Hello and welcome to this issue of Resonance!

I hope you all had a great Christmas and New Year. I am the new Editor of Resonance and I hope to continue the good work done by Jenna and Alex, the previous editors.

In this issue we have lots of different topics to read about. This includes an in-depth look at some of the projects that students this year have undertaken as part of the Skills for Success module in level 3, which is just a small sample of the wide range of projects that are on offer.

Outside of the department, we report on the research that won the latest Nobel Prize in Chemistry, and for those of you that enjoy a fizzy drink or two, check out page 7 for a brief introduction into the chemistry behind your carbonated beverage. Finally, in line with Valentine's Day, we also offer you an insight into the chemistry of love on page 11.

If you enjoy reading Resonance and feel that you have something to share with fellow chemists or would just like to help out, we would love to hear from you! This can be in the form of writing an article on an area of chemistry you find interesting, reporting on exciting news and events from within the Chemistry department or helping with photography, editing and designing the issues. It doesn't even matter if you don't have any ideas for articles or experience - all we are looking for is your enthusiasm! If you are interested then please contact one of us by email, Facebook or just come along to one of the meetings. Remember, if you are an undergraduate, contributing to Resonance can be HEAR accredited.

None of the content in the magazine would have been possible without the help and ideas from all of the contributors on the Resonance News team, so I would like to thank everyone involved for their help producing this issue. And last but not least, thank you for picking up this issue! This is your magazine with ideas, articles and news from chemists here at Sheffield. If you have any news, ideas or comments then please get in touch - we would love to hear from you.

I hope you enjoy the issue!

Zoe Smallwood, Editor
# Table of Contents

Fireworks Lecture Review .......................................................... Page 3
Elemental Factfile: Thorium ....................................................... Page 3
Mechanistic Studies of DNA Repair ........................................... Page 4
Skills for Success ........................................................................ Pages 5-6
    Media Project ........................................................................ Page 5
    Contemporary Philosophical Problems in Chemistry.. Page 5
Today the Kitchen is my Lab ....................................................... Page 6
    The Technician Project............................................................ Page 6
Why do we Enjoy Fizzy Drinks? ................................................ Page 7
Science & Policy ........................................................................ Page 8
An Interview with Jim Thomas .................................................. Pages 9-10
Staff-Student Committee ............................................................ Page 9
A Chemical Romance ................................................................. Page 11
Dainton Going Green ................................................................. Page 12
Chemistry Funpage .................................................................... Page 13

![The Research Cycle](https://pupcomics.com)
It’s not often that the answer to the question “what did you do this evening?” involves waiting for dustbin lids to shoot off toward the ceiling or watching crisp tubes be used like rockets. On the 9th November, however, Dr. Andrew Szydlo gave a lecture on “Fireworks and Waterworks” during which both of the above occurred. Bonfire night had been 4 days earlier, but Dr Szydlo managed to carry out an impressive number of explosions and experiments, such that it may never be known on which night there was the most “bangs.”

Other demonstrations included a model train powered by the adiabatic compression of gas which (after a lot of pumping) became hot enough to ignite the tinder, an iodine clock reaction accompanied by a violin duet, and a finale involving the detonation of hydrogen and oxygen balloons signalled by the tune of a bugle. Never dull for a moment, the lecture encompassed everything that chemistry is stereotypically known for: explosions, flames, colours and fumes.

Thorium was identified by Swedish scientist Jöns Jakob Berzelius who named it after Thor, the Norse god of thunder.

There is more thorium in the Earth’s crust than there is tin - in fact, there is almost three times as much. It is the radioactive decay of the highly abundant isotope Thorium-232 that is responsible for a large amount of the Earth’s internal heat, which causes shifts in the tectonic plates.

Before the link between radioactivity and various health problems had been made, thorium was used in many commercial applications, for example, thorium was combined with radium in the ‘health drink’ called Radithor (which, you may have guessed, was not very successful). Until recently thorium dioxide (ThO₂) was used in camping-lantern mantles, which glowed brightly when heated by a gas flame.

