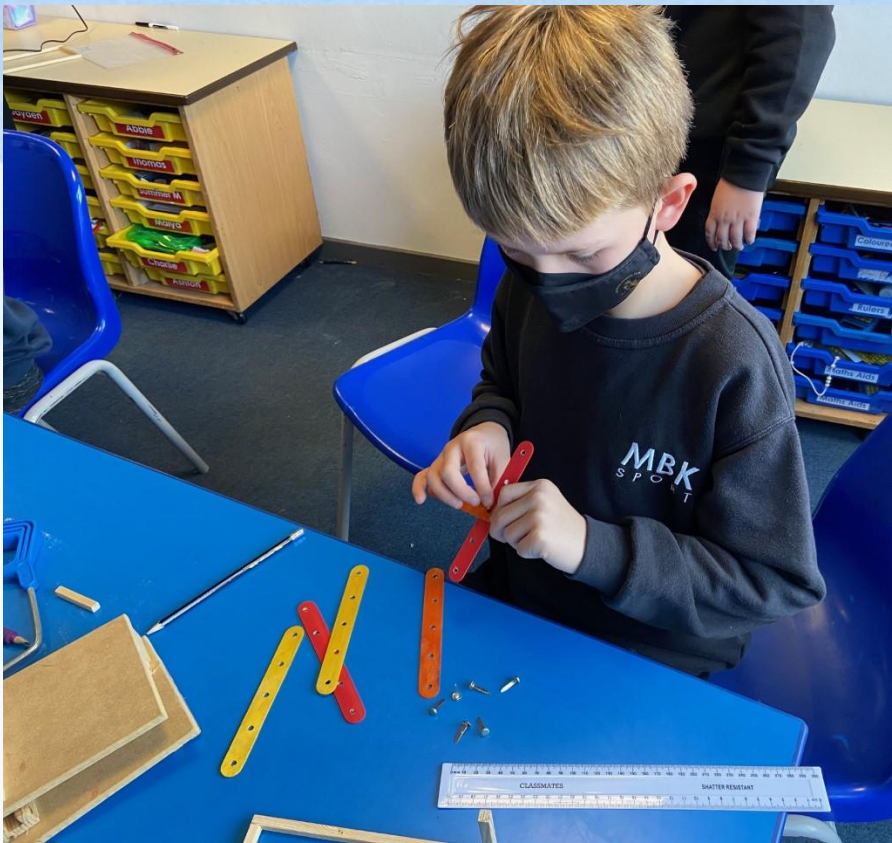
## 1. What do we need to solve?

- ✓ What is the problem you have to overcome or the objective you want to achieve?
- ✓ Discuss what you need to design or create



up items from the surface of Mars...  
-The rover needs to be able to travel over the rocky surface of Mars.  
-A spacecraft will carry the rover so it must be strong.  
-The cost can be quite high.  
-The rover doesn't need to look good, as it won't be seen.





# Today....



# Learning Objectives



- Explore robotic lifting systems.
- Understand the job of a pneumatics and hydraulics engineer responsible for developing a robot to explore Mars.
- Understand simple hydraulic and pneumatic systems.

# Learning Outcomes



- Add a simple pneumatic lifting system to your Mars rover prototype.

# Collecting Samples



Helping to move things.



How many things can you think of that help us to lift and / or move things around?



# Robotic Lifting Systems

What type of things do you think a robot could lift?



# What do you think the ExoMars Rover will be lifting on Mars?

Meteorites have come from Mars, but scientists would like to collect more rocks to help them look for signs of life.

"Black Beauty" The  
Marsian Meteorite

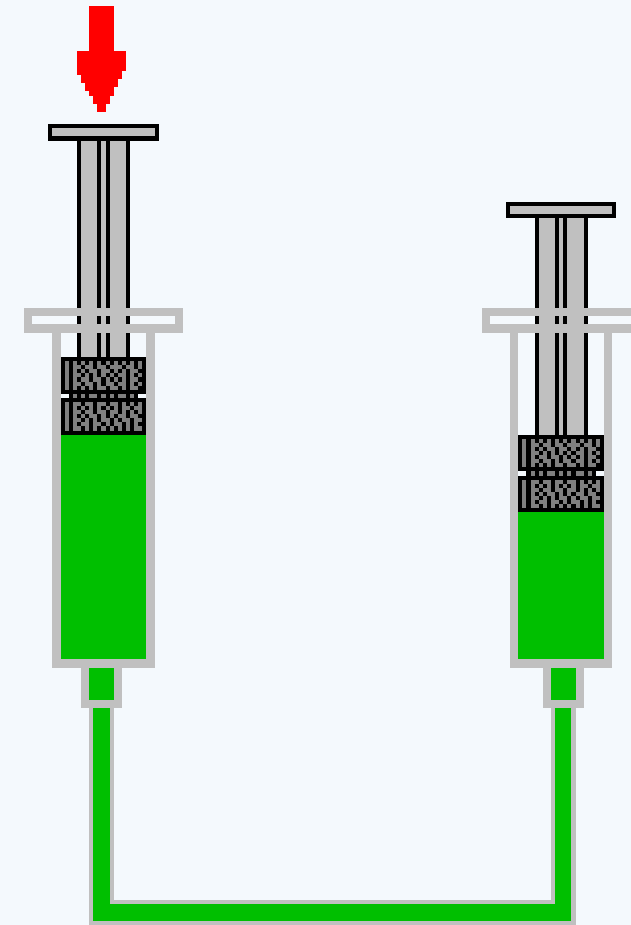
© NASA





# Pneumatics and Hydraulics

- In this pneumatic system a syringe filled with air is pushed down, this moves along the tube and causes another to lift up.
- The first syringe is called a **compressor**, the second is called an **actuator**.



