

## **Introducing young mathematicians to Industry**

*Vivien Ellins describes the development of a productive partnership*

How do you encourage an enthusiasm for mathematics in S2 students and offer one potential solution to a global energy industry facing a skills crisis? TechFest-SetPoint, a charitable organisation promoting Science, Technology, Engineering and Mathematics (the STEM subjects) primarily to schools, developed the following solution.

### **Background**

For many 13-year-olds a winter's Saturday begins with an extra hour or two with the duvet, a leisurely breakfast and the certain knowledge that there's nothing more taxing for the brain than T4. But 45 of their classmates are up, out of the house and on their way to university for a two and a half hour maths masterclass. In the six years that TechFest-SetPoint has been organising the Aberdeen series of Royal Institution Mathematics Masterclasses there has been no shortage of enthusiastic S2 pupils happy for a journey of up to 50 miles to take part in this popular series of six or more lectures. No shortage of lecturers to present a class or teachers to run the tutorial sessions either. A real hub of mathematical enthusiasm in the lecture theatre.

The timetable for the series reads intriguingly. The 2008-09 series starts with a class from Helen Martin at the University of Aberdeen School of Education: 'The Shape of the Future?' Just how many shapes can we build with three pieces of A4 paper? This session is an exploration of all you already know, some things you didn't know and others which you didn't know you knew!

The 2007-08 series ended with a class from Dr Vinay Kathotia, Clothworkers Fellow of Mathematics at the Royal Institution: 'The Josephus Problem'. In Josephus' circle of death only one will survive. Would you let luck decide your destiny? Or would you get Maths to rescue you?

It's probably not too surprising that parents and teachers, having read these tempting snippets with curiosity, eagerly accept their invitation to witness the final class in the

series and the presentation of certificates that follows. Industry plays an important role in the sponsorship of our Masterclass series and a representative is invited to give a brief presentation at the final class. At the end of the morning pupils and parents can both appreciate that maths is a wonderful academic subject and that mathematical skills are extremely valuable to industry.

‘What’s next? Is there anything after this?’ ask the pupils, parents and teachers. Such enthusiasm cannot be, and was not, ignored. In 2004 TechFest-SetPoint developed ‘Maths in the Pipeline’, with industry professionals and lecturers, as the next step for similar pupils age 15, in S4.

### **Development 1 – Maths in the Pipeline**

To set the scene the event was to be held in a business setting, industry professionals would be on-hand as mentors and workshop presenters, real data would be used throughout and the workshops, based on maths, would cover typical problems encountered in following the trail of hydrocarbons from the earth’s core to final production. Oh, and on top of that, there’s that vital skill no business can do without, teamwork. A fairly challenging agenda then for the new ‘trainees’ to cover in a single day.

On a typical ‘Maths In The Pipeline’ day, 48 pupils from eight schools will arrive with their teachers at the smart venue. Chattering stops and an eerie silence falls at the registration desk as each pupil realises there are to be eight teams and they will be the only one from their school in their particular team! Our mentors and presenters introduce themselves. Their roles are varied, from geophysicists to mechanical and process engineers, business analysts to reservoir engineers. But there are some common traits – they all use maths in their jobs, they enjoyed and studied maths to the end of school, and many continued studying maths at university. Clearly, this personal involvement interested participating pupils:

‘You found background information about their subjects and how it links to maths.’ (*Hollie, Aboyne Academy*)

The three morning workshops were designed to help the pupils develop their teamwork. As an example the first of these, ‘Journey to the Centre of the Earth’,

involves the pupils estimating the volume of an oil field, using graphs and calculations on a geological contour map. Questions arise immediately; the experts are needed. The oil field, rather frustratingly, contains a pocket of natural gas! Numbers are BIG. How many cubic metres? Do you have seven zeros or eight? Finally convert into the international unit for this commodity, barrels, curiously abbreviated to bbls. The teamwork is well underway by now, with silence a thing of the past.

The afternoon's Business Challenge, optimising the development of a new field in Azerbaijan, is the highlight of the day and a time to differentiate between the teams. The noise level peaks. There are choices to be made, a deadline to meet, health and safety and the environment to be considered. Each team has to present their solution. Finally a winning team emerges.

'It is often difficult to see the application of a maths technique but today I learned some new applications which were really interesting.'

*(Aileen, Culloden Academy)*

'I want to be a chemical engineer but I didn't know how much there might be to the job. This intrigued me to pursue the job more.'

