Aiming for the stars

David Wooff and Charles O'Brien
Edge Hill University

Over the summer of 2010 fifty-five students from across the North West of England descended on Edge Hill University to participate in a four-day residential summer school. The event was organised under the auspices of the 'Aimhigher' initiative, which has been well established at Edge Hill for a number of years. For those unfamiliar with 'Aimhigher', it seeks to raise aspirations and motivation to enter Higher Education amongst young people from under-represented groups. It is also intended to raise attainment of potential higher education students, strengthen progression routes via vocational courses and improve the aspirations and self-esteem of talented young people.

STEM

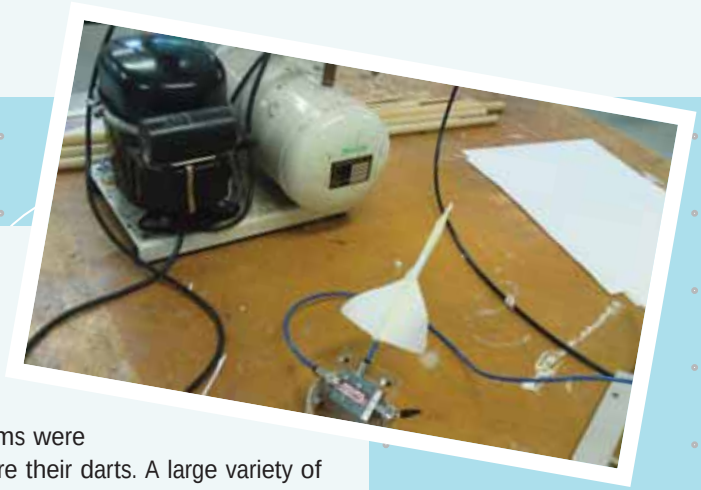
The Aimhigher team at the university works with students in Year 7 to Year 13, in schools primarily in Greater Merseyside and Lancashire but it also works with others from additional counties across the North West. In practice it delivers a tailored package of activities to inspire, raise aspirations and motivate the young people who take part. The students participating in this particular residential all undertook activities linked to Science, Technology, Engineering and Mathematics (STEM).

The programme for the residential course was full and varied with all participants spending various days undertaking lectures and workshops principally within the areas of Science and Design and Technology. These were supplemented by trips and activities associated with the theme of space travel and rockets including; visits to Jodrell Bank Centre for Astrophysics and a local planetarium accompanied by staff from the university.

Model rocket

Integral to the residential experience were two days in the design and technology department at the university. During which time participants undertook many design and technology activities across many areas of the subject which when combined lead to the building and assembly of a working model rocket.

Working in the department, students were initially split into groups concentrating on four different areas; aerodynamics and principles of flight, tail design and manufacture, parachute design and assembly and overall rocket assembly and construction.



Aerodynamics and principles of flight

Although given a heady title, this workshop was designed to help participants understand the necessity of tail fins on a rocket by means of manufacturing simple paper darts. These were then fired down the length of a workshop by using a small air compressor operating at low pressure. Following a discussion, teams were allowed to use A4 paper and masking tape in order to manufacture their darts. A large variety of paper planes, darts and small scale rockets were produced. Those which flew the furthest were a very snug fit onto the launching tube so all the compressed air was used to propel the paper dart forwards. Most models with arrangements of three or four fins proved to be stable in flight, whilst those with less than that tended to 'tumble' through the air. Team members then used this information to help them in their final designs for their fin arrangements on their real rockets.

Overall this was a highly enjoyable experience that all participants, and student ambassadors from within the university fully engaged with. In its own way, it became a mini competition with lines of masking tape being placed on the floor of the workshop to record the furthest flight. The 'winning' flight managed to gain a highly credible distance of seventeen metres, slightly longer than that achieved last year.

Tail design and manufacture

Prior to drawing the tail assembly, teams were supplied with a cardboard tube that would be used to form the body of the rocket. Using the information gained during the aerodynamic testing, and direct measurement of the rocket body tube, teams then designed fin arrangements and supporting rings, which were used to support a solid fuel rocket motor. All design work was undertaken on Techsoft 2D Design and the manufacturing of parts was by means of the department's laser cutter. Once cut out and assembled, the components of the tail assembly were secured using a strong two part adhesive, the final captive ring was held in place with three small screws, which enabled the rocket motors to be installed just prior to firing.

For many participants, this was the first time they had used Techsoft 2D Design to accurately design and manufacture components. Due to the mixed ability of the participants, some required lots of instruction to help them make progress whilst others were more than able to complete this part of the task by themselves.

