



National Physical Laboratory

## NPL Water Rocket Challenge 2012

**Date:** Wednesday 20th June 2012

**Venue:** National Physical Laboratory, TW11 0LW

### The Competition

The aim is to launch a rocket powered by water/air pressure and see how long you can keep it in the air, whilst trying to earn additional bonus seconds by landing it in designated target zones. Your score will be your time in the air plus any bonus seconds gained. There will be a prize for the longest time in the air but the object of the competition is to have the highest score. You can find more details in the rules. (Changes from 2011 are marked in red.)

There will be two separate competitions; one for **schools only** (event venue open for equipment checking from 12.30pm, event starts 13:30 and ends 16:30) and an **open competition** (from 6pm until 9pm), for colleges, universities, businesses, youth clubs, NPL staff or anyone who wishes to enter!

**Registration** will be online at <http://www.npl.co.uk/waterrockets/>

- Teams are limited to 6 people; an adult **must** accompany and is responsible for each team.
- For the schools event, priority will be given to one team per school. If space permits, more than one team may be allowed. However there is usually a high demand for places, so schools may like to run an internal selection competition or consider entering the Open event to guarantee a place.
- Maybe you are not able to get a team together or make a rocket before the event, then why not join one of our workshops on the night? Individuals or groups can come along at 6pm and make a water rocket under the supervision of an NPL science ambassador; then join in with launching rockets for the second and third rounds of the competition. Registration is required, as there will be limited places available.
- Special eggstra-challenge: fire and land a rocket with an egg payload intact. See separate sheet for details.

### Entry Fee

The £25 entry fee per team (or £5 per person for the workshop) is payable on application and is donated to The Shooting Star Children's Hospice, based in Hampton, Middlesex.

[www.shootingstar.org.uk](http://www.shootingstar.org.uk)

### Prizes

First, second & third prizes will be awarded for the afternoon and evening challenges, however there will be no age categories. Several additional prizes will be awarded for **Most Interesting Rocket**, Best Team Uniform, Best Team banner (to be no more than 1m wide), Best Engineering, etc.

### Refreshments

Snacks, refreshments and hot food will be available to purchase from our Sports Pavilion.

Only competing schools team members will be given vouchers entitling them to a free snack in the afternoon event.

Water rockets are fun and easy to make - for construction details, photographs, scores and videos from last year, and more information check out the web site: [www.npl.co.uk/waterrockets](http://www.npl.co.uk/waterrockets)

Why not invite your friends along to watch the event? All **spectators** are welcome at the open competition (£2 entry fee) and all money raised goes towards our chosen charity, The Shooting Star Children's Hospice ([www.shootingstar.org.uk](http://www.shootingstar.org.uk))

# RULES (Page 1/2)

These rules are intended 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. (Changes from 2011 are marked in red.)

## Your 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.
- 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 can launch at angles less than the maximum if you wish.
- 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](mailto:waterrockets@npl.co.uk)
- No free-standing laboratory clamp stands allowed for supporting launchers.

## The Competition Day

- 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. Scores from each will be added together to give a total score. You may bring more than three rockets, but only the **first** rocket launched, which will be labelled on the day, 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. 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
A	15	50	15
B	30	65	10
C	20	75	15

\* So zone A starts 50 metres from the firing line and finishes 65 metres from the firing line.

# RULES (Page 2/2)

- 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

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!

You can download a copy of our water rockets teachers' guide at: [www.npl.co.uk/waterrockets](http://www.npl.co.uk/waterrockets)