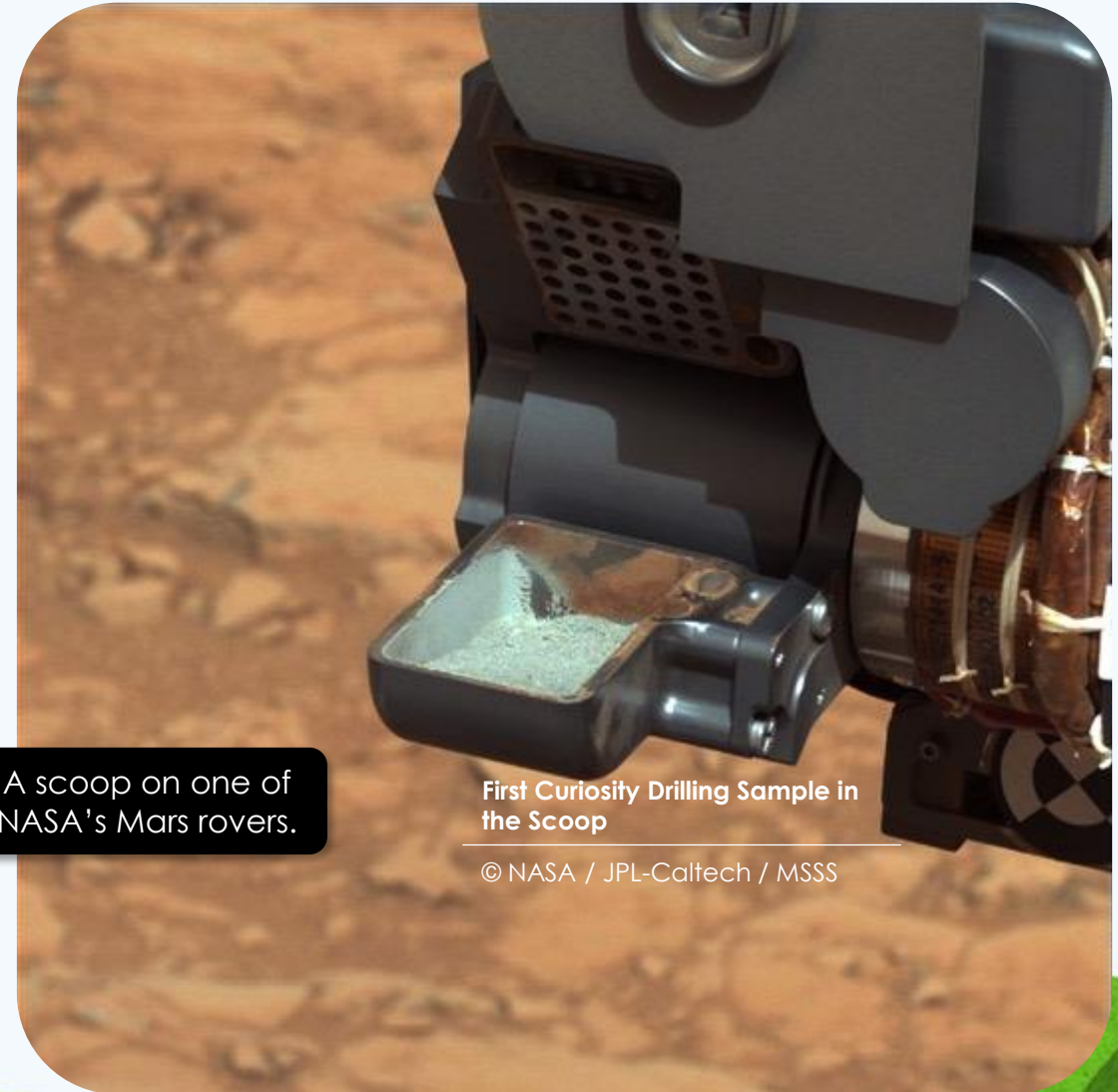
# Mars Rover Scoop

- Hydraulic and pneumatic engineers are responsible for designing systems to help scoops like this move.
- Your scoop is going to be moved by a pneumatic actuator.

A scoop on one of NASA's Mars rovers.

