Rockets and Range – Student Activity

Earth is only one of the eight planets orbiting our Sun. Many of these have their own moons orbiting them. The distances between them are pretty large so we use the Astronomical Unit (AU) as the base measurement. This unit is the distance from Earth to the Sun (149,596,870.7 kilometres).

Travelling through space poses many problems.
Factors to consider could be:

- **Distance**
- **Technology**
- **Fuel load**
- **Opposition** (Position of planets relative to each other)
- **Gravity sling**
- **Is it necessary to send manned spacecraft at all**?

1. **Distance**. The further away from Earth the planet lies, the longer it will take. Mars can be reached in between 150 to 300 days. Jupiter takes very much longer, between 4 and 6 years.
2. **Technology**. Improvement in technology and the use of more efficient fuels to reduce load can shorten time. Launching from space would greatly decrease the fuel required.

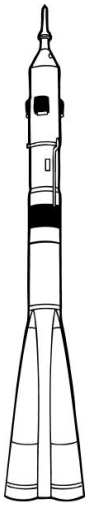
Student Activity

We shall investigate differences encountered in sending rockets to Mars and to Jupiter.

Mars is approximately 0.5AU from Earth.
Jupiter is approximately 4.2AU from Earth.

What is an AU? _____

Why do we use AU? _____

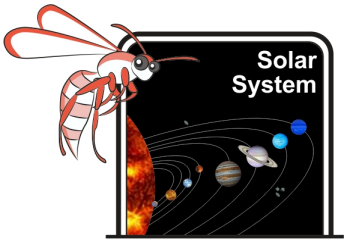


Materials per group

- 4m nylon string or fishing line
- Piece of drinking straw (5 – 6cm long)
- Sticky tape
- Marking pen
- Large balloon
- Tape measure
- Stopwatch/mobile/clock with second hand

Method

1. Thread straw onto string.
2. Stretch out approx. 4m of taut string between two students.
3. Tie loops at the end of the string as handles.
4. Mark the start at least 20cm from one end. Position the straw at the start.
5. Mark 25cm from start for the distance to Mars and 2.1m for the relative distance to Jupiter.



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6. Inflate a balloon and hold it with your fingers round the neck.
7. Attach the straw to the middle of the balloon with sticky tape.
8. Test your setup by releasing your hold on the neck of the balloon. The air from the back of the balloon should drive it forwards along the string.
9. Adjust the equipment for reliable balloon rocket flight.
10. Have a student stationed at Mars and Jupiter to measure the time taken for the rocket to reach these locations.
11. Repeat the experiment to calculate average values.

Why were 25 cm and 2.1m chosen to represent the distances from Earth to Mars and Jupiter?

_____

The average time of any readings can be calculated by adding all the readings up and dividing by the number of readings.
E.g. For readings of 1, 2 and 3. These would be added up to make 6 and this total would be divided by 3, to find the average of 2.

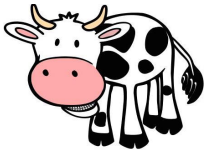
Observations

TEST	Time to Mars (seconds)	Time to Saturn (seconds
1		
2		
3		
Average time		

What did the results of your tests tell you? _____

Was this a fair test? Explain your answer._____

_____



More ideas to consider and perhaps test

Would increased air pressure in the balloon make it travel faster and further? _____

Does the rocket travel at the same speed along the string? _____

Does adding a weight to the rocket affect speed? _____

Would the increased fuel load required for travel to Jupiter affect travel time? _____

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What adjustments could be made to your balloon rocket to make the experiment work better?

_____

_____

_____

_____

Opposition

Planets circle the Sun at different rates. This means that sometimes they are close to each other. When planets are at the closest point to each other, they are said to be “in opposition”.

How often does Jupiter come into opposition to the Earth? _____

If you want to minimise travel time and fuel use, how often would it be in between launches of spacecraft bound for Jupiter?

_____

Every 26 months Mars and Earth are in opposition and these times are selected for Mars launches. Why do you think we chose to investigate the surface of Mars before the surface of Jupiter? List your answers.

_____

_____

_____

_____

Rockets and Range – Student Activity

Activity - Manned spacecraft or not

You are to create a PMI (Plus, Minus & Interesting) chart about manned spacecraft.