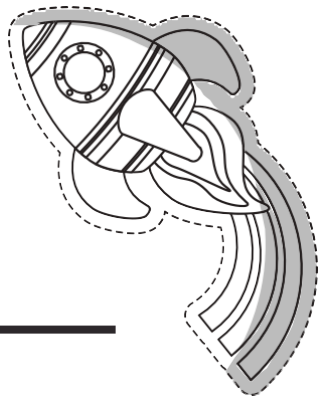
HOW TO RECORD YOUR ROCKET DATA



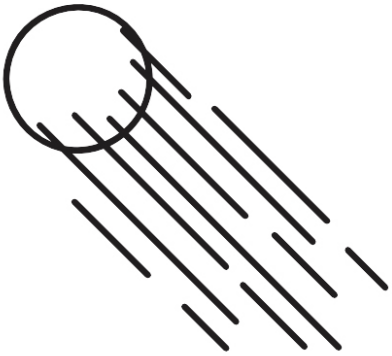
Welcome

To the OMGTech! New Zealand Schools Space Project

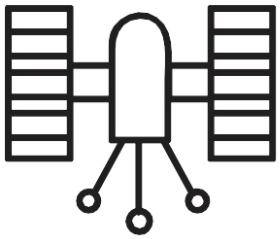
Once you have constructed your rocket, you will need to launch it and then record how far the rocket travelled. There are several ways to do this depending on what gear you have as well as other things you can record too. You can upload all your findings to the OMGTech! website and share your launch with every other school in NZ.
Who can build the fastest rocket!? How high can yours go?

What You Need to Record Distance Data

- A camera or smartphone with a camera that can record video. Ideally a camera that can record 60 frames per second or faster.
- A metre long ruler
- Tall buildings, objects or people to use as a height guide
- A rolling distance counter or a tall person with 1 metre long strides as they walk.



Recording Your Data



After each rocket launch you can record a few pieces of data and upload your findings to our website and compare your launch to other schools launches.

www.omgtech.co.nz/space-results

Here is what you will record and upload to the website to show the world:

- The name of your school
- The names of your mission control launch team (that's you!)
- The type of rocket you built
- The address of your launch site
- The time and date of the launch
- The distance or height your rocket travelled
- The size of bottle you used (how many litres it holds)
- Amount of water or vinegar you used in your rocket experiment (in millilitres)
- How much ballast you used (in grams)
- Notes about your launch. What worked, what didn't. How did you measure your distance?

These bits are optional so you only need to supply these if you did the exercise to calculate them

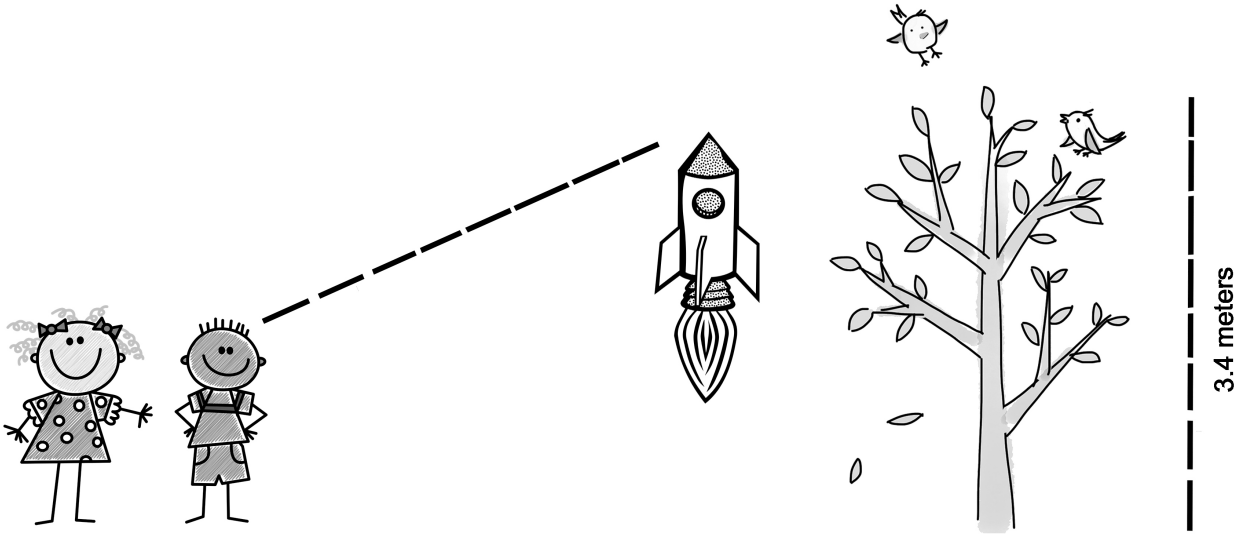
- Temperature at time of launch
- The fastest take off velocity
- Flight time from launch to the highest point