First Curiosity Drilling Sample in the Scoop

© NASA / JPL-Caltech / MSSS

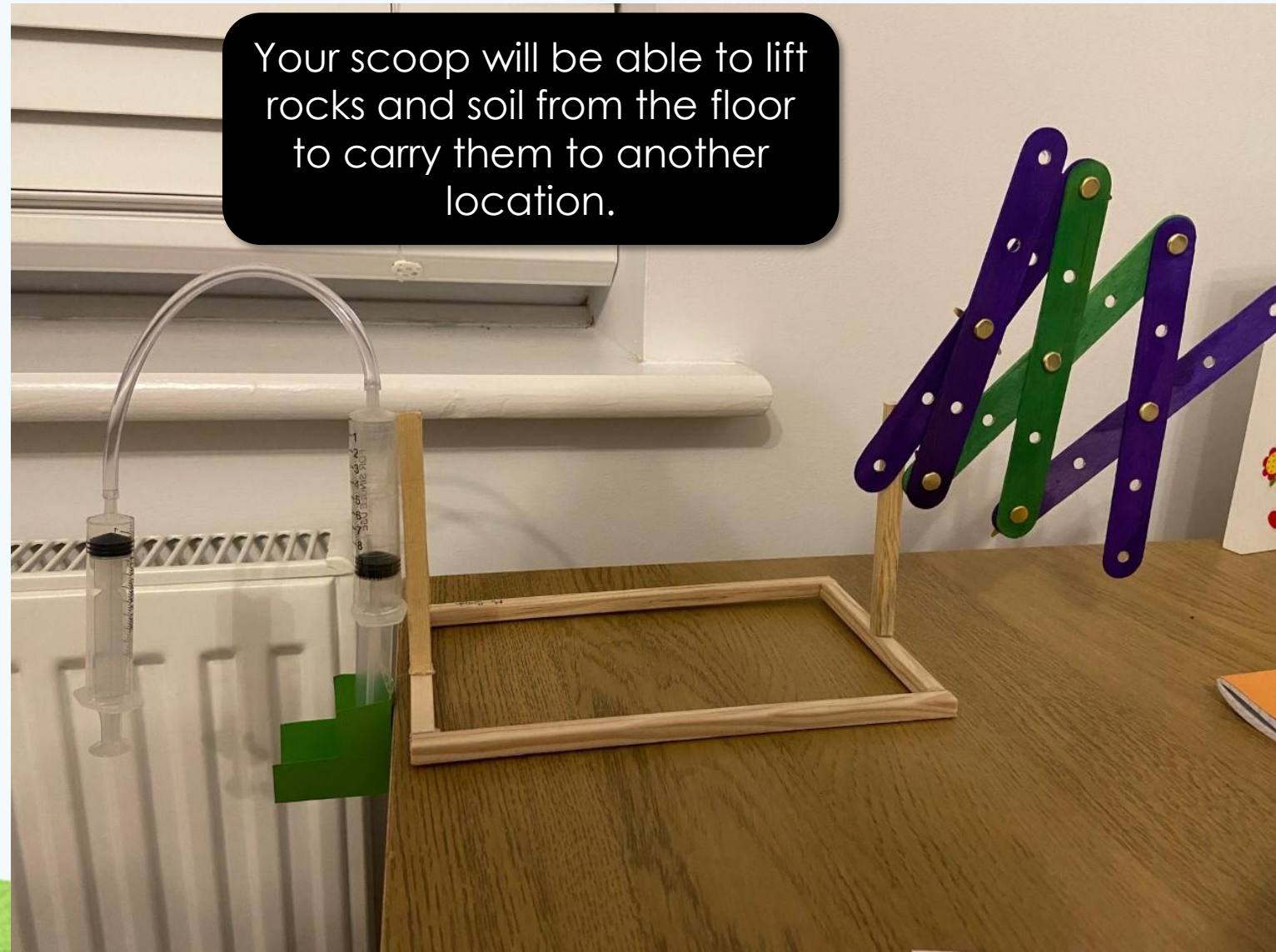


# Making: Pneumatic Scoop

## You will need:

- 10cm long piece of 1x1cm wood.
- 2 x 10ml syringes
- 20cm long piece of plastic tube
- 6x8cm piece of card
- Roll of sticky tape
- Scissors
- PVA Glue
- Hot glue gun

Your scoop will be able to lift rocks and soil from the floor to carry them to another location.



# 1. Measure and cut a 10cm length of wood

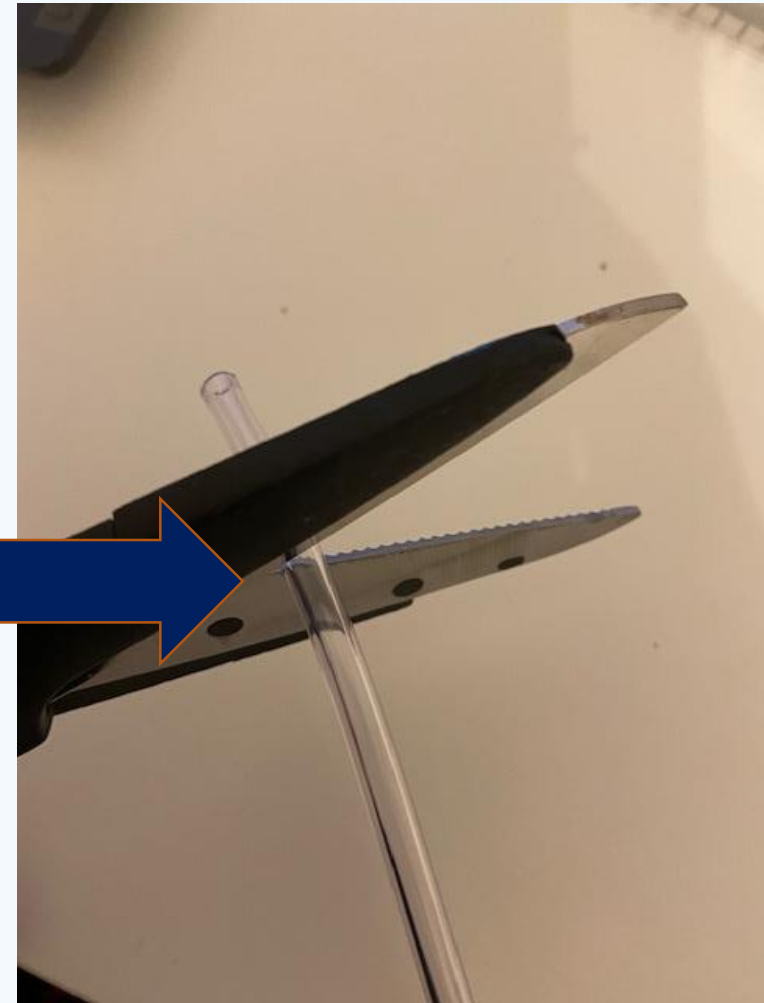
You're all experts at the measuring and cutting.  
No advice needed! 😊



## 2. Cut your tubing

Measure and mark **20cm**.  
Don't waste any; it's  
expensive!

