POSEIDON:

An innovative school oceanography project

A project at a Grammar School in the UK shows how to encourage school-aged pupils to become more engaged in oceanography. Lower sixth form English student **Daniel Emery** writes about building a working drift buoy

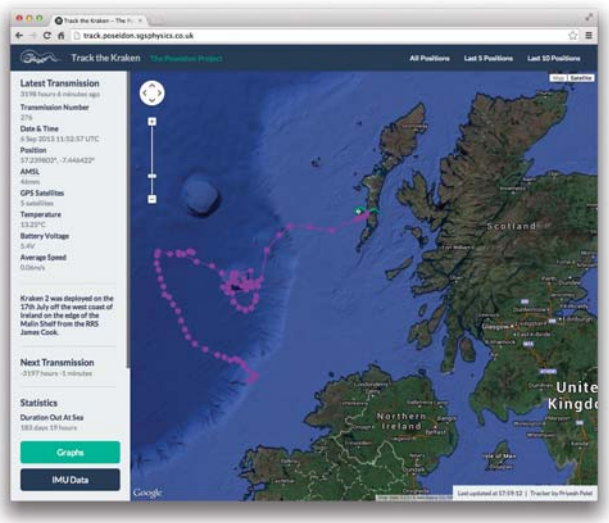
Pupils at Sutton Grammar School in South London have recently been given the opportunity to get involved directly in ocean science. The project, codenamed 'POSEIDON' (Pursuit Of Scientific Evidence Investigating Details of the Ocean Naviface), allowed them to build their own ocean buoy, which could be dropped into the sea to collect data and relay it back to the school.

Jamie Costello, head of physics at the school and originator of the project, explains why POSEIDON was created:

"We'd focused on tracking projects for several years and there was a danger students were not being challenged as much as they had been in earlier ventures. This year we wanted to go bigger and better and really stretch ourselves to create something we could be proud of."

A team to work on the buoy was assembled, with no shortage of volunteers. "I was already very involved in electronics at the school," explains Gregory Brooks, a year-11 student and key member of the team. "POSEIDON was a chance to work on a more advanced project than I was used to, though." The aim of the enterprise was for the pupils' work to be as independent as possible, with Costello and other members of staff teaching the team the basic knowledge required, and then stepping back to allow the more senior and experienced members of the team to lead the project. Similar ventures at the school over the previous few years had shown this 'hands off' approach to work. Previous projects had almost exclusively involved only the oldest pupils at the school, but it was decided that POSEIDON would be as universal as possible, with all years involved to some degree or another by becoming involved in various derivative clubs.

the poseidon project



Screenshot showing the route of Kraken II (track.poseidon.sgsphysics.co.uk)

The designing of the drift buoy – named the 'Kraken' by the team – required skills alien to both teacher and pupils alike. Although Costello understood the principles required to build the buoy, he readily admits that he is no expert in the field of oceanography. Outside help was needed. Entrance to the Rolls Royce science prize, which gives grants to school projects encouraging involvement in the sciences, was able to provide funding, with an initial grant of £1,000, with the sum being increased to £5,000 when it became a finalist of the competition.

From the outset, it was also clear that if the 'Kraken' were to support any kind of measurement systems, the issue of powering it was going to cause a few headaches. What system could be used in order to locate the buoy? A visit to the National Oceanography Centre in Southampton and a talk from Professor Gwyn Griffiths, knowledgeable in the design of drifters, was able to answer a number of questions, with Professor Karen Heywood – an oceanographer from the University of East Anglia – also providing invaluable advice.

Initial problems about how the outer casing of the buoy should be designed were quickly overcome thanks to Wiz Deas at Matrix Composite Materials Ltd, who helped the team to design a round, fibreglass shell that would house all of the electronics. Members of the team established a design group of those more interested in the materials rather than the electronics. A team member said, "I wasn't sure I would be able to keep up with the rest of the group on the electronics side of things, but really wanted to be involved in the project. In the end, building

the casing proved a lot more fun and challenging than I had thought!"

With very little involvement from teachers, the team of pupils fast grew in confidence and began researching ways in which issues could be overcome. An ingenious method for tracking the buoy was established, using a system of light sensors that could measure the relative length of night and day time, and therefore calculate where it was located geographically. The problem of how to power the buoy was solved with the discovery of a long-lasting battery.

