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The Institute of Materials, Minerals & Mining

Schools Affiliate Scheme

Issue 28
Spring Term 2008

NEWS

Three weeks to go…

By the time you read this in the New Year I shall no doubt be a sleep deprived Mum!

The prospect of becoming a parent really does focus the mind and I can't help but wonder how new materials will enhance the life of our child. Will he play with thermochromic ducks in his bath, will his first bicycle be made from carbon fibre composite, will tissue engineering help to improve his quality of life long after we have gone? I can't also help but ponder how our use of materials may affect the planet that we are leaving for our son and future generations. In this issue the centre pages focus on just one area in which materials technology may help lead to a cleaner, greener future. Hydrogen has been suggested as that ultimate clean fuel for many years so here the pros and cons will be discussed.

Also in this issue you will find your complete guide to booking a school visit, including feedback from a school and the latest booking diaries for both materials and mining and minerals talks.

It is getting to that time of year again when your students might be thinking about enrolling on a taster course. On page 8 you can find out more about some of the courses on offer from the Smallpeice Trust. This year they are launching another new course in Engineering Materials at the University of Manchester.

On page 9 you can read about the final of the 2007 Greenpower electric car competition and find out how you can participate in future.

On pages 10 and 11 you can catch up with what Toby has been doing in his first term in post and read first hand how useful a trip to the Ecton Hill Field Studies Association could be.

Finally, before I go, just a quick reminder! If you are going to be attending the ASE meeting please go along and say hello to Peter and Toby, who will be manning the stand for the duration of the conference. This is your perfect opportunity to meet the team face to face and find out how we can help to support your teaching!

This newsletter is written and edited by
Dr Diane Aston, Education Co-ordinator.
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Booking a School Visit - your comprehensive guide!

At our last Education Committee meeting in August we discussed at length the trials and tribulations of booking a visit. There are a large number of Schools Affiliate Scheme members that have never made use of this popular benefit, despite being members for many years, and we were trying to identify why this should be.

One reason we are aware of is that it can be very difficult to find a suitable date in the visit diary. Over the past few years visits have become increasingly popular and the diary fills up a good term in advance. To address this issue, and to provide a better service to our members, we have recently appointed Toby White to cover the Minerals and Mining aspects of the curriculum, and we are still in the process of recruiting another Education Co-ordinator to deliver materials-based activities. Hopefully the list of available dates published in the newsletter is a good start to letting you know when free days are available.

Another suggested reason for schools not requesting a visit was a lack of support from their senior management team. Below there is a quote Mike Lumley and a summary of the results of the 2006-2007 academic year's feedback is enclosed; all of which might assist with gaining the necessary support.

One teacher on the Committee suggested that schools didn't know exactly what format a visit could take and this made it difficult to obtain permission. The simple answer to this is that the format of the visit is incredibly flexible and can be designed to fit in with your timetable and teaching plan. We are willing to run up to three session per day and these could all be the same activity or a mixture of activities. A few examples are given below:

- ***School A would like the whole of year 10 science to hear about smart materials.*** There are a number of ways of accommodating this and different schools find the way that suits them best. The easiest from our point of view would be to split the year in to 3 groups and deliver the talks 3 times on the same day. This might involve taking some pupils out of ordinary lessons or could be accommodated in normal lessons. Alternatively it could be done during normal lesson times over a couple of days, diary permitting.
- ***School B would like an in-depth talk on materials to a small group of A- level physics students.*** This would normally be pretty easy to organise during normal lesson time. Sometimes the school is happy to just have the one talk, others want to make best use of the time during the visit day and will organise talks for other groups perhaps under guise of a Gifted and Talented event.

Feedback from Mike Lumley

(Curriculum Leader for Design and Technology at Sandbach School, Cheshire)

If you haven't experienced Dr Diane Aston in full flow on her materials topics then you have really missed out! There are lots of benefits from being a School Affiliate Scheme member (monthly magazine, teachers events, students visits etc) however the main one is Diane herself!

Diane has been to my school on several occasions and she has always given the pupils an excellent experience. Her in-depth knowledge of her subject matter is only surpassed by her incredible enthusiasm. She last visited us in May when she conducted her 'Crash helmets for eggs' activity with a Year 7 group. Using various materials, pupils were required to build a protective package for an egg which would withstand the impact with the floor from a height of 2 metres. Pupils were taught about the properties of various types of packaging materials, and were then given time to put this knowledge to good use. A thoroughly active, creative and enjoyable lesson.