Parachute design and manufacture

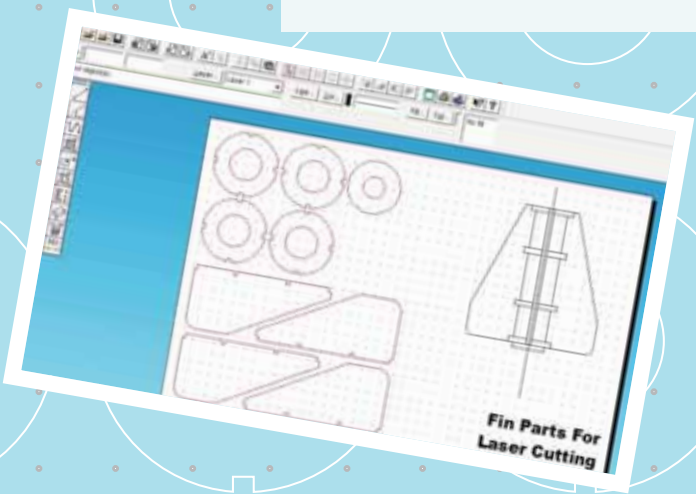
Team members also used lightweight fabric and sewing machines to manufacture parachutes to enable their rockets to slowly drift back down to earth once they had reached their maximum height during flight. Paper patterns were made so that participants could work out how the parts would fit together once assembled.

Overall rocket assembly

Use was made of the 3D rapid prototyping machine to manufacture the piston part and nose cone needed to complete the rocket assembly. These were first drawn and modelled in 3D on Solidworks software before being manufactured. Slots were cut into the tubes to house the fins and tail assembly and once located, these were glued in place. Two 40mm long pieces of small diameter acrylic tubing were also fixed to the side of the rocket to allow them to be attached to the launching tower to ensure a vertical liftoff. The 'piston' was then inserted into the rocket body and the parachute placed on top of that.

The piston was also manufactured on the rapid prototyping machine. The purpose of this part is to push the parachute out of the rocket body and enable it to be deployed to allow the rocket to slowly drift back to earth.

Finally, the nose cone was fitted and the rocket was ready to go. Teams were given the opportunity to paint their rockets and add embellishments of their choice, many did so and in some cases they used vinyl lettering to add their team name to their rockets.



Launch day

Launching of the rockets was left until the last day of the residential experience. On the day of the launch, family and friends had come to collect the participants and all gathered to watch the rockets blast off into the sky.

An area away from the main university buildings was selected and the launch tower positioned in such a way as to direct all rockets away from people, cars and buildings. After a few moments of fixing the solid fuel rocket motors into place and securing the fuse, the rockets were then wired up to the firing button.

Then came time for blast off…. Team's elected two people to launch the rockets and in front of their friends and peers, the fruits of their labours blasted off into the sky. With one exception, the rockets all glided safely down to earth allowing teams to retrieve them, at their leisure. It would be safe to say that the rockets all reached heights in excess of twenty-five metres at the height of their flights.

Following the firing of all rockets, participants assembled back in the design and technology department for a final debrief and conclusion to the experience. At this stage they were able to reflect on their experiences and draw from it many aspects which could be used in their future education and working lives; ability to work to a deadline, ability to work in teams, aspects of leadership and management and co-operation. Alongside these they also gained or enhanced their subject knowledge in many aspects within the subject of design and technology ranging from systems and control to textiles technology and resistant materials. ■

Implications for schools and the curriculum

The theme for the residential experience builds upon the highly successful work initially established a number of years ago by Charles O'Brien and his love of space exploration. The current lead technologist for the project; David Wooff, Senior Lecturer in Design and Technology, explains that all of the elements involved in the design and manufacture of the rockets can be undertaken in most secondary schools using equipment that they have available to them. He goes on to comment that the area of rocketeering covers links between many curricular areas including those covered under the auspices of STEM. However, the impact and potential to reach further afield into areas like business studies and citizenship where it is possible to debate the ethics and morals of space exploration particularly in light of the pressures put on the world's economies should also be considered.

In response to questions about the residential experience David comments: *"Without a doubt, the highlight of the experience for many of the participants was watching their rockets soaring high into the sky, and it was clear what a sense of pride and achievement they had in their work."*

Overall the whole event was a great success and the team at Edge Hill University is looking to build on the success of this year's event in order to make next year's even better for all of those fortunate enough to take part in it.