However, most of these applications of thorium are no more, due to health concerns. The one exception is tungsten welding electrodes, which contain up to 2% thorium to increase the high-temperature strength of the tungsten electrodes.

Due to its surprisingly high abundance and relatively high radioactivity, the use of thorium as a fuel in nuclear reactors is being explored in an attempt to replace uranium, which is also three times less abundant than the godly element. However, progress has been slow and only a few thorium reactors are in existence.
Chemical biology is one of the main areas of research within the chemistry department here at Sheffield, with many researchers including Professor Jane Grasby, Dr Jim Reid and Dr Barbara Ciani working in this area. Some of our most famous alumni, Richard J Roberts and Hans Adolf Krebs also focused on this area and achieved the highest acclaim in science, the Nobel Prize. The recent Nobel Prize for chemistry was again awarded for progress in this field, to three individual scientists; Tomas Lindahl, Paul Modrich and Aziz Sancar. Their separate research into DNA repair mechanisms has greatly increased our understanding of how we can be here today.

During the mid 20th century it was thought that DNA, the building block of life, was a very stable molecule. Dr Tomas Lindahl’s research proved that this was in fact, not the case. This lead to questions: how can multicellular organisms exist and pass on genetic information to an offspring, without major mutations? To answer these questions, researchers began to investigate the enzymes and repair mechanisms within the cell that are vital to repair mutations and enable complex life to function.

Tomas Lindahl’s early research focused on mutations caused by the amino group of the cytosine base being easily lost. When this isn’t present the base will pair with adenine instead of guanine- this defect causes a mutation. Realising that there has to be a process in place to prevent this, he started to investigate the enzymes responsible. This led to his determination of the base excision repair process and how the enzyme, glycosylase, functions in human cells to remove these mismatched base pairs.

DNA is constantly being attacked and damaged by environmental and lifestyle factors such as UV radiation and smoking. It was the work done by Aziz Sancar that allowed us to understand how this damage doesn’t cause a domino effect within the cell which leads to permanent damage. Whilst working at the Yale University School of Medicine he was able to investigate the dark system, one of the two mechanisms used in bacteria to repair UV radiation damage. Here he showed that enzymes are able, via two cuts, to remove the damaged fragment and then recode a new fragment using DNA polymerase.

The third contributor to the Nobel Prize was Dr Paul Modrich. His research initially focused on the enzyme deoxyadenosine methylase, and its role in repair and replication. It is able to methylate the template DNA strand at the adenosine base so that only the newly formed strand, containing the mismatched base, is removed and replaced. This sparked his full analysis of the mismatch repair process, and led to recreating the mechanism and studying it in detail.

The vital work performed by these three scientists, among others, has enabled great progress in the cancer research field. Many cancers make use of switching off repair mechanisms leading to mutations and this explains why people can become resistant to drug treatments such as chemotherapy. In the future we may be able to develop cancer treatments which switch off the repair mechanisms in cancer cells specifically and completely, leading to their death whilst healthy cells are mostly unaffected. The Nobel Prize was awarded to recognise the importance of this work, both in furthering our understanding of fundamental biological processes and in its application to future medical therapies.
Skills for Success

By Amelia Newman and Francesca Dennis

As part of their study, level 3 students undertake a “Skills for Success” project. This involves each student working for a set number of hours on a project within the department. Amelia Newman and Francesca Dennis report on some of the projects from this year.

THE MEDIA PROJECT
Task: Students will work as a group on a news-worthy item in the department

Since the creation of Resonance two years ago, the media project has moved to film to report on recent research in the department. The group decided on looking at Professor Armes’ research into polymer self-assembly as this has exciting biomedical applications, in particular the long term storage of undifferentiated mammalian cells. The finished product is a promotional video for the MSc Polymers for Advanced Technologies course offered here in Sheffield, including this polymer research as well as interviews with members of the department.