As if this wasn't enough Diane then turned her attention to my Year 12 and 13 students (who were only two weeks away from their Product Design examinations). Diane gave a superb illustrated talk on smart materials which had the students' attention throughout (if only I could do that!). How pleased I was a couple of weeks later when I saw that a question on each paper required this information of the students.

Many thanks Diane, hope to see you again soon!

- ***School C would like a talk to yr 12 Product Design, a talk to yr 11 Engineers and a practical activity for year 7.*** Again, provided all three of these groups are timetabled on the same day, this is no problem to organise.

These three scenarios are only examples of the sorts of visits that I have done over the years. Any combination of lessons is possible! If you have links with members of staff in other departments then they can also get involved to make best use of the time available. All of the sessions available are designed to fit in to a lesson and can be adapted to pretty much any duration from 40 minutes to 2 hours or more! Talks can also be given to groups of teachers.

Another suggested reason for a school not booking was that the teacher simply didn't know how to go about it. So here is your step by step guide to booking a visit:

1. Contact us! Get in touch with myself (diane.aston@iom3.org) for materials visits or Toby White (toby.white@iom3.org) for minerals and mining visits or alternatively Anita Horton (anita.horton@iom3.org) for either and we will give you the most up to date list of available dates for visits. As a rough guide, you should contact us a good three months in advance, but the earlier you get in touch, the more choice you will have.
2. Once you have decided on a date from the list let us know as soon as possible, as dates are allocated on a first come first served basis. Once we have a date from you your visit will be put on to the visit diary as provisional and we will send a booking confirmation form out to you.
3. Where possible we will discuss your requirements with you at the time of booking so that all you need to do is check the details on the booking form before signing and returning it to us to confirm the visit. Sometimes we will send a blank booking form out for you to complete the details of the visit. This will typically happen when you have booked many months in advance to secure a particular date, but might not be sure who you would like us to work with. Filling in the form is pretty simple stuff, we simply need to know the start and end time(s) of the lesson(s), the year group(s) we will be working with, the subject these pupils are studying, the group size(s) and the activity you would like us to deliver. If you are not sure what lessons are available or which one would be most suitable, again get in touch and we can let you know and help you to decide. Just as a reminder, a list of available activities is enclosed with this newsletter.
4. **Sign and return your completed booking confirmation form as soon as you can**. Visits are all only provisional until we receive a completed, signed form and we ask that you return your form a month in advance of your visit at the latest. If you have not done this your visit may be cancelled.
5. We will arrive on the day of the visit approximately half an hour before the start of the first session so that there is time to catch a breath and get set up. More often than not you will not hear from us between sending the form back and us turning up on the day. This is nothing to worry about!. If there is a problem we will contact you using the details supplied on the booking confirmation form, so please make sure that these are correct!
6. Usually around a month after the visit you will receive an evaluation form for each session. We ask that you and your colleagues complete these as thoroughly as possible and return them promptly so that we can monitor the effectiveness and suitability of the activities we offer.

If at any point during the booking process you are unsure please get in touch with us, we are here to help! E-mail is the easiest way to do this, but if you would rather telephone, you can ring 01302 320486. I hope this helps and look forward to hearing from you and visiting your school soon.

steeluniversity.org launches new activities for pupils

steeluniversity.org is a free to use, award-winning, on-line initiative developed by the International Iron and Steel Institute to provide a comprehensive package of highly interactive and informative, e-learning resources on all aspects of iron and steelmaking processes. It provides an opportunity to study and apply the basic scientific, metallurgical and engineering principles that underpin the production and use of steel. At its heart is a series of realistic, game-like simulations of the main steelmaking operations and two new exercises suitable for schools have recently been added. The **Life of Iron** game and quiz can be used to test the knowledge of learners and you can explore the site at www.steeluniversity.org

School Visit Diaries

Being as we now have both Materials and Minerals and Mining activities on offer, I thought the best approach would be to give you the two lists of bookings and available dates separately.

