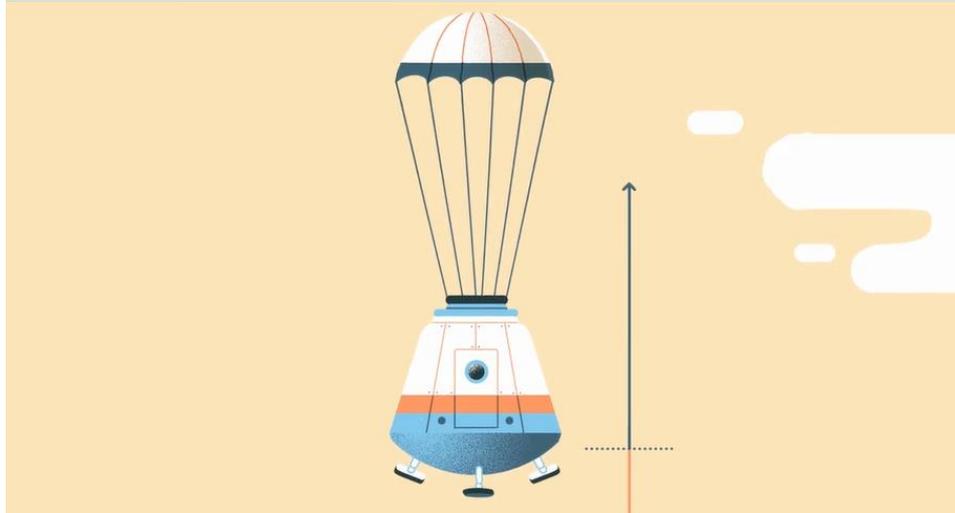


Forces on a Space Probe

Key Stage 4

Topics covered: weight, air resistance, force, velocity, acceleration, balanced and unbalanced forces

Watch the video "Newton's Laws of Motion", <https://vimeo.com/159043081>



After travelling 8 months through the Solar System to get to Mars, NASA's Curiosity rover experienced changing forces as it descended through the Martian atmosphere to land on the surface in August 2012.

Its descent consisted of a period of free fall followed by a parachuted descent and finally it used small thrusters to slow it down enough for it to land safely.

1. What two forces would be acting on a space probe as it descends down to Mars' surface?
2. For each of the following diagrams on the next page:
 - a) Label the forces
 - b) Describe the forces (balanced or unbalanced)
 - c) Describe the speed (speeding up, slowing down or at a constant speed)
 - d) Describe the acceleration (accelerating, decelerating or no acceleration / deceleration)

3. Conclusions:

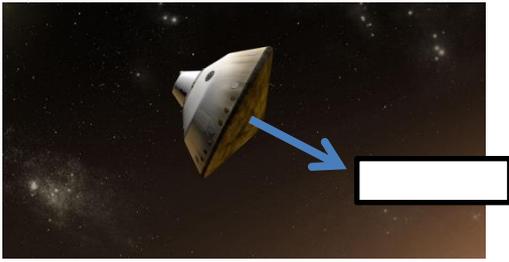
- a) **Newton's first law:** If the _____ are balanced, the object's speed will _____ and if the forces are unbalanced, the object's speed will _____ .
- b) **Newton's second law:** An object will _____ if the forces on it are _____ .

4. Thinking about forces and Newton's 3 laws, why was a parachute used to slow down the descent of the Curiosity rover as it fell to Mars?

Watch this video 'Curiosity's Seven Minutes of Terror' which shows the daring landing procedure of the probe onto the Martian surface.

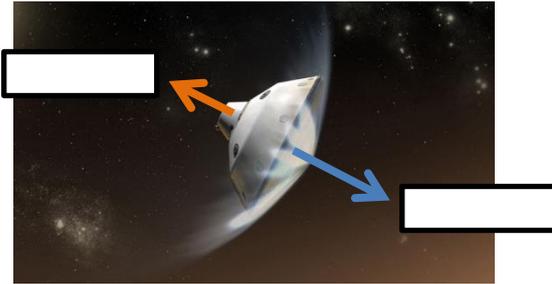
<http://www.jpl.nasa.gov/video/details.php?id=1090>

Pulled in by Mars' gravity from space



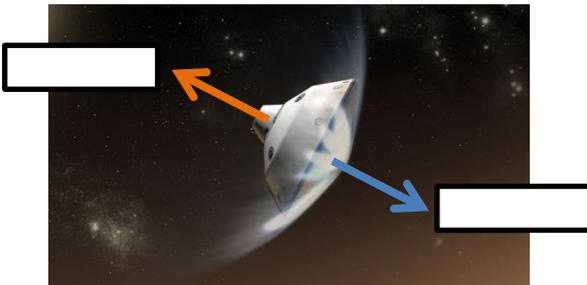
Description

Falling through Mars' atmosphere



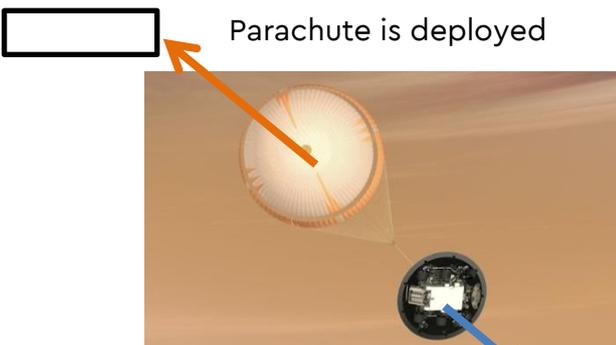
Description

Continues falling through Mars' atmosphere



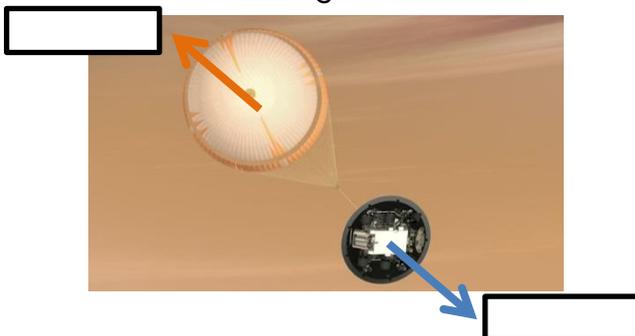
Description

Parachute is deployed



Description

Continues falling to Mars' surface



Description

Forces on a Space Probe: **ANSWERS**

Key Stage 4

1. Weight or gravity (acting downwards towards the planet's surface)
Air resistance or drag (acting upwards away from the planet's surface)
2. Blue arrow denotes the force of weight or gravity
Orange arrow denotes the force of air resistance or drag
Image 1 – unbalanced forces, speeding up, accelerating
Image 2 – unbalanced forces, speeding up, accelerating
Image 3 – balanced forces, constant speed (terminal velocity),
not accelerating or decelerating
Image 4 – unbalanced forces, slowing down, decelerating
Image 5 – balanced forces, constant speed (new terminal
velocity), not accelerating or decelerating
3. a) Forces, remain constant, change (speed up / slow down)
b) Accelerate or decelerate, unbalanced
Or the opposite - not accelerate or decelerate, balanced
4. By Newton's third law, the landing rover experiences an equal (in size) and opposite (in direction) force from the surface as a result of the impact force of the rover on the surface. By using a parachute, the speed of the rover upon impact is lowered; therefore the deceleration experienced as it hits the surface is lowered and so the force on the rover would also be lowered.