Robogals Science Challenge

Minor Challenge Set #2
STEM Field: Physics
Level: Senior
Challenge Name: Projectile Motion
Project Cost: 0-20 USD
Materials Required:

- 30 cm long tube or similar
    - e.g. foam pipe insulation or the cardboard tube from a roll of foil
- Strong rubber band
- Duct tape or similar
- Cardboard
- Scissors
- String
- Protractor or a printout of a protractor
- Push pin or blu tack or similar
- Small weight e.g. bulldog clip or nut
- Metre stick
- Tape measure or similar
- Things to decorate your rocket e.g. stickers, glitter etc

Safety:

- Take care when using sharp scissors
- It is advised to launch the rocket in open area and not directly in pathways

Duration:

- The challenge take approximately an afternoon to finish, however, the time guideline is an estimation only, and students and mentors can complete the tasks around their schedules

Introduction:

Have you ever noticed when you throw a ball it travels in an arc shape? As the ball travels horizontally away from you, it also travels vertically up and then down. This is because the **force of gravity** is acting on the ball. This path the ball takes is called **projectile motion**.

In this experiment, we will create a rocket as our projectile and investigate its **projectile motion**. How far away the rocket flies from the launch site depends on 4 factors:

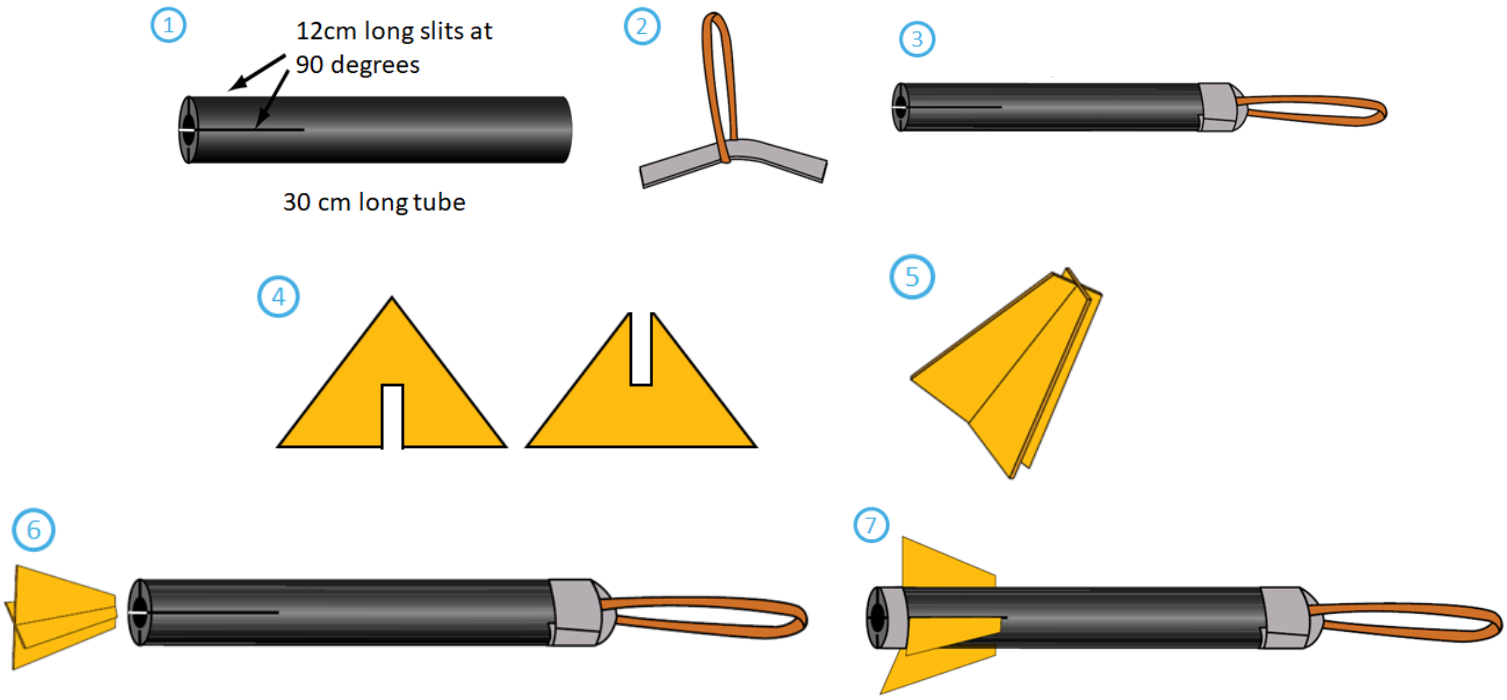
1. Gravity
2. The Launch Angle
3. The Initial Velocity (or speed)
4. And Atmospheric Drag (air friction)

We will investigate the effect of the **launch angle** on how far our rockets fly from the launch site.