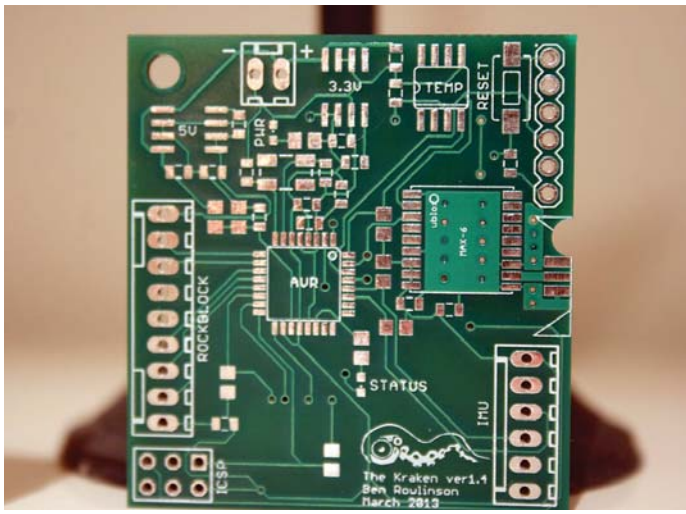
As the main project began to take form, offshoot electronics clubs were also set up. Each year the group, ranging from years 7 to 10 (older students being at work on the buoy itself) was given the opportunity to participate in an electronics club, with material relating to POSEIDON. As with the main project, the pupils were encouraged to take responsibility for the work they were doing. Once basic electronics skills had been learnt, it was left to the students to decide what they would do with them. Ideas for projects ranged from an electronic thermometer, which could be placed inside the Kraken, to an LED clock that would count down the seconds until the buoy's launch.

The Kraken in its development

Efforts were also made to interest others not directly involved in the project. Sweepstakes were organised at the school, with students placing pins in a map of the North Sea to indicate where they thought the buoy might end up. Participants would then be able to track its progress via an interactive map on the project website (the route the buoy took can be seen at track.poseidon.sgsphysics.co.uk). A visit to the houses of Parliament by the POSEIDON team provided an opportunity to publicise the project in the school's local newspaper. Links were also established with a local primary school, with lessons on oceanography being taught to the primary school pupils.

By April 2013, the main team had made good progress. After early difficulties, the Kraken

now had an outer shell, and was, thanks to the design team, painted in a suitably sea-monster-like fashion. The team would also now be able to receive messages from their creation as they finalised their method of tracking and communicating with the buoy: hooking themselves up to an iridium satellite network, via RockBLOCK, a small remote device that can send data via the satellite system – as described in the November 2013 issue of *Marine Scientist* by Rock Seven, the company which makes RockBLOCK. The week before the launch proved stressful as the team raced to compete the inner workings of their buoy in time. "There really was a point when I thought we weren't going to finish," says Daniel Saul, a senior member of the team. After frantic last minute work, all that remained was to combine machinery and case, with the electronics encased in a hard, waterproof foam inside the shell in order to protect them against the battering they would receive from the oceanic elements.



Kraken PCB. Kindly manufactured by Cambridge Circuit Co Ltd.