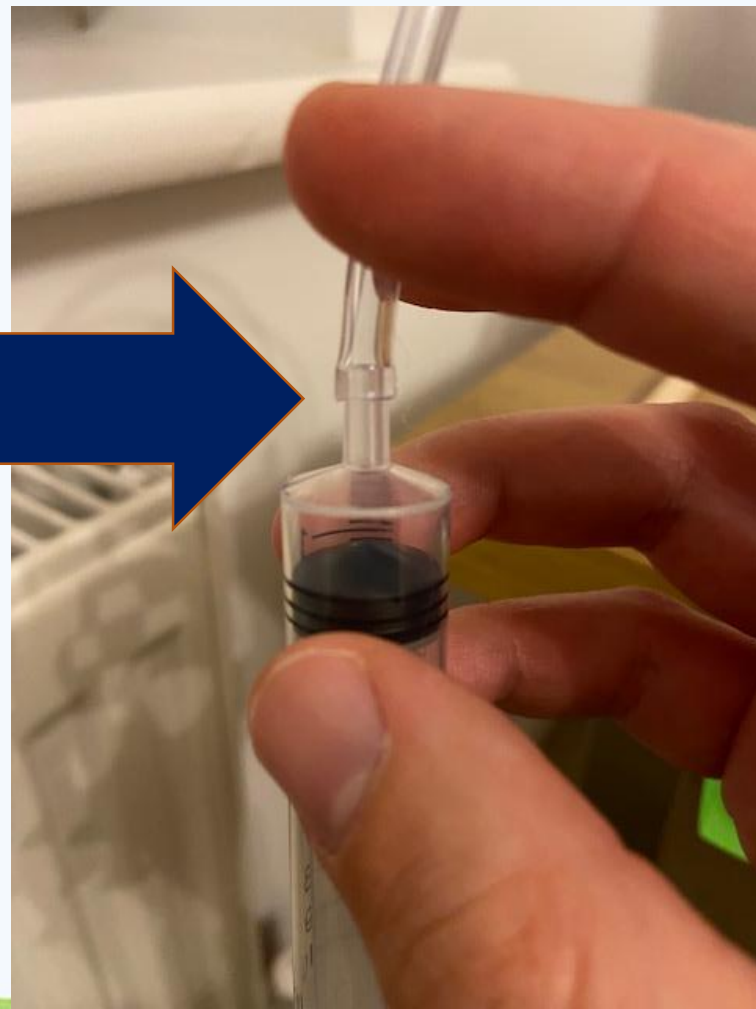
Use the fulcrum to help you get  
more force when you cut.



# 3. Attach your tubing to your syringes

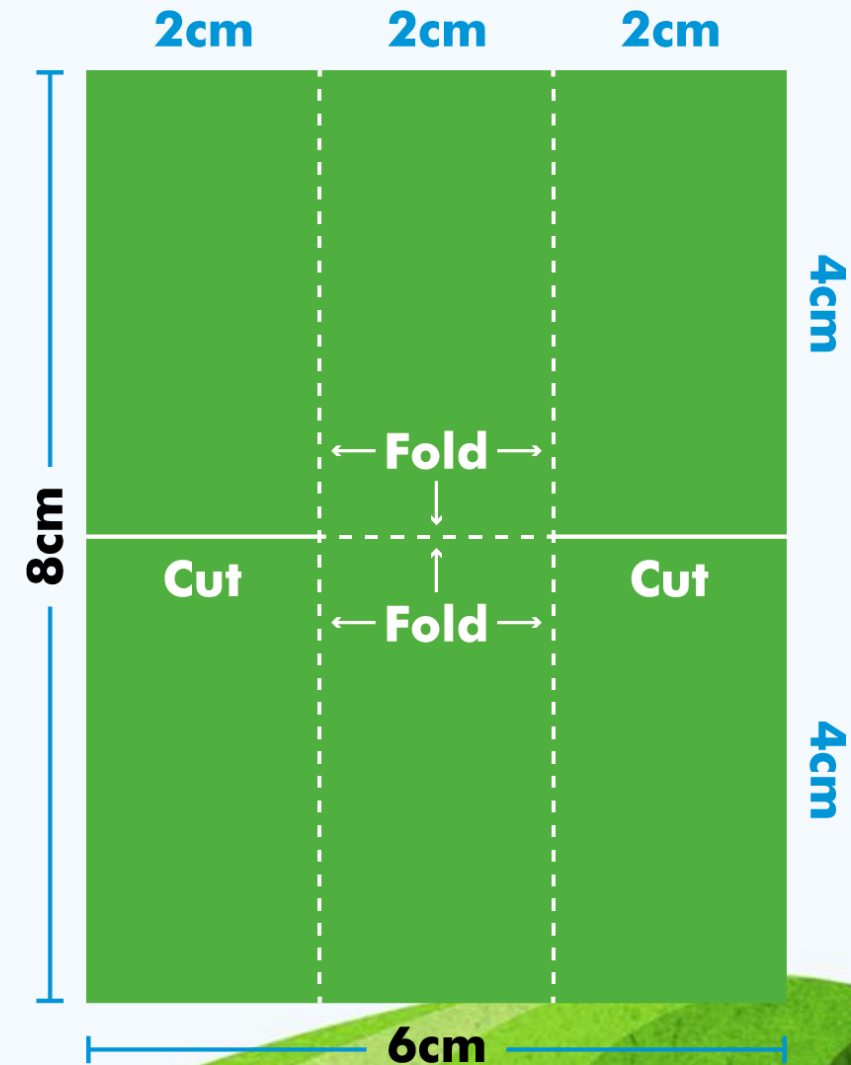
- No air can escape or the gas won't be able to push the plunger.

