Space Universities Network
Supporting the Space Higher Education Community

CASE STUDY

Title

Water Rocket Competition – University of Bristol

Summary

Based on a suggestion by Kingston University London, who run this as a curricular competition, Bristol SEDS ran a water rocket competition in October 2017 with the aim to have multiple teams competing to design and build water rockets. 5 teams of 3-4 students competed, each producing a design and building a rocket to carry an egg payload and then launched their rockets, once on a test launch day and once again being judged on competition day.

Figure 1: Bristol SEDS teams get ready to launch their rockets on the (v cold) competition day

Aims/Objectives

The water rocket competition was aimed to start off the new year of activities for Bristol SEDS and to retain new members with an engaging and immediate activity. The teams would have to be able to design, build and launch and recover their rocket carrying an egg payload and achieve the highest possible altitude, and perform both these tasks repeatably. The objective was to have fun, develop team work, design iteration and manufacturing skills and make space exciting.

What was the context / background?

The simplicity of the competition and the abundance of resources available online for the building of water rockets made this an easy choice for an activity to introduce the new year of society recruits. It offered the chance for all members ranging from experienced in space engineering challenges to the newer members to get a feel for rocketry and design in a simple easy and low-cost way. The project was inspired by the work done in **Kingston University London** where water rocket design is integrated into the course structure of the undergraduate Space Engineering course.

How was it organised and who was involved?

The process for organising the competition was:

- Present project to society, organise teams, hand out documentation on how to build water rockets (http://www.npl.co.uk/upload/pdf/wr_booklet_print.pdf)
- Provide resources / set maximum budget that teams can use for buying resources
- Run workshop / assistance sessions twice a week
- Run a test launch weekend
- Run final launch weekend
- Judge competition
- Run final presentation session showing winning team and feedback

What resources did you need?

Equipment:

Full-bore rocket launcher £35 inc p&p from company 'rocket fun': http://rocket-fun.com/products.html

http://rocket-fun.com/PDF%20Files/Fixed%20Base%20Multi%20Angle%20Laucher%20Info%20Pack.pdf

2L soft drink bottles x5

Cardboard for fins and nose cone

12 inch Parachutes x2 approx £9 each : https://www.modelrockets.co.uk/shop/parachutes/12-inch-thin-mil-nylon-parachute-p-3269.html

Optional: altimeter to measure height: pnut https://www.modelrockets.co.uk/shop/recovery-hardware-electronics/pnut-altimeter-logger-ukroc-approved-p-3482.html?osCsid=apqtvndaab5bisan7fac46fot5 £69.99
Also requires data cable: http://www.rocketsandthings.com/view/product/342/ £25.50

Total £60 (all equipment reuseable) not including altimeter.

Commented [LB1]: link

Describe the activity

A water rocket is a simple and safe way of demonstrating the principles behind rocket propulsion. The competition aimed to get teams of students to design the nose cone, tail fins and use a pressure vessel, mainly a 2-litre fizzy drink bottle. The rocket is partly filled with water and pressurised using a pump while attached to a launch tube. Once ready for lift-off, a launch pin is pulled out from the launch tube and the rocket is propelled into the air. The rocket has a parachute that will deploy at max altitude and allow the rocket to be recovered. The rocket would also have to have a compartment or area where an egg 'test' payload will be stored during launch and recovery to test the safety of the rocket.

The teams were given basic materials like cardboard and a 2-litre bottle to make the water rocket but were encouraged to obtain more materials and were given a maximum budget of £20 that they could use for this project, £10 of which would be reimbursed by the society. The teams were then given time over 4 weeks to design their rockets using this documentation:

http://rocket-fun.com/PDF%20Files/Fixed%20Base%20Multi%20Angle%20Laucher%20Info%20Pack.pdf

as a basis and were encouraged to experiment with different ideas and to be creative.

The teams met twice a week with the committee to oversee the projects and to assist any problems as well as helping the teams with building in the university workshops. Some teams opted for 3D printed parts and/or experimenting with alternative propellants like carbonated drinks as well as multiple stages.

A chance to test their rockets was given the week before launch. This allowed the teams to refine their design which also showed that getting the parachutes to deploy correctly was tricky.

Figure 2: Images of the parachute, the egg payload and the rocket on the fullbore launcher

The final launch weekend followed a week after the test launch where all teams took turns launching their rockets. The most successful team was that which launched and landed with no damage to the egg, whilst achieving the highest altitude.

Figure 3: Image of one of the teams assembling their rocket on the launcher

Has it been evaluated? What feedback have you had?

All teams said they enjoyed the activity. Some teams would have preferred more guidance in deploying the parachute. The activity inspired most students to return to future activities with the society.

Key Learning Points

More guidance with how to deploy the parachute will be required in the future. Use of guides available online can be incorporated into the competition: http://txsnapper.eezway.org/waterrocketguy/ezd.html. The competition could be made more challenging if the rockets were required to use staging, a height-triggered parachute deployment and by including an altimeter. Guides for building multistage water rockets are available online: http://www.instructables.com/id/Professional-water-rocket-guide/

The launch site needed to be away from the public for health and safety. Weather is always an issue in October/November in the UK! Dealing with wind blowing away the rockets made recovery challenging at times. By the end of the competition deployment of the parachute was better understood which will be useful in future iterations.

Adapting this to a bigger group would require more resources in terms of more cardboard for fins and more 2 litre bottles. This activity could be shrunk to a weekend activity, where on the first day the teams can race to build their rockets after a lecture on the basics of the rocket principles and the next day can be dedicated to launching the rockets where the rocket with the highest altitude that lands safely will be the winner.

Thematic Categories (tick any that apply to your case study)

Method		Topic	
Online Text and Notes	☐	Orbits and Trajectories	☐
Assessment Materials	☐	Rocket Propulsion	x☐
Video and Audio Lectures	☐	AOCS/ADCS	☐
Lecture Slides	☐	Payloads	☐
Curricula	☐	Power	☐
Video and Audio Clips	☐	Communications	☐
Recommended textbooks	☐	On Board Data Handling	☐
Useful software	☐	Systems	☐
Worksheets and Projects	☐	Mechanical	☐
Simulations	☐	Thermal	☐
Tutors' Guides	☐	Astronomy	☐
	☐	Earth Observation	☐
	☐	History of Spaceflight	☐
	☐	Other	x☐

Contact Details

Name of Organisation	Bristol-SEDS
Contact Name	Professor Lucy Berthoud
Email Address	Lucy.Berthoud@bristol.ac.uk
Links	http://www.bristol-seds.co.uk/water-rockets/2017/11/01/water-rockets-2017.html

Thanks to the University of Bristol for this case study.

The work to prepare this case study for SUN was funded by:

and