



NPL Water Rocket Challenge 2019

Date: Wednesday 19th June 2019

Venue: National Physical Laboratory sports ground, TW11 0EB

The Challenge

The aim is to launch a rocket powered by water/air pressure and land it in designated target zones, whilst trying to earn additional bonus points by time of flight. Your score will be your time in the air plus bonus seconds gained from landing in target zones. People have tried using parachutes to achieve long flight times and whilst there will be a prize for the longest time in the air; these rockets tend to get caught by the wind and land outside the scoring zone resulting in a null score.

	Equipment check from	Launch starts	Awards	End
Schools Only	11:30	12:30	15:15	15:30
Open Competition*	18:00	18:30	20:15	20:30

*For families, friends, colleges, universities, apprentices, youth clubs, NPL staff or anyone wishing to enter.

Registration will be online at www.npl.co.uk/wrc

- Teams are limited to 6 people; an adult **must** accompany and is responsible for each team, **no under 6's allowed in teams and launch bays.**
- Space permitting, more than one team may be allowed per school, though with the high demand for places, schools often run an internal selection competition or enter the Open event to guarantee a place.
- Those unable to gather a team or make a rocket before the event **may join our workshop** where, from 18:00, individuals or groups can make a water rocket under the supervision of an NPL science ambassador; then join in with launching from 18:30. **'Workshop Preregistration' is required**, as there are limited places.
- Eggstra-challenge: fire and land your rocket with an egg payload (provided by us) intact.

Entry Fees: £30 per team (afternoon and evening), **£100 per Apprentice team, £5 per workshop rocket** is payable on registration with proceeds going to The Shooting Star Children's Hospice: www.shootingstarchase.org.uk

Prizes: First, second & third prizes will be awarded for the afternoon and evening challenges with no age categories. Several additional prizes will be awarded for things like: **Best Apprentice team Entrant**, Most Interesting Rocket, Best Team Uniform, Best Team Banner (to be no more than 1 m wide), Best Engineering, etc.

Refreshments: In the afternoon schools event food is not provided, so bring your own packed lunches as there are no nearby shops. We will provide squash and water during the event free of charge. In the evening, snacks, refreshments and hot food will be available to purchase from our Sports Pavilion.

Water rockets are fun and easy to make

For construction details, examples of launchers, photographs, scores and videos from previous years, and more information check out our web site: www.npl.co.uk/wrc

Weather?

Unpredictability of weather means launch decisions may be left until the launch hour! If you arrive and strong winds, heavy rain or lightning impede launching, we have storm shelter and under cover activities.

Why not invite your friends along to watch the event?

For child protection reasons, in the afternoon, no parent spectators other than team helpers are permitted. Spectators are welcome at the evening open competition (£2 entry fee) and all money raised goes towards our chosen charity, The Shooting Star Children's Hospice: www.shootingstarchase.org.uk



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Rules are to keep everyone safe, but not prevent innovative and imaginative solutions.

The Challenge

You are required to construct a rocket (or rockets) and launching system to compete against other teams within the constraints below.

Your Equipment

- Competitors bring their own rockets, launchers and team. NPL provides no equipment!
- All energy given to the rocket must only come from the water/air pressure combination. No other source of energy is allowed. You can only compress air manually, with a foot or bicycle pump.
- No external metal parts are allowed on the rocket, but are allowed on the launch mechanism.
- You are only allowed to use plastic bottles specifically designed for holding pressure, or that have been pressure tested (for example carbonated drink bottles). Please do not re-use bottles from previous competitions as they are likely to explode.
- Your launch apparatus must be secure and must be able to robustly control the rocket's flight direction.
- **No glass or sharp objects to be used in/on the rocket.**
- Particular care must be taken so that the rocket's launch direction is not changed when the launch mechanism is released. This means, that handheld launches, systems requiring human support, or launches guided by flexible wire rods will not be allowed.
- In previous years some people just relied on a simple wire loop to align their launch. These cannot control launch direction so will not be permitted.
- You will need a launcher capable of launching a rocket at a variable vertical angle of up to 60° to the horizontal. The maximum launch angle will be decided on the day. You may launch at angles less than the maximum.
- If your rocket has fixed wings then a maximum variable launch angle of 30° to the horizontal is allowed. The maximum launch angle will be decided on the day.
- Multistage rockets are permitted, so long as the 'scoring' part is labelled by NPL prior to launch.
- If you are not sure your rocket or launcher will pass the safety inspection, please contact us in advance at waterrockets@npl.co.uk
- No free-standing laboratory clamp stands allowed for supporting launchers.

The Competition Day

- No under 6's allowed in the launch bays.
- When you arrive and have checked in at the registration tent, your launch apparatus and all rockets will be safety checked. Judges can disqualify any equipment considered unsafe.
- You **must** use all safety equipment provided on the day (eyewear and ear protectors).
- There will be three rounds. You may bring more than three rockets, but only the **first** rocket launched (which will be labelled by us) in each round will count towards your total score.
- The duration of each round is normally 30 minutes, but please listen for details on the day. When you are ready to launch, alert a marshal and they will tell you if it is safe and will time your flight. If you cannot fire within the time allocated for the round, your score for that round will be zero.
- Your team will be assigned a marshal who will inform you of the correct launching elevation angle and indicate permissible directions of flight. As soon as your rocket leaves the launcher the marshal will start the stopwatch, and will stop the watch when the labelled part of the rocket touches the ground, a tree, a building or goes out of sight. The Marshall's timing is the official value. You will not be disqualified if small parts of the rocket come off and land early inside or outside the landing zone, but it will be at the marshal's discretion to decide which is the largest part of the rocket.
- Rockets shall be launched from the firing line towards the landing zone. The landing zone is a large grassed area 200 m by 200 m, adjacent to the firing line containing bonus zones. For your safety please do not walk into this area unless it has been announced that it is safe to do so.
- Bonus seconds will be awarded according to this table:

Zone	Bonus seconds	* Distance from firing line /m	Depth of bonus zone /m	* So zone A starts 50 metres from the firing line and finishes 65 metres from the firing line.
A	15	50	15	
B	30	65	10	
C	20	75	15	



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- You must ensure the label provided is attached to your rocket for each round so that rockets can be identified and awarded bonus seconds according to the zone they land in.
- For safety's sake any fast falling rockets **must** land in the landing zone or you will get no points for that round. If soft-landing rockets (e.g. rockets with parachutes) land outside the landing zone their time will be counted for the *longest time in the air* award.

The following map isn't necessarily to scale.



Tips

Download our water rockets and launcher designs booklets in the resources section of www.npl.co.uk/wrc

Bring along more than just one rocket, and/or means of carrying out running repairs – you may have to repair rockets between rounds.

Do test your rocket out before you come to the event, there is nothing more disappointing than finding your rocket doesn't work on the day. You might want to have several designs to try out. You can use a different rocket for each round if you wish. Remember it could be windy, this might be an advantage, but **remember you must fire away from the crowd and land in the landing zone.**

It is recommended that you only use plastic bottles and containers that have been designed to store carbonated drinks; these will be able to withstand the pressure. We have regularly pumped these up to pressures of over 120 psi (7 bar) without failures, but remember they might fail, so eye and ear protection is advisable.

Do not use glass bottles or plastic bottles designed for still water.

Do not use bottles more than 6 months old (previous year's rockets have exploded!).

Be careful that in building your rocket you don't weaken the plastic bottle with glues, solvents, paints etc.

Try pressure testing your rocket full of water, this means if it fails you only get wet!