You will have to use some force to make sure the end of the syringe actually fits into the tube!



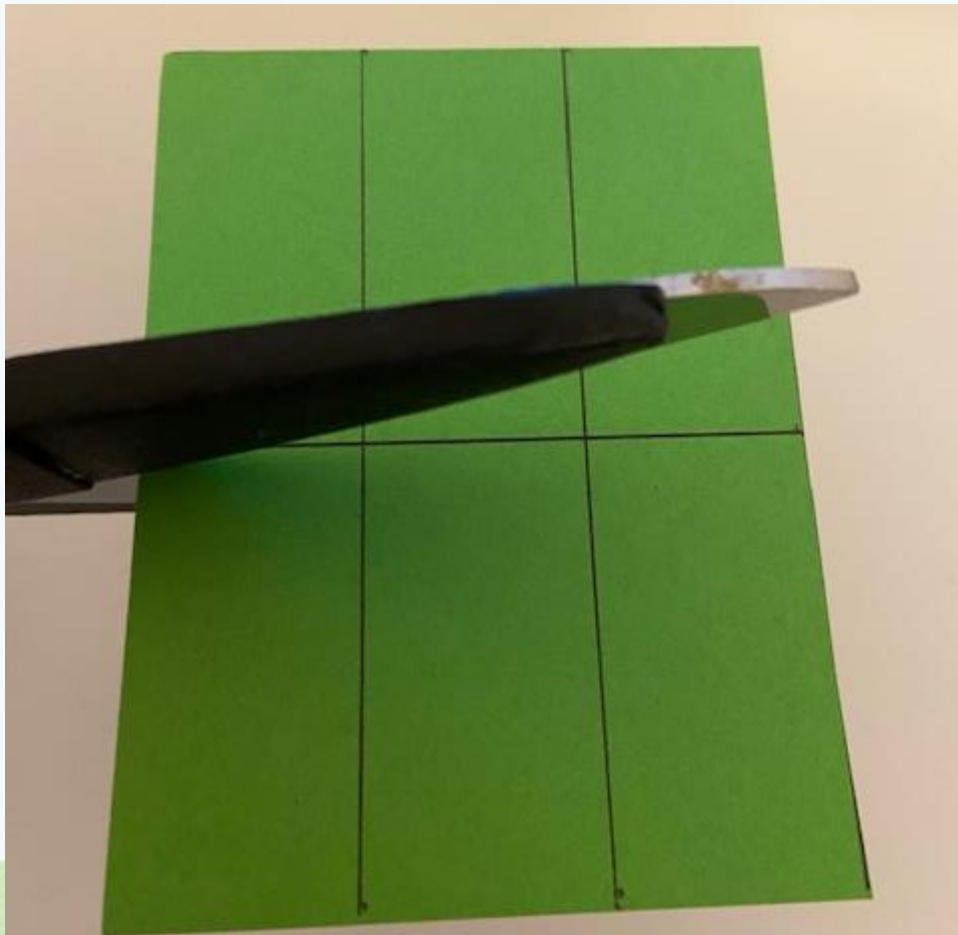
# 4. Make your scoop

1. Use a pencil to split up the 6x8cm piece of card as shown.
2. Cut and fold where shown.

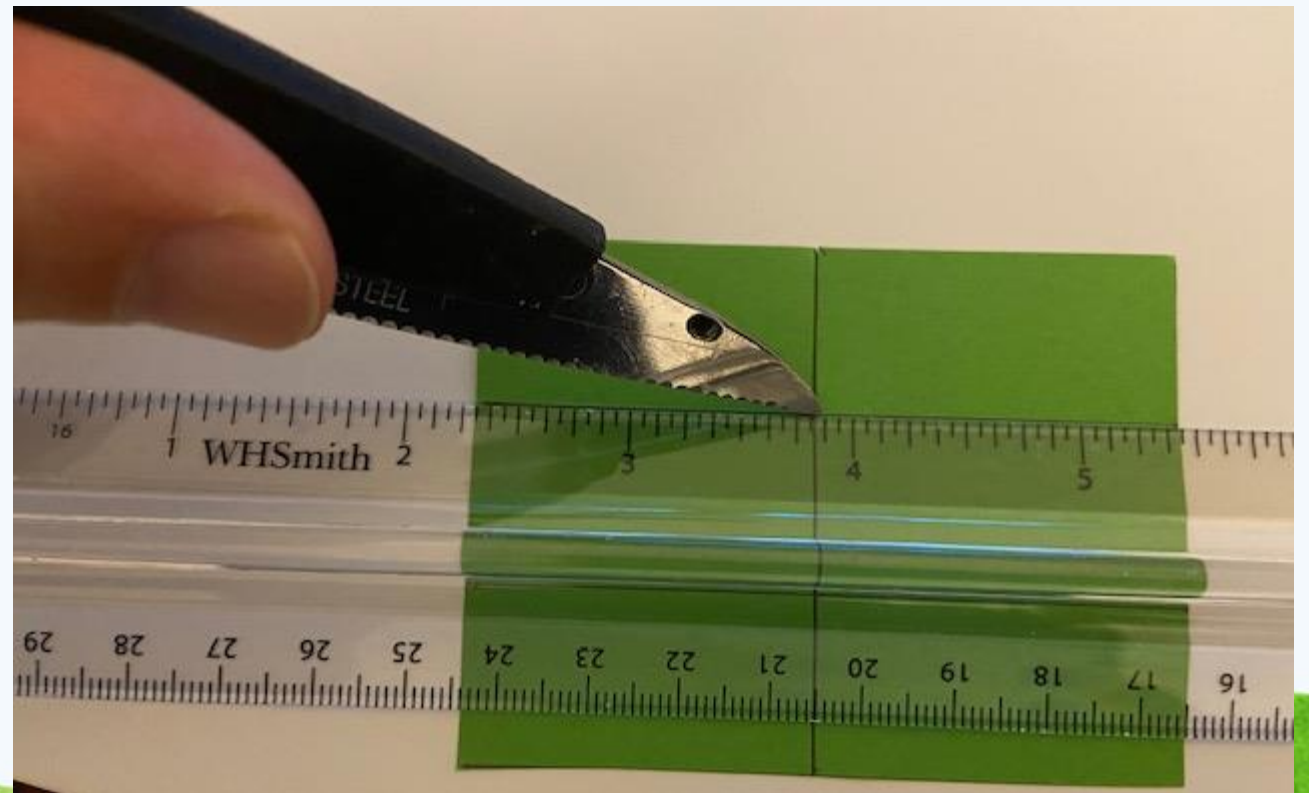