Materials visits

January	
3-5	ASE Annual Meeting, Liverpool
10	Bungay High School, Suffolk
11	Blundell's School, Tiverton
17	Ellon Academy, Aberdeenshire
18	Mearns Academy, Laurencekirk
22	Walton High School, Stafford
24	Strathclyde University, Glasgow
29	Sir John Deane's College, Northwich
30	St George's Girls' School,. Edinburgh
February	
4	Spennymoor School, nr Durham
12	University of Wales, Caerleon
18	University of Sunderland
20	Dulwich College, South London
27	Canon Slade School, Bolton
28	Heckmondwike Grammar School
29	Dartford Technology College
March	
3-5	Lutterworth College, Leics
6	Bryanston School, Blandford Forum
10	St Aidan's C of E, Harrogate
11	St John Fisher Catholic, Harrogate
12	Our Lady Queen of Peace School, Skelmersdale
13	Carr Hill High, Preston

The following dates are still available for visits in the Spring Term. If you would like to book one of these please contact Anita Horton on 01302 380908 or e-mail anita.horton@iom3.org.

February: 07, 13, 14, 15, 21, 22

March: 26, 27, 28, 31

Minerals and Mining visits

After a number of successful visits in the Autumn Term Toby will be visiting the following schools in the Spring Term…

January	
3-5	ASE Annual Meeting, Liverpool
17	King Edward VI Grammar, Chelmsford
18	Westcliffe High School for Boys, Essex
February	
6	Rednock School, Gloucester
7	Wells Cathedral School, Somerset
March	
5	Hagley Catholic High School, Worcs

If you would like to book for Toby to visit your school to deliver a minerals and mining related lesson you should contact him by e-mailing toby.white@iom3.org or alternatively contact Anita. The following dates are still available for the Spring Term:

January: 08, 09, 23, 24, 30

February: 12, 14, 26, 29

March: 06, 13

SAS Resources

By now you should have received 'Packaging the Facts', the Schools Affiliate Scheme resource for 2007. We are now in the process of deciding what the resource for 2008 should be and we were thinking that it should possibly have a Minerals and Mining theme.

If you have any ideas for a suitable resource or think a specific format would be useful please let us know. This resource is being specifically written for members of the Scheme and it is important to us that we produce something that will be relevant and useful.

Please let us know your thoughts by e-mailing diane.aston@iom3.org

HYDROGEN - A clean, green fuel for the future?

Unless you live in your own little isolated bubble, you are probably all too aware from reports in the media that our continued and increased reliance on fossils fuels could be accelerating global warming. Though there is still a great deal of debate about exactly how much of an influence our use of these fuels, in particular the amount of greenhouse gases like carbon dioxide that we are pumping into the atmosphere, is having on climate change, one this is certain: fossil fuels are finite fuels and one day they will run out, or become uneconomical to use! For may years now we have been looking at developing sustainable and renewable energy sources, using natural resources like the wind, sun, water and the heat of the earth to generate power.

One area that has been of particular interest is the possible use of hydrogen as a fuel. Hydrogen, the first element to be formed in the early Universe, is the simplest element consisting of just one proton and one electron. So how exactly could this substance change the way we produce and use energy?

What is the Hydrogen Economy?

The Hydrogen Economy is a term that has been around now for many years and basically describes an economy in which hydrogen replaces traditional fossil fuels as the main source of energy. Energy from hydrogen could be used to generate electricity for use around the home or office, or for more mobile applications ranging from transport to portable electronic devices.

Obviously making such a drastic change in the type of primary energy source that we use would not be easy. A whole new infrastructure for production, storage and distribution would be required and existing systems would need to be replaced. However, research teams around the world are working right now on ways of overcoming these obstacles one at a time.

The chief advantage of using hydrogen as a fuel is that carbon dioxide is not produced at the site of end use. However, this greenhouse gas may be generated during the processes that are used to produce the hydrogen in the first place. But, it is possible to produce hydrogen cleanly and eliminate the generation of green house gases altogether.

How can we produce hydrogen?

Hydrogen is the most abundant element in the Universe, however, its low density means that it is only found in the Earth's atmosphere, in its gaseous form, at a concentration of about 1ppm. There are many abundant and easily obtainable hydrogen-containing compounds, the most important if which is water. Hydrocarbons such as methane and indeed oil are also rich in hydrogen.

Hydrogen has been produced commercially for many years by mixing methane with steam at a temperature of around 1000°C, where the following chemical reaction occurs:

$$CH_4 + H_20 \rightarrow 3H_2 + CO$$

Although this does produce lots of hydrogen gas, the by-product, carbon monoxide is an important greenhouse gas and this is exactly what the hydrogen economy aims to eliminate.

This is the key issue with producing hydrogen as a fuel - how can hydrogen be produced without generating greenhouse gases?