Instructions:

Create your Rocket

1) On one end of the 30cm tube, cut four 12cm long slits at 90 degrees apart. This is for the wings of your rocket.
2) Cut a length of duct tape and loop it through the rubber band
3) Secure the rubber band in place at the top of the rocket. Use extra duct tape as necessary
4) For the wings, cut two triangles out of the cardboard. On one triangle cut a slit from the bottom to the middle. And on the other triangle cut from the top to the middle
5) Slot the two triangles together
6) Slide these wings into the slits of your rocket
7) Secure wings from falling off with duct tape wrapped around the bottom of the tube
8) Time to decorate!
   Your rocket is now ready to launch!



Create your Launcher

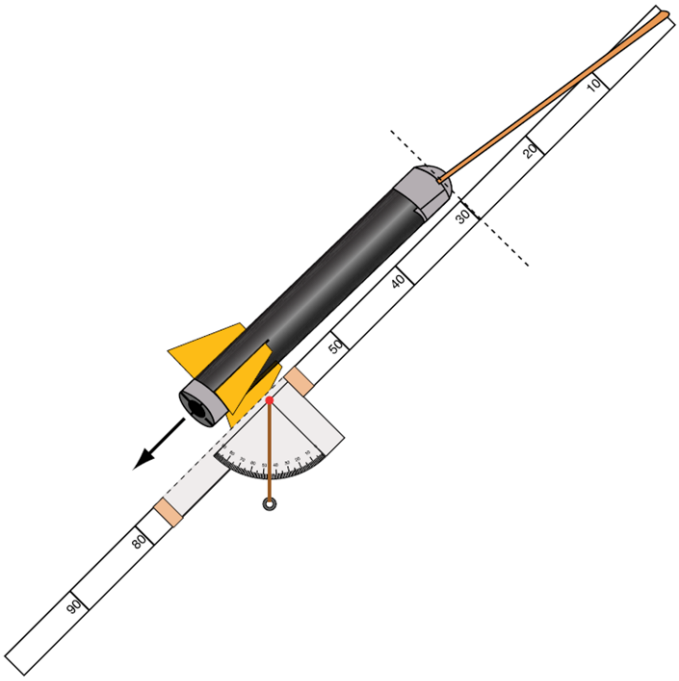
9) Take your protractor and stick it onto the metre stick so that the centre of it lines up with the 60 cm mark on the metre stick.
10) Stick the push pin or blu tack on the 60 cm mark
11) Attach the string to the push pin
12) Apply a small weight to the end of the string and let it fall freely.
13) To read the angle of your launcher, look at where the string and weight falls and read the angle from your protractor

Launching your Rocket

Try launching your rocket outside or in a big open space. Be sure not to aim it at a person.

14) Loop the rubber band over the end of the metre stick
15) Pull on the wings-end of the rocket until its nose lines up with the 30cm mark on the metre stick
16) Tilt the launcher to your chosen angle
17) Let go of your rocket and watch it fly!

[**Top Tip!** Be sure to measure the distance to where the rocket first touched the ground and not where the rocked ended up after sliding across the floor]



Record your launch angles and distance travelled in a table like the one below:

Launch Angle (degrees)	Distance (metres)

18) Repeat the launch of your rocket two more times, and record the launch angle, and distance in the table above.

Extension - Wings

The wings of your rocket are very important. They keep the rocket stabilised as it flies through the air. They keep the rocket pointing in the right direction. Try making wings of different shapes and sizes. Do they affect how your rocket flies?

Reflection Questions:

- Are there any improvements you would make to this challenge?
- What real world application/s can you apply this challenge to?
- What are the key science and engineering concepts that relate to this challenge?

- What happens when you launch your rocket at 90 degrees and 0 degrees?
- At what angle did the rocket travel furthest?
- How does the force of gravity affect the rocket?
    - How does gravity affect the rocket as it flies up into the air?
    - How does gravity affect the rocket as it falls down to the ground?

Submission Guidelines:

- Submit photos of the experiment setup and your results of the launch angle and distance. Include a short summary that addresses the reflection questions.

> Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with your parent or guardian first.

- The submission form is on the Minor Challenges page: https://sciencechallenge.org.au/index.php/minor-challenges/
  Fill out the details and make sure you upload your submission.

Learn More! Resources:

- Investigate projectile motion further with this online simulation! See what happens when you change other variables and watch how your projectiles fly through the air: https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html

- If you enjoyed making a rocket you may enjoy learning more about astronaut Dr Mae Jemison. She is the first woman of colour in space and has had an amazing and diverse career. Hear from her about why she wanted to go into space and how she got there: https://www.youtube.com/watch?v=B0vGDfuWhfI

Bibliography:

- NASA, Build and Launch a Foam Rocket [online] Available at: https://www.jpl.nasa.gov/edu/teach/activity/foam-rocket/ [Accessed 25 Feb, 2022]