## 4. Make your scoop

Cut and fold where the diagram shows.



You should score your card with your scissors on your fold lines to make it easier to fold.





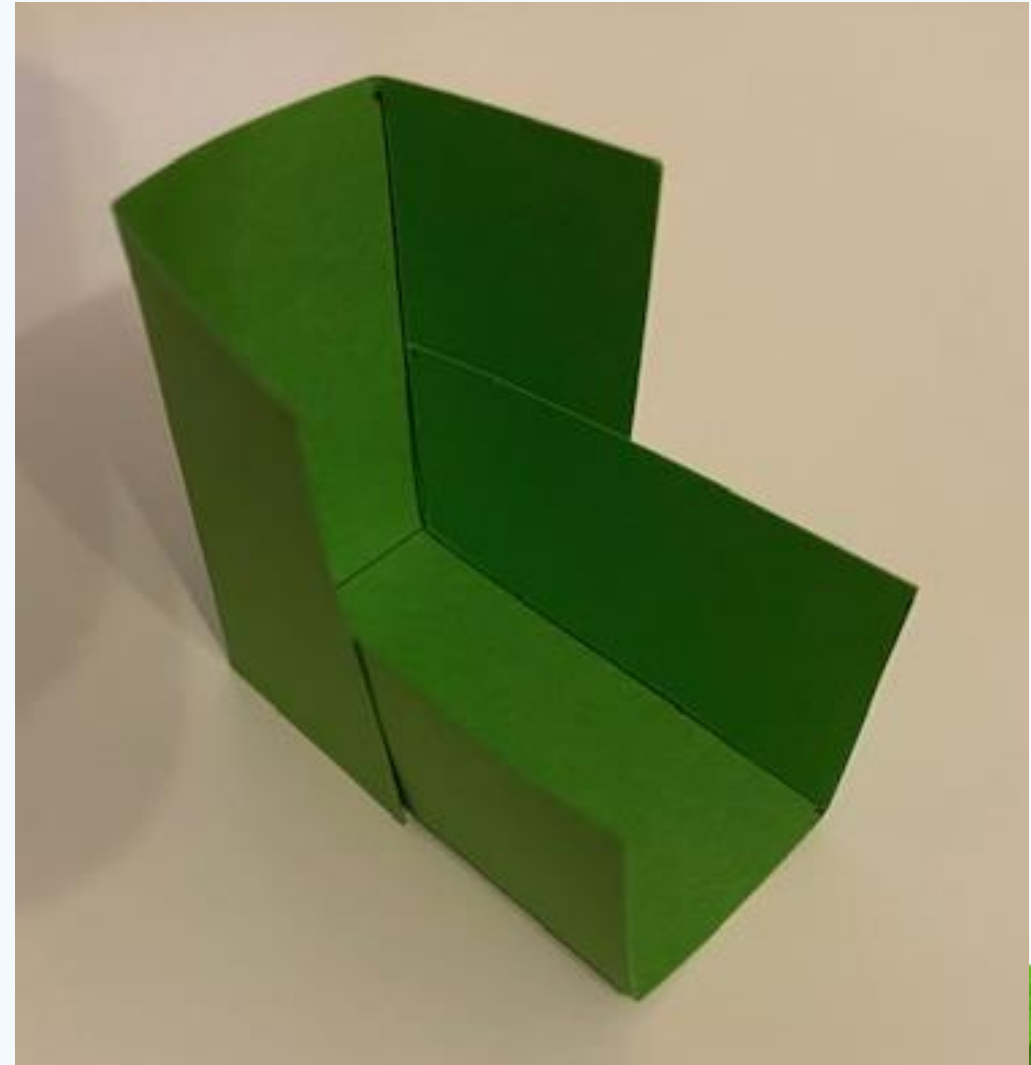
## 4. Make your scoop

Glue the small areas shown with a glue stick.