There are really three main options for producing hydrogen. Firstly, it can be extracted from methane in the reaction described above and this technique has been used commercially for many years for producing hydrogen for use in the Haber Process to make ammonia. As mentioned already though, this slightly defeats the object of using hydrogen as a fuel, as greenhouse gases are produced as a by-product of hydrogen generation. Secondly, hydrogen gas can be filtered from natural gas where it occurs its diatomic form. Doing this requires the natural gas to be passed through a filter with sufficiently small pores to only allow the hydrogen through. Research is being carried out to develop a material which is capable of doing this on a commercial level. The downside to both of these options is that they still rely on fossil fuels as the raw material from which hydrogen is extracted. The third option could completely remove our reliance on fossil fuels and uses water as the hydrogen source.

Electrolysis of water provides a sustainable source of 'clean' hydrogen, but it does require the input of electrical energy to drive the process. The ultimate solution to this would be to use energy from a sustainable source (e.g. geothermal energy, solar energy etc.). Producing hydrogen in this way could be done centrally on a large scale for distribution to end users or it could be produced locally and used directly by the end user. In either case the hydrogen produced would need to be stored, perhaps only for a short amount of time and this brings with it a whole host of other problems which need to be solved.

How can we store hydrogen?

One of the biggest hurdles to over come if we are to use hydrogen on a large scale is how to store it prior to use. Hydrogen gas has a low density and storing it in its ambient form would require tanks which would simply be impractical in size. It is possible to store compressed hydrogen gas or even liquefied hydrogen in tanks, but these methods also have problems. The tanks needed to store the hydrogen under pressure would need to be pretty substantial and very heavy and the tanks needed to store liquid hydrogen would need to be very well insulated to prevent it from evaporating. All three of these techniques have one serious safety consideration. Hydrogen is a very combustible element and storage in either its liquid or gaseous form would be dangerous (liquid hydrogen and liquid oxygen are mixed together in rocket fuel!).

There are two other methods for storing hydrogen which are less risky. In the first method hydrogen is stored chemically as a hydride or other hydrogen-containing compound. In the form of a stable metal hydride, for example, the hydrogen can be stored and transported safely to the point of use, where it can be liberated. Again this technique has problems associated with it. At the moment high temperatures and pressures are required to get hydrides to form in the first place and to then decompose and liberate hydrogen for use.

The final method uses a solid material to contain hydrogen in its molecular form. Storage materials include carbon nanotubes and metal-organic frameworks. These materials contain pores in which hydrogen gas can be stored. Since the hydrogen is stored in its molecular form this method does not have the same problems associated with it as using a hydride and similar storage densities to liquefied hydrogen can be achieved.

Once a safe and effective method of storing and transporting hydrogen is found it may then be used as a fuel.

How can we use hydrogen?

The chief way of using hydrogen as a fuel is in a fuel cell. Fuel cells have been around for many years and are basically a way of converting chemical energy into electrical energy. Unlike a battery, which is also an electrochemical conversion device, fuel cells do not store energy, they generate a DC voltage and must be connected to the equipment they will power or to batteries which will store the energy.

The hydrogen-oxygen fuel cell was invented in 1839 by Sir William Grove. He knew that he could separate water into its constituent elements using electrolysis and suggested that electricity and water could be made by recombining hydrogen and oxygen. Using his very primitive 'gas voltaic battery' he proved his theory to be true.

A number of different types of fuel cells exist Some of these are better for large stationary power generation plants and others are better for more portable devices.

Alkaline fuel cells (AFC) have been used by the United States Space program since the 1960s and are the oldest design of fuel cell. However they are very susceptible to contamination and require the hydrogen and oxygen to be very pure.

Solid oxide fuel cells (SOFC) again use the combination of hydrogen and oxygen to generate electricity but they do this at very high temperatures (700-1000°C). When in continuous use this type of system is very stable and could be used to generate electricity on a large scale. Electricity can be generated from a SOFC in two ways increasing their overall efficiency. Firstly, electricity is generated by the recombination of hydrogen and oxygen in the fuel cell itself, and secondly the high temperature steam produced by the fuel cell is used to drive a more conventional generator.