Recording the Distance of Your Rockets

There are a few ways you can measure how far your rocket travels.

The Power of Observation

As the rocket will go straight up, it will be hard to see how high the rocket goes from underneath. Using this method you can use an official observer to record the height by observing the launch from far away and comparing the height to something else that is tall that you know the height of.



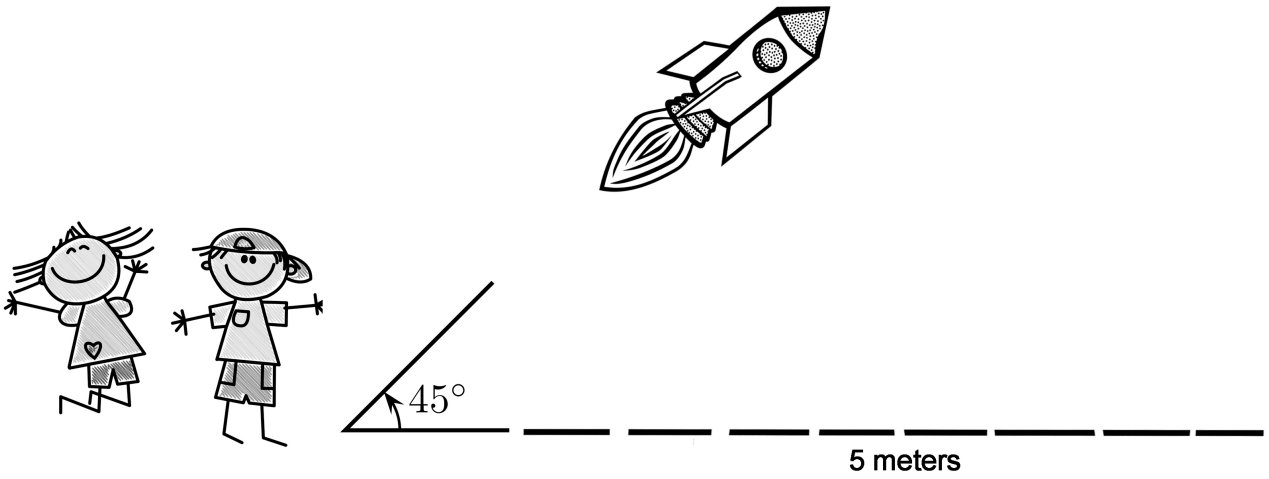
1. Have a look around your launch site to find other objects that are tall, like:
    - your teacher (1.5m-2m)
    - rugby goal posts (3m to the cross bar or 6m to the top of the posts)
    - a 2 story school building (10m)
    - a very tall tree (10m-20m - you will need to know the height of the tree)
2. Position your rocket launch close to, but not right next to the tall object. You don't want it landing on a roof or in a tree. Move your rocket about 10m away from the tall object if you are worried about your rocket landing on it.
3. Appoint someone to be your Official Observer and get them to stand far enough away so they are the same distance from the rocket as they are to the tall object, and so you can see both at the same time using a video camera.
4. The official observer can use a video camera on a phone or tablet to record the launch so you can measure the distance later as a team. Ask them to start recording before the launch. Keep the camera as still as possible.
5. Once the rocket has launched, you can watch the recorded video and see how much higher the rocket travelled than your tall object. Measure how many of the tall object can fit underneath the highest point the rocket travelled to.