## 4. Make your scoop

Hold the card in place to make a scoop shape.



## 5. Attach your scoop to the plunger.

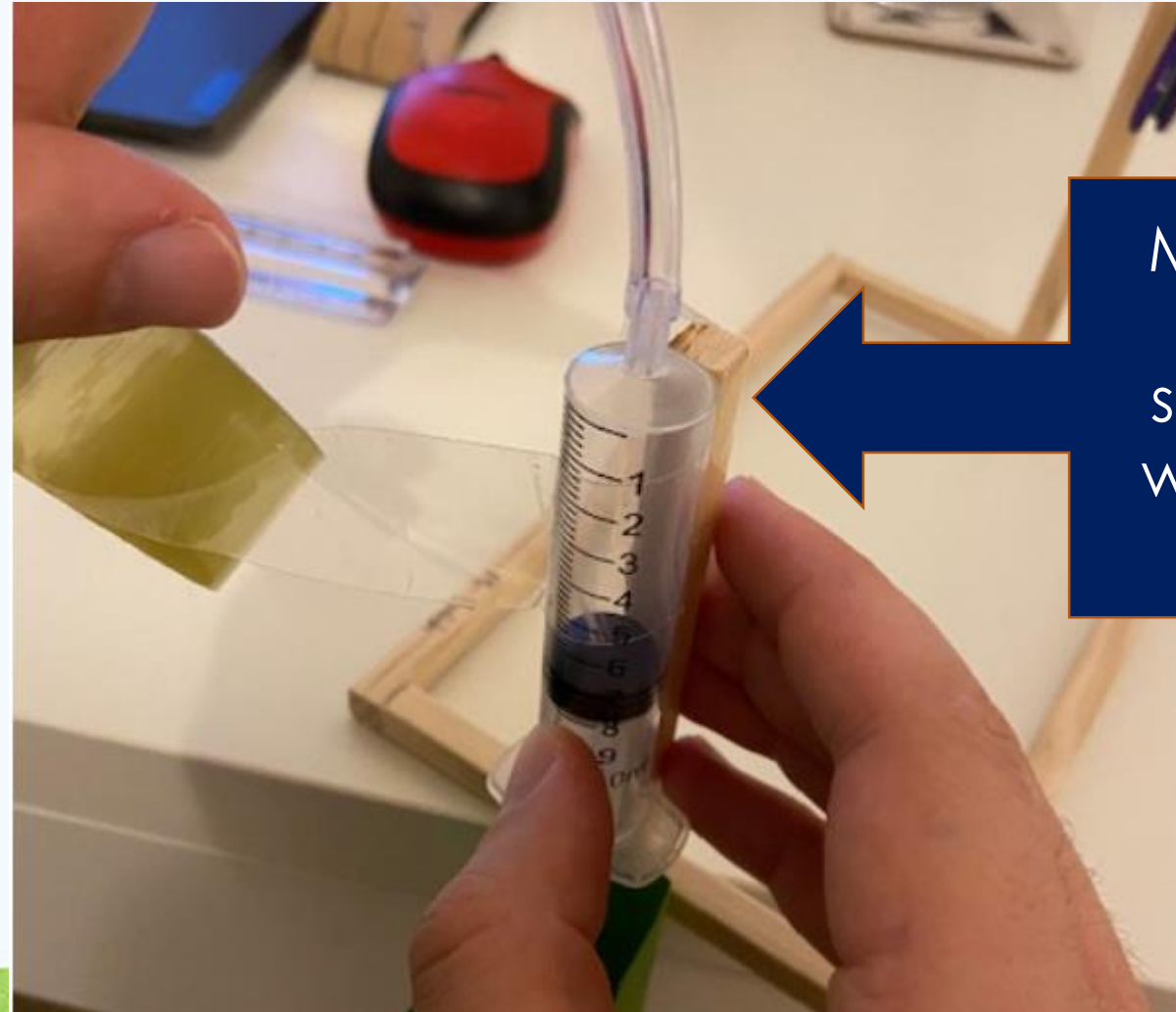
Use a blob of hot glue to fix the plunger to the scoop.