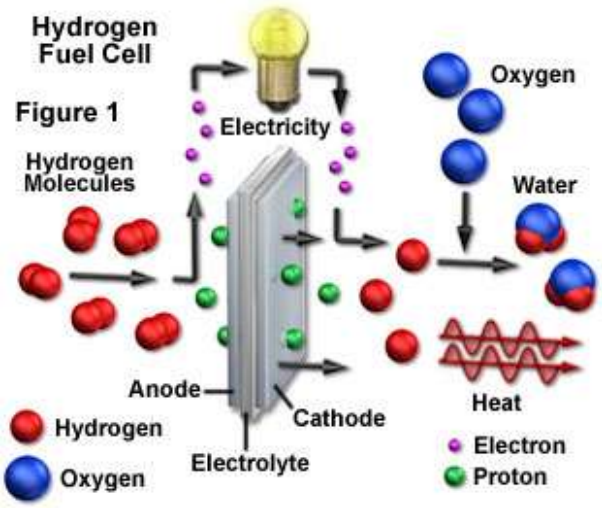
Proton exchange membrane fuel cells (PEMFC) offer the most promise as they operate at room temperature and can be made in a variety of sizes. It is also one of the simplest types of fuel cell consisting of just four parts.

- The anode has channels etched in to it, to ensure that the hydrogen gas is dispersed equally over its surface, where the following reaction occurs:

$$H_2 \rightarrow 2H^+ + 2e^-$$

- The cathode is also etched to ensure that the oxygen is distributed evenly. At the cathode the electrons from the external circuit recombine with hydrogen ions that have diffused through the membrane and oxygen to produce water.
- The catalyst facilitates the reaction between hydrogen and oxygen and is usually made from platinum in the form of nano-particles coated on to carbon paper or cloth.
- The proton exchange membrane is the electrolyte between the anode and cathode. It only allows the passage of positively charged particles and forces electrons to flow around the external circuit.

A schematic diagram of a PEMFC is shown below.



Where can hydrogen be used?

The main reason for using fuel cells is to reduce pollution, whether this is from a power station or exhaust fumes from a car. However, it is important the make sure that the fuel cells used are as energy efficient as possible. In theory, using pure hydrogen a fuel cell can achieve an efficiency of 80%. In reality, when connected to systems which will convert the electrical energy into mechanical work an overall efficiency of about 64% is more realistic.

Fuel cell powered vehicles are not very common at the moment and indeed it could be another 5 or 10 years before they are a practical solution. In these vehicles the electricity generated by the fuel cell would be used to power electric motors, making the vehicles very quiet.

As well as being used to power cars one of the main suggested uses of fuel cells is to power buses. Many cities across the world are now looking at investing in this technology for clean, pollution-free public transport.

It has also been suggested that one day we will all have a bank of fuel cells in our home to generate electricity when we need it to power our appliances.

Can we learn from the stars?

Using hydrogen in a fuel cell is just one way of producing clean energy, but we could look to the starts to find an alternative way of generating energy on a large scale.

At the heart of our Sun hydrogen is combining to produce helium which generates huge amounts of energy. Nuclear fusion has been the subject of scientific research for many years and we may be getting closer to finding a way of using hydrogen fusion on a practical scale.

The JET (Joint European Torus) project, located at the UK AEA Culham Science Centre in Oxfordshire is home to the largest and most powerful magnetic confinement fusion device in the world and is carrying out fusion experiments on a scale close to that of a possible commercial fusion reactor.

Where can I find out more?

Both Wikipedia and 'How Stuff Works' have good articles looking at all aspects of using hydrogen as a fuel, however, the data that is quoted by both of these sites is very focussed on the USA.

The Hydrogen Materials Group in the Materials Department at the University of Birmingham is carrying out research on all aspects of hydrogen production, storage and use. They even have a working fuel cell-powered narrowboat! You can find out more at www.hydrogen.bham.ac.uk.

For more information about fusion you can visit www.fusion.org.uk. The AEAs laboratories at Culham in Oxfordshire offer a range of resources, activities and visits for schools.

Fancy a taster of Materials, Minerals or Mining Engineering?

The Smallpeice Trust has teamed up with a host of leading businesses and institutions to launch a challenging and innovative timetable of national courses in 2008 for young people. These short courses all challenge the misconception that engineering is 'dry' and 'boring', providing a fun foundation for learning whilst proving that engineering is in fact evident in virtually every aspect of daily life.

Most of the courses take place in the summer, although some take place at other times in the year in January and March. The courses are affiliated to the Royal Academy of Engineering Best programme and are designed to take students interest in engineering a step further with emphasis on creativity, design and team-working.

