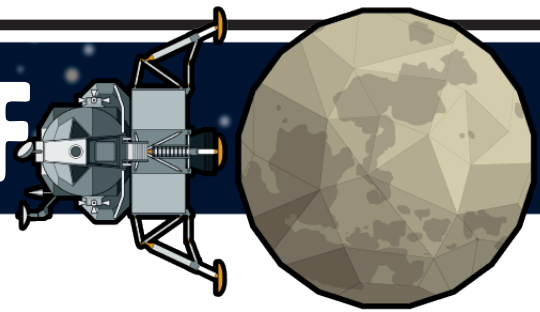# 14.2 LUNAR LIFT OFF

This is the very last time a human was on the Moon. When Apollo 17 blasted off from the surface, it left in an explosion of bolts! These bolts had to fire to separate the LEM (Lunar Excursion Module) from the descent stage below it. The decent stage was left on the Moon and can still be seen in high resolution images like the one on the right taken by the Lunar Reconnaissance Orbiter.

The video shows the LEM lift off slowed down to 1/10 normal speed. The sequence is shown below:

Challenger Descent Stage
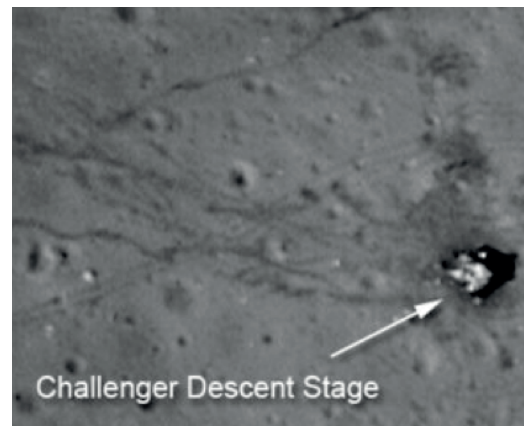
What is the camera doing during this lift off?   **How can you tell?**

After taking this effect into account, the relative position of the LEM over time has been mapped out.

Calculate the average speed of the LEM for each time interval: MEASURE FROM THE BOTTOM OF THE ASCENT STAGE.

4 seconds

3 seconds

2 seconds

1 second

0 seconds
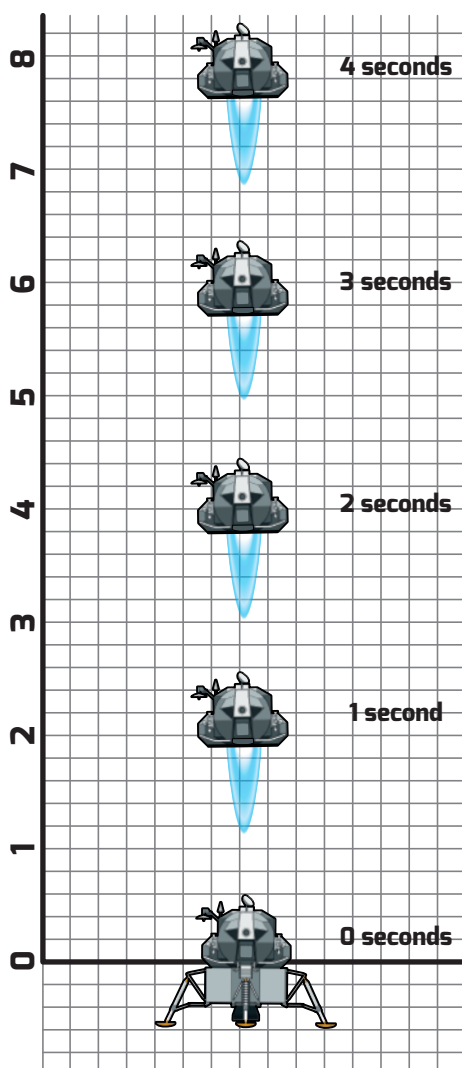
Time interval	Distance travelled (m)	Average speed
0-1 s		
1-2 s		
2-3 s		
3-4 s		

Example calculation for first row:
0-1s the bottom of the LEM is on 1.9m so height gained = final-original = 1.9 m – 0 m = 1.9 m.

$$speed = \frac{distance}{time} = \frac{1.9}{1} = 1.9 \ m/s$$

What do your results tell you about how the LEM was moving over this time frame?

How do you think this speed would differ if the same force was used to propel the LEM from the surface of the Earth? Explain your answer.