STEMBOT

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Water rocket

Key words

-Rocket

-Presure

-Action / Reaction mecanism

-Physics

The science behind

Introduction :

In the Video,
We observe that by putting air into the rocket, the cap of the bottle comes out and the bottle takes off, expelling the water it contains.
But what is the reason for this?
The air in the bottle exerts more and more pressure on the walls of the bottle and also on the water in the bottle. When the air pressure on the water becomes too great, the cap on the bottle is ejected and the water quickly escapes. This makes the rocket take off. When the rocket has completely emptied itself, it returns to Earth. The physical principle used in the water rocket is the action/reaction principle.

History :

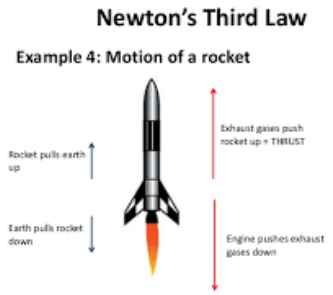
The principle of action-reaction was stated by Isaac Newton and is known as Newton's third law. He says:
If an object A exerts a force on object B, then object B must exert a force of equal magnitude and opposite direction back on object A.
This law represents a certain symmetry in nature: forces always occur in pairs, and one body cannot exert a force on another without experiencing a force itself.

Explanation of the phenomenon :

a) Newton third law

The rocket's mode of propulsion is due to the air initially contained in the tank. The principle uses the properties of air, which are its compressibility and elasticity.

The energy that we transfer from our biceps, after inflation, to the air contained in the bottle, will be used to eject the mass of water contained in the bottle (as well as the mass of compressed air). It is the downward ejection of a fluid that makes the vehicle move upwards.



Credit :jjcastronomy

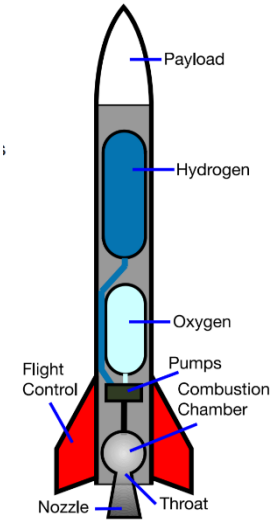
b) Pressure

When air is injected into the cylinder, the pressure inside the cylinder increases. The 'bar' is a unit measuring air pressure (1 bar is about 1 kg/cm2)
Higher pressure means more stored energy. This means that the amount of water in the bottle will come out faster and therefore the bottle will go faster and higher. There is a limit to the pressure in the bottle, we can't put more than 8 bar in a bottle, otherwise it might explode. In our example we can't choose when the cork expels, we need a more advanced launcher that prevents the cork from coming out of the bottle and a pump with which we have a pressure gauge to check the pressure.

Every day life

The water rocket uses the action-reaction principle, but many other objects around us also use it.

For Ariane rockets, it is the same phenomenon: the engine ejects gases at high speed towards the ground (this is the action) and, in reaction, the rocket undergoes a thrust in the opposite direction. It can then take off from the ground if this thrust is greater than its weight. Moreover, this mode of operation works just as well in the atmosphere as in a vacuum (we speak of anaerobic propulsion, i.e. without air) and the propulsion is all the stronger as the flow rate (mass of gas ejected each second) and the speed of gas ejection are high.
To produce these gases, each stage of the rocket carries its own fuel and oxidiser, which burn together in a combustion chamber; the gases are then accelerated by expansion in a nozzle. The higher the pressure and temperature of combustion, the higher the ejection speed. This is one and a half times higher in cryogenic engines (using hydrogen and liquid oxygen) than in conventional engines (using solid propulsion).
Airplanes fly by generating lift through their wings; similarly, helicopters also need lift to fly and hover in the air. In the latter, rotors (or blades) achieve this impressive feat. The rotors push air downwards, allowing the chopper to move upwards against the force of gravity.



Credit : fjalonso.blogspot.com

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