Among the newest of courses is the 'Engineering materials' course at the University of Manchester. Students will discover the breadth of materials science, with sessions exploring not just Engineering materials; but also biomedical materials science and technical textiles. This adds to the existing two 'Materials technology' courses at the Universities of Oxford and Cambridge where students will discover the rich and varied world of materials science and transforming theory into practical reality. Course highlights include:

- Coming up with new ideas to solve practical engineering problems, working individually and as part of a team
- Learning the art of materials selection, combination and optimum use in materials technology across a range of engineering application
- Discovering the fundamental relationships between different materials, the form they take and the processes they will perform
- Exploring the physical and chemical properties of modern materials and how they determine their application
- Understanding the classification of materials according to their properties and working characteristics

Now in it's second year running, the two Mining and Minerals courses at University of Exeter (Camborne School of Mines) and University of Leeds, provide students with a firm insight into the earth's natural resources including gold, diamonds, coal, oil, clay, granite and limestone. Sponsored by two of the largest mining companies in the world – Rio Tinto and Anglo American, students will have the opportunity to visit quarries and see first-hand a modern mining operation in action. Course highlights include:

- Learning about how minerals are found, mined and processed to their end use
- Finding out more about minerals and their properties and what will happen when they eventually run out
- Understanding how to survey minerals using the latest computerised techniques and equipment
- Crushing, processing and refining minerals using modern machinery processes
- Visiting one of the UK's largest limestone quarries to witness a modern mining operation in action (University of Leeds only)
- Discovering more facts about mining and minerals at the Eden Project's new educational centre (Camborne course only)
- Gaining an understanding of the wide range of career prospects available to mining graduates, including world travel and exploration
- Meeting and talking to young engineers who are already on the path and able to share their advice and knowledge

Over the last year, The Smallpeice Trust has reached out to over 8,000 young people through it's different subsidised 4-day residential courses and 1-day in-school curriculum enrichment activities.

For further information, visit www.smallpeicetrust.org.uk or call 01926 333200

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The 2007 Greenpower F24 Finals Day Report

The weather came up trumps on the 14th of October for the ninth National Final of the Greenpower Formula 24 Electric Car Series. This year the seventy-one cars that made it to Goodwood came from twelve regional heats, held from Croft Motor Racing Circuit in the north to the Cornwall Showgrounds in the far West Country. All the heats had been to the new four hour, no battery charging, format that had been introduced this year to encourage a deeper exploration of how to get even more out of the four 12-volt lead/acid units that provide the power package for the 240 watt, 24-volt motors that propel the cars.

Traditionally the Institute of Materials, Minerals and Mining have judged and awarded the trophy for 'Innovative Use of Materials' at the Finals, but this year it was decided to go down a different route and weigh all of the cars to see which was the lightest, hence rewarding the use of lightweight materials, which is a key element of electric car design.

As the cars lined up for scrutineering the Institute judging team, led by Mike Shergold, marked out all of the likely contenders and they went over to the weighing bay for their statistics to be recorded.

Then it was to the racing! Seventy-one cars lined up in rows of five across the main straight at Goodwood and, at 1300hrs sharp the Earl of March let the hooter off and each row pulled smoothly away with all the cars streaming down to Madgwick Bend. The first through the chicane to take an early lead was 'Phoenix' from Seaford College just ahead of the number one 'seed' EVO4 from Eltham College in London. Old champions 'Turbo Tortoise' from Furze Platt School in Maidenhead and it's sister car 'Super Snail', both with their all conquering streamlined canopies cut back to meet the new regulations, still kept up with the front runners. Inspired driving by 'Turbo Tortoise' took the team into the lead where they remained for the first half-hour as sixty-eight of the cars all engaged in their own battles down the field. The missing few were already in the paddock being fixed!

The new shortened race meant the pits were a hive of activity throughout the four hours as teams still had to utilise six drivers. There was also the battery strategy for teams to focus on. With no battery charging available this season, the timing of the first battery change and then the subsequent use of the 'recovered' batteries was crucial. All spare batteries were kept in 'Battery Quarantine' under the eagle eyes of the two Battery Marshals, ensuring fair play.

As the race progressed 'Phoenix' settled into the lead maintaining a steady three to four lap advantage over the chasing pack. However in the top ten the changes were frequent, especially when pit stops started to have their effect. The various approaches schools had adopted in designing their cars all proved valid as they sparred for places throughout the race.

After four hours hard racing 'Phoenix' took the chequered flag followed by TSR4 and TSR2 from Trinity School in Croydon.

The winner of the Institute trophy for 'Lightest Car in the Race' went to St. Swithun's School's car 'Bananarama,' pictured left. This remarkable car had the ability to race in both the F35 and F24 Finals by changing its motor. So, despite it having to carry the extra weight demanded by the F35 regulations where suspension is mandatory, it was able to take the award. This car also holds the Greenpower lap record at Goodwood in its Formula 35 guise. However problems in the Formula 24 race caused it to finally finish in eighteenth place.

