

Water rocket with automatic parachute

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Principles of operation

- **Water is the reaction mass, air stores energy in the form of pressure**

Predicted reached altitude [1]

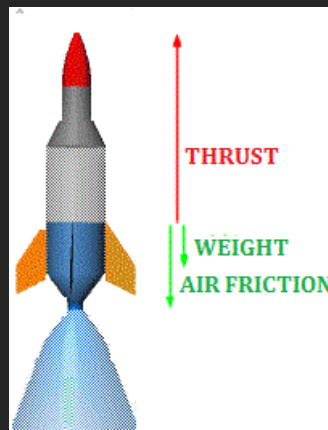
$$h = \left(\frac{M_i}{M_r}\right)^2 \cdot \left(\frac{P_i}{\rho g}\right)$$

h: predicted height
M_i: mass of water
M_r: mass of rocket + water
P_i: applied pressure (4,1bar)
ρ: density of water
g: gravity acceleration

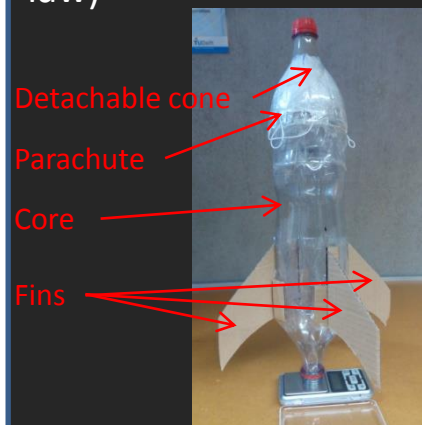
Up to 34 m with 1 l of water

- The vessel is initially pressurized to **4.1 bars**

- When the cap is removed the water jet thrusts the rocket upwards. (Newton 3rd law)

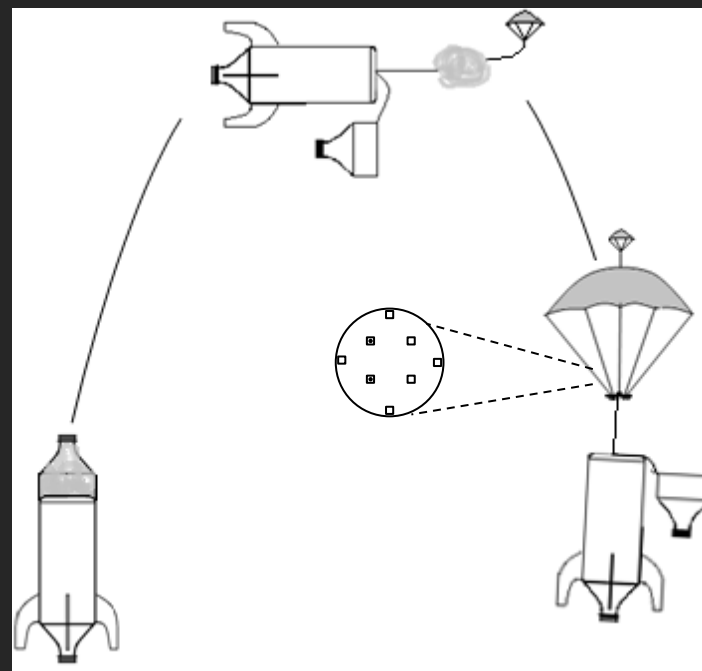


4 fins ensure stability during the initial phase, when the centre of mass is lower due to the presence of water.



Innovation

- The parachute is stored in the detachable loose nosecone
- Gravity, inertia and air drag secure the cone to the rocket
- At the top of the parabolic motion separation occurs due to gravity and parachute is exposed
- A **small guidance parachute** ensures full deployment of primary chute



Sustainability

- Approximately 90% of the used material is recycled
- Thanks to the paracute system the rocket is repeatedly launchable

Safety concerns

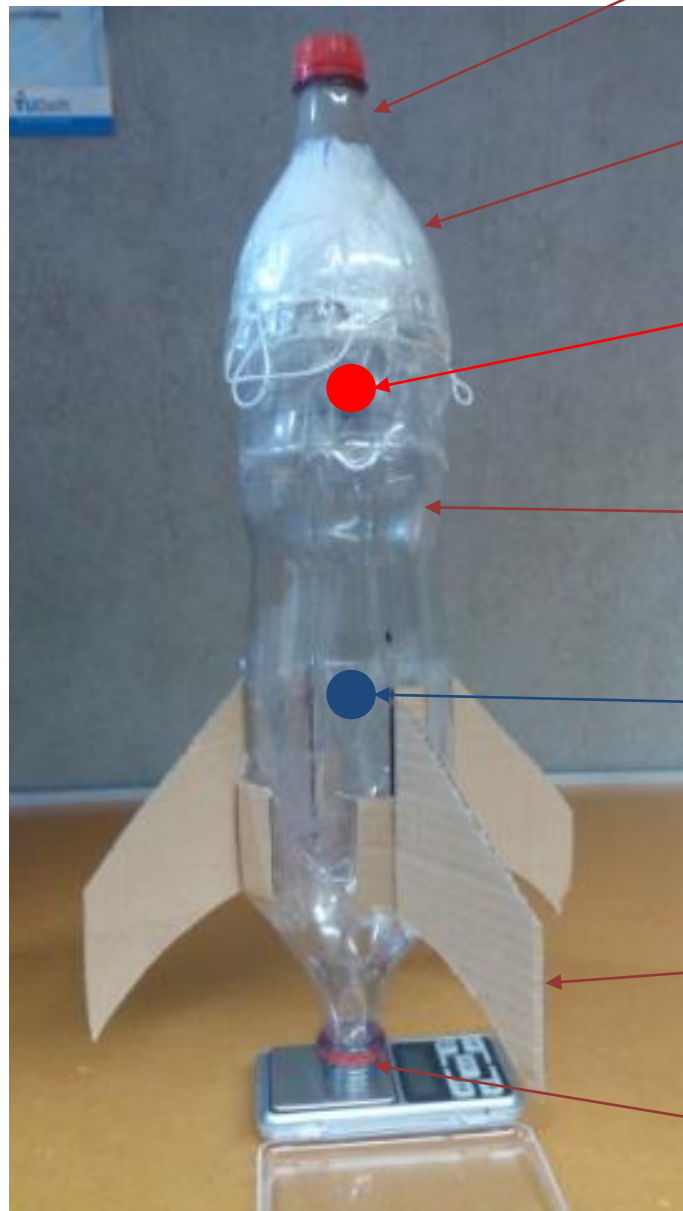
- Everything is attached to the bottle, no falling objects, the whole rocket comes back in one piece
- The rocket uses a paracute therefore it falls down slowly, the landing spot is visible in advance
- No hard materials
- The bottle's structure is certified to holding the required pressure.

References

- [1] Schultz, William W. "ME 495 Winter 2012 Lecture"

Fully assembled structure

Empty weight: 131.8 g



Clay weight for stability during ascending

Detachable nosecone containing parachute

Centre of mass

Pressurized water vessel : can sustain up to 4.1 bars pressure

Centre of pressure

Fins for aerodynamic stability during initial acceleration stage

Nozzle