

The Trouble With Space...

You may have seen that on Saturday 30/5/20, a SpaceX vehicle was launched into space from a NASA facility. This was the first launch from the US for 9 years. The Dragon Capsule docked with the ISS (International Space Station) with three astronauts on board.

Your task is to research three Scientific areas to do with space and life on the ISS. Each is tied to a strand of Science (Biology, Chemistry and Physics).

Biology and Space

Please research the following areas:

1. The effect of weightlessness on the human body.

Include:

- Brain
- Dizziness
- Bones

Use these resources to help you:

http://www.esa.int/ESA_Multimedia/Videos/2016/06/Tim_Peake_s_dizziness_experiment

<https://www.wired.co.uk/article/tim-peake-experiments-in-space>

<https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/The.Brain.in.Space.html>

2. Muscle mass in space. Research what happens to your muscles in weightlessness and why. Please include how to counter these issues, what do astronauts do on the ISS? You can use these resources to help you, and find your own if you want.

https://www.nasa.gov/pdf/64249main_ffs_factsheets_hbp_atrophy.pdf

<https://www.universetoday.com/142555/new-ideas-to-reduce-muscle-loss-during-spaceflight/>

<https://www.innerbody.com/image/musfov.html>

Chemistry and Space

Please research the following areas:

1. How vital resources are recycled and waste is disposed on the ISS

Include:

- Air
- Water
- Waste disposal

Use the following resources along with your own to help

<https://www.youtube.com/watch?v=W-2Rlnnf2sw>

<https://www.youtube.com/watch?v=aRpquuToJgY>

<https://www.youtube.com/watch?v=P4yZ6i8Vpig>

<https://www.youtube.com/watch?v=0xI6coAS85c>

2. How composite materials have influenced space rocket design

Include:

- What a composite material is
- How composite materials are used in aircraft and space rockets

Use the following video and your own knowledge and research about composite materials

<https://www.youtube.com/watch?v=tZhH2B-EI1I>

Dragon control simulator game:

<https://iss-sim.spacex.com/>

Physics and Space

<https://lab.nstmf.org/gravity>

For a rocket to launch, the thrust acting upwards must overcome the weight acting downwards so that there is a resultant upward force. This means that engineers and physicists must finely tune the forces to make sure that the rocket will move upwards safely.

In this activity, you will look at how changing the mass, thrust and thrust time affect the height reached by a rocket after launch. You will consider the effect of drag (air resistance) and whether the reducing mass due to fuel use affects the height reached.

Open up this website and follow the instructions below.

<https://www.sciencelearn.org.nz/resources/407-rocket-launch-challenge>



For students – Analysing rocket launches

Activity 1: Use the rocket launch simulation to make a rocket go as high as possible

Leave drag and mass change switched off and change values for the first three columns to try to get each rocket flying as high as possible.

1. Changing thrust.

Launch settings					Launch results	
Mass of rocket (kg)	Thrust (N)	Time of thrust (s)	Drag	Mass change	Height reached (m)	Maximum speed (m/s)
8,000	100,000	100	OFF	OFF		
8,000	130,000	100	OFF	OFF		
8,000	160,000	100	OFF	OFF		

Challenge: For a 8,000 kg rocket and a thrust time of 100 s, what thrust makes the rocket reach a height of 69 km? Answer: Thrust = _____ N

2. Changing time of thrust.

Launch settings					Launch results	
Mass of rocket (kg)	Thrust (N)	Time of thrust (s)	Drag	Mass change	Height reached (m)	Maximum speed (m/s)
8,000	130,000	60	OFF	OFF		
8,000	130,000	100	OFF	OFF		
8,000	130,000	140	OFF	OFF		

Challenge: For a 8,000 kg rocket and a thrust of 130,000 N, what thrust time makes the rocket reach a height of 34 km? Answer: Thrust time = _____ s

3. Changing mass.

Launch settings					Launch results	
Mass of rocket (kg)	Thrust	Time of thrust (s)	Drag	Mass change	Height reached (m)	Maximum speed (m/s)

	(N)					
6,000	130,000	100	OFF	OFF		
8,000	130,000	100	OFF	OFF		
10,000	130,000	100	OFF	OFF		

Challenge: For a thrust of 130,000 N and a thrust time of 100 s, what rocket mass makes the rocket reach a height of 220 km? Answer: mass = _____ kg

4. Find the maximum height you can reach for each rocket.

Launch settings					Launch results	
Mass of rocket (kg)	Thrust (N)	Time of thrust (s)	Drag	Mass change	Height reached (m)	Maximum speed (m/s)
12,000			OFF	OFF		
10,000			OFF	OFF		
8,000			OFF	OFF		
6,000			OFF	OFF		
4,000			OFF	OFF		

5. What was your highest distance? _____ km

6. What did you do to make your rocket travel higher?

7. Using your results above, what three things can be done to make a rocket go faster and higher?

- The **mass** of the rocket can be increased/decreased
- The **thrust** can be increased/decreased
- The **time of the thrust** can be increased/decreased

8. What happens to the **speed** of the rocket while the engine is creating thrust?

- The **speed** of the rocket increases/decreases/stays the same

9. When is the speed of the rocket at its fastest?

10. What happens to the speed of the rocket when the engine has finished producing thrust?

- The **speed** of the rocket increases/decreases/stays the same

11. Why does a rocket keep moving upwards even after the thrust has finished?

12. What is the minimum thrust needed to launch each of the following rocket masses?

Mass of rocket (kg)	12,000	10,000	8,000	6,000	4,000
Minimum thrust (N)					

13. Why does a rocket with more mass need more thrust to launch it?

Activity 2: How does drag influence the height reached by a rocket?

Drag is the air resistance that opposes the motion of a rocket. There is always drag as an object moves through the air

14. For each of the following, record results for a rocket if there was no drag acting (ideal world) and then compare the results when drag is switched on (real world).

Launch settings					Launch results	
Mass of rocket (kg)	Thrust (N)	Time of thrust (s)	Drag	Mass change	Height reached (m)	Maximum speed (m/s)
8,000	160,000	100	OFF	OFF		
4,000	80,000	100	OFF	OFF		

2,000	40,000	100	OFF	OFF		
8,000	160,000	100	ON	OFF		
4,000	80,000	100	ON	OFF		
2,000	40,000	100	ON	OFF		

15. Which rocket was affected the most by drag?

Activity 3: How does the loss of mass from the rocket engine affect motion?

Launch settings					Launch results	
Mass of rocket (kg)	Thrust (N)	Time of thrust (s)	Drag	Mass change	Height reached (m)	Maximum speed (m/s)
8,000	140,000	100	OFF	OFF		
8,000	140,000	100	OFF	ON		

16. How does the rocket's motion change when mass change is switched on?

17. With drag and mass change both switched on what is the greatest height you can reach with any combination of launch settings? This is the simulation's ultimate challenge.

Note that the simulation will not allow you to choose the smallest mass and the greatest thrust for the greatest time. As you increase the thrust, the minimum rocket mass also increases. Also, some setting combinations produce great stresses on the rocket during flight and it will explode. This is most embarrassing and very costly. Choose carefully.

Launch settings					Launch results	
Mass of rocket (kg)	Thrust (N)	Time of thrust (s)	Drag	Mass change	Height reached (m)	Maximum speed (m/s)
			ON	ON		