The ninth Final of Greenpower Formula 24 was enjoyed by all and the standard of entries was the best yet. The presence of a number of hybrid and all electric cars on display augmented the carbon-free message of the day!

For more information about the Greenpower competition you can visit www.greenpower.co.uk

Mining and Minerals Update…

Having returned from a wonderful trip to Australia in August, I am now settling into my role as Education Co-ordinator for Minerals and Mining. The Antipodean visit confirmed that there are massive opportunities in the minerals sector at the moment. The high demand for natural resources, driven by development in China, India and elsewhere, is unlikely to diminish in the foreseeable future. The fact that mining and mineral engineers will continue to be in high demand globally is certainly worth telling your students about!

In the UK, there seems to be a resurgent interest in coal for power generation. We still have massive resources and significant research continues to explore ways of minimising carbon emissions. Demand for aggregates continues at a high level, supporting the development and regeneration that is taking place in many parts of the UK (not least for the 2012 Olympics). Although 25% of UK aggregates are from recycled or secondary sources, 200 million tonnes of crushed rock or sand & gravel is still required. Along with the variety of industrial minerals that we still produce, it means there are still a good number of jobs in the UK for those interested in the minerals industry.

The ESTA (Earth Science Teacher's Association) conference in Belfast in September was excellent as always. There were some great talks and some really imaginative ideas for the teaching of geology in schools. The trip to Giant's Causeway was an added bonus! I would thoroughly recommend ESTA (www.esta-uk.org) as a valuable resource for geology teachers, indeed for all teachers who have to teach some geology as part of the curriculum.

By the time you read this, I will have finished preparing a Key Stage 4 Science lesson on metal extraction and processing, looking at iron and steels, copper and aluminium (and possibly some others). All my lessons so far have focussed on the geology syllabi, so this addition means I can offer something to schools who do not teach geology. Eventually there will be a KS4 lesson on construction materials, and possibly material for KS3 as well. If there is anything else you think I can help with, please do not hesitate to contact me.

Although it is not a core subject, geology is taught at GCSE or A-level in over 300 centres across England and Wales. If you have a geology department at your school or college, why not pass this newsletter (and the last one) on to them, so they can see what is available to support their teaching. If you don't have a geology department, I would still be very happy to come and deliver the new lesson. I have included a list of available dates (see page 4), so please contact me direct if you want to book a visit.

See you soon,

Toby

(Toby.White@iom3.org)

Minerals and Mining at the University of Leeds

In addition to the Minerals and Mining course run by the Smallpeice Trust at the University of Leeds, the Faculty of Engineering is running a course on Mine Design and Engineering for Geologists in July 2008.

This is a 3 day residential course aimed at year 12 students studying geology and it will feature a number of site visits in addition to a programme of lectures which will address some of the topics covered in year 13 as well as giving an insight in to the industry.

The course is free to attend and includes all meals and accommodation in University Halls of Residence.

If you would like more information please see the leaflet enclosed with this newsletter or contact Heather Strachan by e-mailing H.K.Strachan@leeds.ac.uk, phoning 0113 343 2498, writing to her at SPEME, University of Leeds, Leeds, LS2 9JT.

Ecton Hill Mine - an excellent resource!

You may remember reading about the newly re-opened Ecton Hill Field Studies Centre in the newsletter a couple of issues back. Well a number of schools have now been for visits and experienced this excellent resource first hand. But you don't need to take my word for it, here is a review from one school that travelled a long way to visit Ecton…

Eight year 13 Chemistry students and three teachers from Walthamstow Hall in Sevenoaks experienced the Ecton Hill Field Studies Association's Minerals and Chemistry Course one weekend in early October.

Millions of years ago the limestone that forms Ecton Hill in the Peak District was buckled by movements in the Earth's crust until some of the flat layers stood pointing upwards. The cracks generated gradually filled with complex copper solutions that formed a rich vein of copper ore. As we scrambled up the slippery grass slope on a misty autumn morning, we were told about the generations of miners who risked their lives climbing down ladders into the mine, with nothing but candles to light their way. The ore that was brought out was sorted by women and children and we climbed to one of their spoil heaps. We were told that the Duke of Devonshire made enough money from the rich ore containing 50% copper compounds to build Chatsworth House. The women and children lived hard lives, and they were too efficient to leave anything but tiny pieces for us. We could still pick out fragments of copper, lead and iron-rich minerals to take back and test for metal ions.