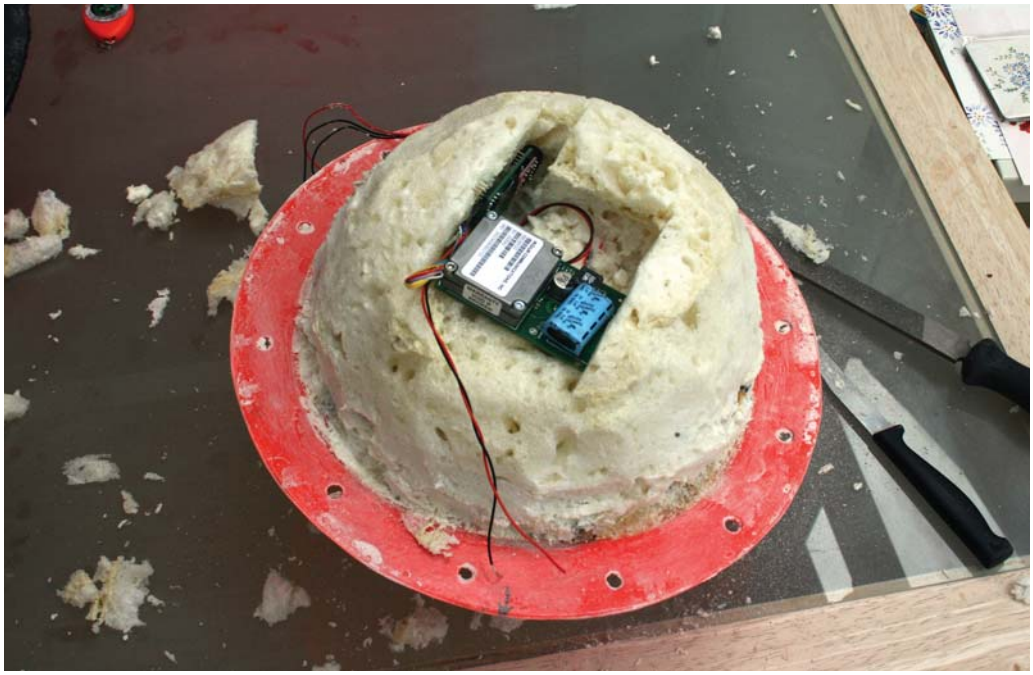
Launching Kraken off the East coast

The original plan had been to launch the Kraken from the coast of Scotland into the Atlantic, where it had the greatest chance of being pulled away from land and into the deep ocean – but doing so proved to be logistically impossible. The buoy would have to be launched from East Anglia, the irony of which was not lost on the team. POSEIDON's ancestor APEX, the first of the electronics projects Costello had run, had been a weather balloon. After initial success in the first few years of running the project, the balloon had been lost over the North Sea when it was caught up in strong winds after being launched not far from where the Kraken was to begin its own journey. Crashing into the ocean, the balloon appeared to have been lost until it was washed up and discovered on a Dutch beach. The question of how it had got there in the first place was what inspired the creation of a device capable of tracking the tides.

The pupils released the Kraken on 6 April 2013, in relatively calm weather. For many, the moment was one of pride and the highlight of their project. "Seeing the Kraken dropped into the sea made it feel like all of the hours of work we had put in had been for something," said Eddie Evans.

For the first few hours, all seemed well, as it drifted calmly out to sea. Very soon, however, strong winds and tides pushed the buoy back to shore, with it eventually making landfall a few days later on the English coast, where it was picked up by its understandably disappointed creators. They had hoped that the buoy would make it out into deeper seas and survive at least for a few weeks.

Determined not to fail, the team started work on a new model of the buoy. Excitingly, members of the Scottish Association for Marine Science (SAMS) – who had been in touch with the project for a while, having advised against launching from the Scottish coast in the first place – offered to launch the new buoy. This would be from the ship *RRS James Cook* that they would take on their expedition to the Malin Shelf. With this incentive, and the work they had done on the Kraken as a model, the team worked more quickly and efficiently than ever before, producing the Kraken Mark II – or 'Leviathan' – in just a couple of months. Delivered to Scotland and launched in August 2013, the buoy managed to travel from the edge of the Main Shelf off the West Coast of Ireland all the way to South Uist in the Outer Hebrides – a shorter distance than the team had perhaps been hoping for, but, nevertheless, one of which they could be proud.



Kraken II

"Collaboration with Professionals in the field was central to the success of the project," says Costello. "Not only were they on hand to offer technical advice and support but they were also able to steer the project in directions not previously considered by the team. Furthermore, we should not underestimate the impact working professionals have on excited young minds."

Marie Porter and Estelle Dumont, both of SAMS, gave freely of their time, turning the launch of Kraken II into a science drama broadcast on twitter. Earlier in the year, PhD Student Louise Biddle (UEA) came into the school to give the entire student body a brief look at her work. For many, this was the first piece of Oceanography they had ever experienced at school.

Not so for some lucky children at Mile end Primary Aberdeen. Dr Bee Berx, Marine Scotland, has also used the drifter idea to promote her work. As a STEM ambassador, Bee runs short sessions explaining basic drifter concepts. She then encourages schools to adopt a drifter of their own. Pupils can then track these independently. A fine example of subject promotion, sharing a passion for studying the seas.

Oceanography does not figure prominently in the UK's secondary science curriculum, being more likely to come up in geography. The existence of a project, where the construction of a device such as those built, is a novel concept in most secondary schools. Schemes such as POSEIDON widen the horizons

of pupils and challenge those who are able and willing to be stretched. The science curriculum often pushes pupils towards a limited range of career paths: medicine, accountancy and so on. Students involved in the POSEIDON project experienced something that they might not have done otherwise. From their visits to various oceanography centres and universities, and from their own experience of building an ocean drifter, these pupils have developed an interest in oceanography that they will carry with them for a lifetime.

They certainly enjoyed themselves enough to want to repeat the experience, with many of them returning to take part in new projects. One amongst these is the building of satellite trackers, which will be used to study otters by a team of scientists in the Gabon. Conservationists have expressed interest in the school constructing a fleet of smaller buoys that would be released with baby turtles, which could then be followed as they float on ocean currents. The most ambitious project, and the focus of the team's attention, is the building of an ROV (Remotely Operated underwater Vehicle). In keeping with the theme of Greek gods, this new project has been baptised 'Triton', and is set to be the school's biggest yet.

With many thanks to English teacher Mr Hugh Barlin and Physics teacher Mr Jamie Costello for help with earlier drafts of this article.

Kraken II ready for launch aboard the *RRS James Cook*