Space rockets

1

Lesson Plan

Teaching aims

To illustrate with reference to rocket engines the ideas:

- that forces are required to change the speed and momentum of an object

- force = mass x acceleration

- the principle of conservation of momentum in a straight line

- ion propulsion is a viable way of powering objects travelling through space

- energy transfers are involved.

Learning outcomes

All students should understand that a force is needed to change the speed or direction of a spacecraft and that the force can come either from chemical rockets or ion thrusters.

Most will also understand the changes in momentum and energies in a rocket launch.

Some will understand the advantages and disadvantages of ion propulsion.

Starter
Ask a student to stand with both feet on a skateboard. Ask the class what will happen when you the teacher throw a heavy object, for example a rucksack, which the student catches? Using 'think-pair-share' ask what will happen and why. Elicit ideas about forces, friction, momentum, energy transfer.
or
Show the picture and ask the students to decide on the best answer:

He/she will not move because there is too much friction

He/she will move backwards because of the force of the bag

He/she will move backwards because of conservation of momentum

Discuss ideas about forces, friction, momentum and energy. Elicit other examples of forces and momentum and ask the students to write down five other examples. These could include ice and roller skaters, firing a gun, rugby tackle, car crashes, bat and ball games, snooker, jet and rocket engines.

Main
Show the video clip of a rocket lift off. Ask the students to think about the forces, momentum and energy changes involved in a launch.

Show the lift off focussing on the forces involved - lift from engines, weight, air resistance increasing.

Repeat but this time focus on **momentum** and then the **energy changes.**

Explain that rocket engines are complex and use highly inflammable chemicals which can go badly wrong. Show the picture of the failure of an early Vanguard rocket in the US. Or show the 'Top Gear' replay of the launch of the Robin Reliant.

Class activity
Bubble powered rockets (about 20mins)
See separate sheet and template.
or
Choose an outside demonstration or activity such as water rockets, stomp rockets or commercially available chemical rocket kits.

Once a spacecraft has been launched the alternative to chemical fuel in space is ion propulsion.

Show the video clip of Karen Aplin explaining about ion drives and her work at RAL.

Plenary
How do the bubble powered rockets work? - make links to forces, momentum, energy transfers.

How does ion propulsion work? Are the forces, momentum and energy changes the same or different?

What are the advantages and disadvantages of chemical and ion propulsion?