We had driven up from Kent the night before, and our three excellent instructors quickly conveyed their enormous enthusiasm for the geology, chemistry and history of the area. We had earned our packed lunch by the time we returned with our samples. The next treat was a walk right into the mine along a horizontal access tunnel, where we could get some feel for what it was like being a miner, though the modern lights on our helmets made it a lot less scary.

When we came back we had the chance to use some real chemistry to analyse our samples. We crushed our pieces of rock and treated them with nitric acid. The solutions could then be tested for ions using characteristic coloured complexes like ammonia with copper or thiocyanate with iron. It was very special to be able to use our chemistry on real samples, and still be able to see the colours we normally only see using pure chemicals in test tubes.

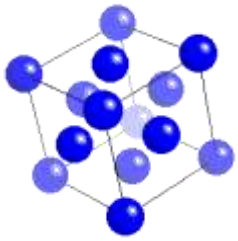
We had a demonstration of some types of reaction that we were not allowed to do for ourselves, such as using concentrated hydrochloric acid to turn our copper solutions green. There was also a model working lime kiln to see. At the end of the afternoon the icing on the cake was to make some black powder (gunpowder) that the miners used to use. We set it off outside and it was just like fireworks.

The Ecton Hill centre gave us a rare chance to experience chemistry in a real context. Half the enjoyment was the infectious enthusiasm of the instructors and their ability to convey this to girls and teachers. We have already booked to go again next year!

If you would like to find out more about the EHFSA or indeed book a visit you should contact Anita Horton (anita.horton@iom3.org)

Copper

Looking through the past issue of the newsletter, I can't quite believe I have not featured copper in the element page so here goes…



Face centred cubic crystal structure of copper

- The basics: atomic number 29, melting point 1084°C, boiling point 2567°C, density 8.96gcm-3
- Copper is reddish transistion metal which has a face-centred cubic cystal structure at room temperature, making it very ductile and malleable.
- Copper has been known since Ancient Times as it can occur in its metallic form in nature. Copper beads dating back to 9000BC have been found in the Middle East and the earliest evidence of copper smelting dates back to 5000BC.
- The name copper or cuprum dates back to the Roman Empire where the metal was principally mined in Cyprus. Copper was named Cyprium meaning metal of Cyprus and in mythology it was linked to the goddess Venus.
- Today the main sources of copper are found in Chile, Peru, Canada and the US. Deposits of copper ores are also found in Europe and Africa.
- The largest open cast copper mine in the world is located at Bingham Canyon in Utah (see picture right). The hole in the ground which makes up the mine is 1.2km deep and 2.5km wide and since mining commenced in the early 1900s the pit has yielded 15.4 million tonnes of copper, 715 tonnes of gold, 5900 tonnes of silver and 386,000 tonnes of molybdenum! Gold and silver are closely related to copper in terms of their electron configuration.

- Ecton Hill Copper Mine in Staffordshire (which you can visit for field studies) has been worked since the Bronze Age and was an important copper mine in this country for many years.
- Many copper minerals exist and these can be based on sulphides (such as chalcopyrite), carbonates (such as the beautifully coloured malachite) and the oxide cuprite. Most of the commercial mines extract sulphide ores
- Copper is an extremely good electrical and thermal conductor (second only to silver) which has led to its extensive use in electrical wiring and electronics. Copper is used in printed circuit boards, motors, generators and the windings on transformers. Its heat dissipating properties are utilised in heat sinks for computers.
- Copper pipes have been used for many years for carrying water as it does not react with this substance.
- Copper will oxidise slowly in air, giving the characteristic green colour of verdigirs (see picture right). This corrosion product is itself very chemically stable. Since it is easy to form to shape many old buildings have roofs and guttering made from copper which have oxidised across the years.

- Copper and its alloys have been used for coinage for many centuies. A typical coinage alloys is cupronickel containing 75% copper and 25% nickel.
- Other important copper alloys are brass (typcially containing either 70% Cu and 30% Zn or 60% Cu and 40% Zn) and bronze which typically contains copper and tin. Many of these alloys have been used for centuries and indeed we have been using bronze successfully since the Bornze Age!
- In recent years it has been discovered that copper and its alloys have excellent antimicrobial properties, inhibiting the growth of viruses, bacteria (including MRSA), moulds and fungi. A number of scientific studies have shown that using copper or brass for door furniture and taps etc. can actually reduce the spread of bacterial infections.

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