## 6. Attach the scoop to the stand.

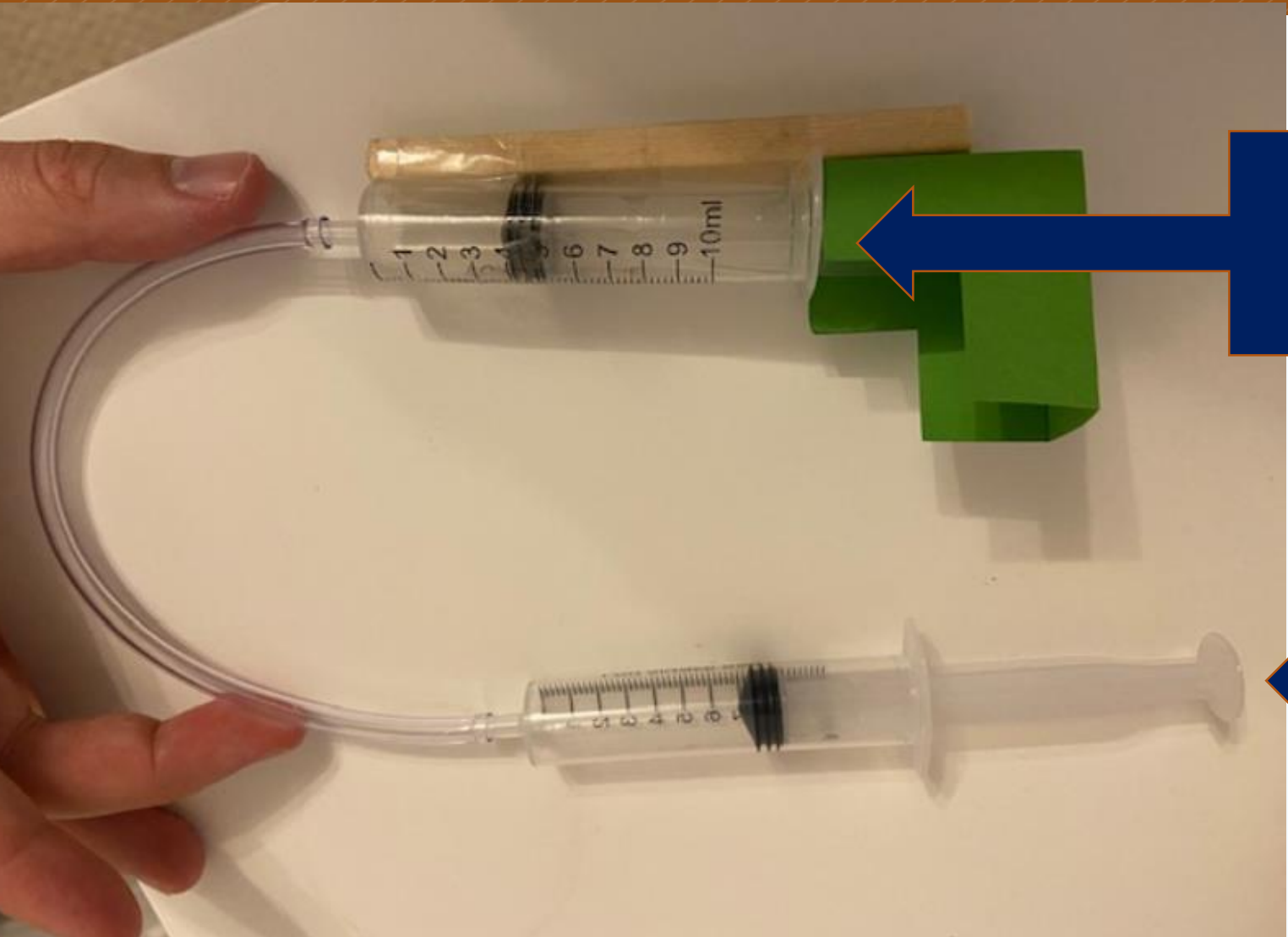
Sellotape the syringe to the wooden stand.

Do it at the top and bottom.



Make sure the top of your syringe is level with the top of your stand.

# 7. Attach the second syringe.



Make sure that if one end is pushed in...

...the other end must be pushed out.

## 8. Glue your stand to your chassis.

Remember to wait for the glue gun to warm up, and hold the post firmly to the chassis for a few seconds.



# Test

- Once all of your parts are set, try to raise and lower the scoop.
- If it does this try and get the rover to drive towards some sample pieces of gravel and lift them.

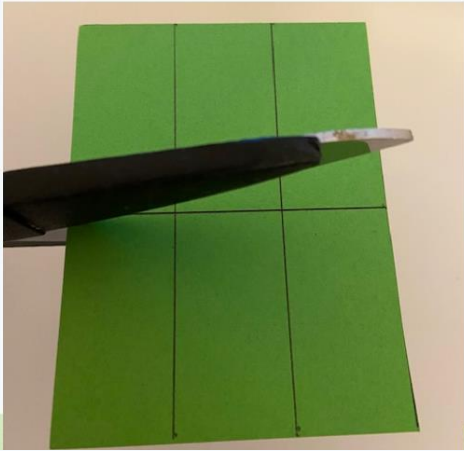
*How could you make the scoop pick up a larger sample?*



# Making the Scoop: Printout

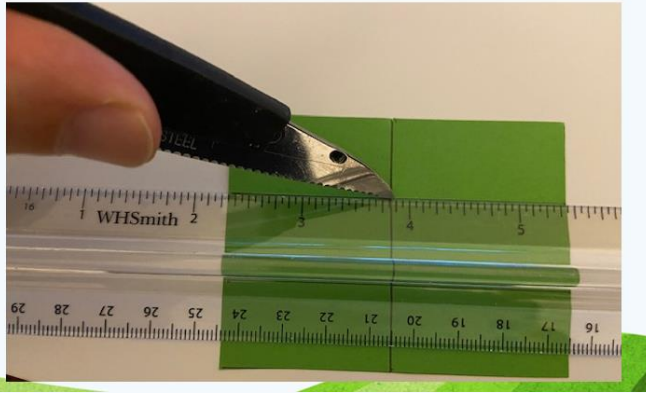
1

Cut and fold where the diagram shows.



2

You should score your card with your scissors on your fold lines to make it easier to fold.



4

Hold the card in place to make a scoop shape.



5

Use a blob of hot glue to fix the plunger to the scoop.



3

Glue the small areas shown with a glue stick.





# Finished!