*(Christopher, Inverurie Academy)*

The first day of 'Maths In The Pipeline' went exceedingly well. Following the same formula the event now runs to capacity on three separate days in Aberdeen and one in Inverness with plans for spreading it further afield. The pupils were so keen, learnt so much and all the feedback was positive. Yet there was still so much more they could learn. So, naturally enough, this led to the next phase.

'I particularly like how each school is represented and the different schools and the development of their team skills. I would love to see some similar workshops being brought into schools to help make the curriculum more relevant to the pupils.' *(Dr Diane Duguid, Kemnay Academy)*

## **Development 2 – STEM in the Pipeline**

In 2006 'STEM in the Pipeline' was developed as a three-month project for S6 pupils to illustrate that to tackle a real industry problem you need to integrate your subject knowledge of physics, maths, chemistry and geology. More depth was needed, more data was needed and more mentors would be needed.

The original development team was TechFest-SetPoint and a group of BP young professionals. Expertise from Hughes Christensen and the University of Aberdeen was brought in for additional drilling and geology materials. Since 2006 the development team has expanded and now draws additionally from young professionals at Chevron and ConocoPhillips. Now in its third year, 'STEM In The Pipeline 2008' has attracted an entry of 16 school teams comprising 97 pupils from Aberdeen and Aberdeenshire. The maths background has carried through: a number of these pupils are studying Advanced Higher Maths and/or thinking of a career in engineering thanks to this insight into industry.

'For many pupils, in their last year at school, the project provides a real insight into the world of work and what a career in engineering would entail.'  
*(Kirsty, St Margaret's School for Girls)*

As the first of three phases of 'STEM in the Pipeline', the Introduction Day takes place in August at the University of Aberdeen. The school teams arrive early and before long are immersed into a series of four workshops. The day has been well thought out, the workshops well planned. They are delivered by the professionals and their enthusiasm for their subjects is catching. They talk easily with the pupils and explain things well. The topics are not familiar to the school teams - geology, drilling and reservoir, finance, processing. The workshops, a mix of information and 'hands-on', all go down very well. At the close of the busy and informative day the pupils emerge with a clear overview of the industry; they can identify and have knowledge of key processes. The teams return to school armed with half a dozen large seismic charts, a reference book and a sizeable project to tackle. The project asks them to produce a Field Development Plan for the fictitious, yet realistic STEM field. They won't be alone though, help is just an email away!

The main project work takes place at school between August and November. It involves establishing the volume of oil in the field, optimising the production profile –

how many wells to drill, over how many years, at what cost -- balancing investment with payback time. The final project task is in two parts: firstly, to design a separator to separate the resultant oil, gas and water; and secondly, to calculate the CO<sub>2</sub> emissions over the life of the field. As this work gets underway problems arise, results need checking, research is needed. The experience of the mentors is called in, helping the pupils to analyse and make decisions in these unfamiliar areas. Each pupil spends a minimum of 40 hours on the project, many a great deal more than this. Their work is done in free periods, after school, at home, in the holidays even. The more they put in, the more they get out. Their interest and enthusiasm is evident: it's there to be seen in the written reports and later in their presentations to the judges.

'It was really worthwhile and I learnt a lot about the oil industry as well as core skills such as the importance of teamwork.' (*Fiona, The Gordon Schools*)

Projects have deadlines and the pressure mounts towards the due date at the end of November. December, preparing to meet the panel of judges who will assess their project, is the most nervous time for the teams. Their new-found knowledge will be put to the test at the Presentation Day by senior professionals. Surprisingly, judging by the last two years, this actually emerges as one of the highlights of the pupils' day. They appreciate the friendly manner of the professionals and enjoy answering their difficult questions. For their part the judges are impressed with the depth of the pupils understanding and the quality of the work they have produced – in technical, environmental and business terms. The pupils have excelled, they have shown their individual and team qualities and the value of their school education to an industry looking to attract new talent.

'It encourages you to think outside the curriculum and gives anyone looking at related jobs a view into the industry & what is involved.'

(*Ruari, Banff Academy*)

The hardest task now is down to the judges. With long deliberation one team eventually emerges as the winner. What next? Well, the winning team are invited, and early in the next year, present their work to a large professional audience at a meeting of the Energy Institute. The teachers? Teachers appreciate the contribution 'STEM in the Pipeline' makes to the four capacities underpinning the Scottish *Curriculum for Excellence*.

'Helps to build successful learners, effective contributors, confident individuals, responsible citizens - A Curriculum for Excellence.'

*(Mrs Karen Birnie, Aboyne Academy)*

The pupils? For the time being, they return to school, Advanced Higher examinations and university applications. However, further equipped with a valuable range of key skills, first-hand industry experience and information, a promising career cannot be far away.