Launching Horizontally for Distance

You can make your rocket travel very far by launching it sideways at an angle. First make sure that the open field is still wide open where the rocket will land. This could be over 50 metres away.

1. Place 2 smooth sticks into the ground at a 45 degree angle to act as a tray for your rocket, aiming in the direction you want the rocket to go. When the rocket is ready lay it on the angled sticks. Now the rocket is aiming at a 45 degree angle sideways toward the target part of your field.
2. If you are making a bottle rocket, when you pump up and launch the rocket, it will go very far in the direction it was pointing, this could be up to 50 metres.

   Ensure you have enough space in front of you for the rocket to travel!
3. Measure this distance with a rolling distance counter, or by measuring the strides of a tall person, like your teacher, which will be approximately one metre. Try different stick-angles to see which one results in the farthest flight.

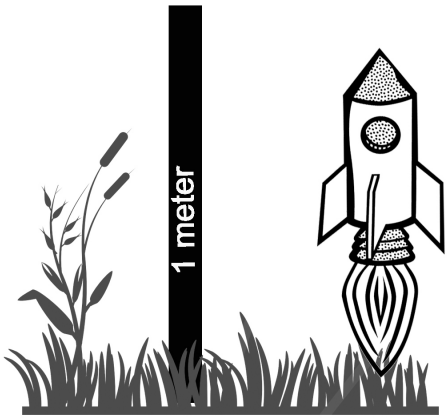


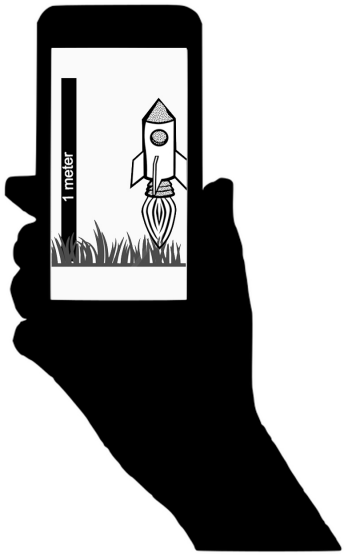
Recording Lift off Acceleration and Velocity (Advanced)

Put a small stick in the ground right beside your rocket. Tape a metre-stick ruler to the small stick so that it is vertical right beside your rocket.

Set your video camera or smartphone to the fastest frame-rate possible and film the rocket lifting off. When you view the video later you will be able to see how far the rocket went from one frame to the next.

You can view your video camera frame rate in your phone camera settings.





1. Velocity will be Distance (cm) travelled per frame (from one frame to the next) * Frame Rate (in frames per second). The answer will be in units of cm/second.

E.g. If you used a frame-rate of 60 frames per second and the rocket moved 10cm between frames:
10cm * 60 frames per second = velocity of 600cm/s (or 6 metres per second)

2. To calculate acceleration, you will need to calculate the velocity of the rocket for two adjacent pairs of frames. So, calculate the first velocity from frame 1 to frame 2 like you did above. Then calculate the second velocity from frame 2 to frame 3.

The **change** in velocity per frame at that point in the rocket's flight will be (second velocity – first velocity) / the number of frames between the two points you measured velocity at.

The acceleration will be the change in velocity per frame * Frame Rate (in frames per second).

The answer will be in units of cm/second^2. You can change this to metres/second^2 by dividing the answer by 100.

Example

Frame	Height off ground (tip)	Velocity	Acceleration
first	35cm		
second	45cm	45cm-35cm = 10cm per frame. 10cm/frame x 60 frame/second = 600cm per second	
third	56cm	56cm-45cm = 11cm per frame. 10cm/frame x 60 frame/second = 660cm per second	660cm/s - 600cm/s = 60cm/s change per frame. 60cm/s/f x 60f/s = 3600cm/s/s
fourth	69cm	69cm-56cm= 13cm per frame. 10cm/frame x 60 frame/second = 780cm per second	780cm/s - 660cm/s = 120cm/s change per frame. 120cm/s/f x 60f/s = 7200cm/s/s

If you calculate acceleration for different pairs of frames, what do you notice about acceleration? Is it changing over time