The project tested communication skills to the maximum, both on and off screen and ensuring everyone was confident in their role was very important; this came with compiling a clear and detailed storyboard. Abbie from the media team describes the biggest challenge as feeling comfortable on camera. This took time but full preparation and self-confidence made the process easier and more enjoyable. She would be likely to choose the same project again, speaking overall Abbie enjoyed the experience; “The recording and editing processes both required time and a lot of patience but having a final product you feel proud of is great”.

Another aspect of the project was organisation of the debate, including advertising in the department and on Facebook to draw attention to the event, as attendance contributes to the final mark. Confidence in their knowledge and research helped make the debate easier, and they are both proud of how well they performed in front of an audience. Overall Elle enjoyed the process; she said “the project helped develop useful skills and looks great on my CV as I want to follow a career in law”.

CONTEMPORARY PHILOSOPHICAL PROBLEMS IN CHEMISTRY
Task: Students will present one side of the argument in a debate on a contemporary problem in chemistry

Going into the project, the group were hoping to improve public speaking and research skills. The process was relaxed and began with conducting in depth individual research into their specific debate question. Elle and Halisha spoke about their topic, “This house believes that thalidomide should be used on cancer patients”; Elle recalls “It was difficult to argue against an argument I was for, especially as it was mostly a factual debate and less about personal opinion”.

Another aspect of the project was organisation of the debate, including advertising in the department and on Facebook to draw attention to the event, as attendance contributes to the final mark. Confidence in their knowledge and research helped make the debate easier, and they are both proud of how well they performed in front of an audience. Overall Elle enjoyed the process; she said “the project helped develop useful skills and looks great on my CV as I want to follow a career in law”.

5
The project was chosen with the aim of developing independent research and presentation skills. Using their home kitchen, the group performed a simple investigation of a hypothesis. At the end of the process the presentations were given in front of the rest of the group, this helped to calm nerves as everyone was in the same boat and due to the freedom of the project all the presentations were quite different! Speaking to Olivia about the project, she describes having confidence in your experiment and conclusions helped make the presentation easier, and designing the hypothesis yourself made it easy to talk about. Throughout the process, time management and organisational skills were key, as all the work is independent. Speaking overall, Olivia was pleased with the project; she says “I was surprised that the highlight was actually giving the presentation, it was nice that everyone was in the same situation and to see people respond well to the work I’d done”.

“All of these things taught me patience, accuracy and further lab skills. It allowed me to learn about the department further as well as learning and applying new skills that can be transferred to better lab practice. It was a very rewarding experience and I would pick the same project again.”

THE TECHNICIAN PROJECT

Task: Students will shadow a departmental technician in their day to day tasks.

Francesca chose to do the research technician project for her skills for success, which involved shadowing three research technicians. This enabled her to gain a great insight into the behind the scenes jobs that keep the departments researchers working. Her hands on experience ranged from cleaning and refitting a low vacuum pump, to looking at mouse brain cells infected with scrapie (the sheep version of Bovine spongiform encephalopathy, ‘mad cow disease’) to learning how to wire a plug correctly; a great life skill! She also completed tasks such as running standardised elemental analysis samples, helped with titrations to determine iodine and chlorine content, approved COSHH forms and observed cyanide work. Francesca says: “all of these things taught me patience, accuracy and further lab skills. It allowed me to learn about the department further as well as learning and applying new skills that can be transferred to better lab practice, further work experience and ultimately a job. It was a very rewarding experience and I would pick the same project again.”
Why do we enjoy fizzy drinks?

Putting the Fizz into Drinks

Initially thought to have medicinal properties, carbonated water has been on the market for centuries. English chemist Joseph Priestley (1733–1804) was the first to discover artificially carbonated water in Leeds, by experimenting with the gases produced during the fermentation processes in a brewery. In 1772, he demonstrated a small carbonating apparatus to the College of Physicians in London.

Carbonated water has two components, water and carbon dioxide. The carbon dioxide is introduced into the water at low temperature and high pressures. In these conditions, CO₂ has a higher solubility. The water will absorb as much carbon dioxide as it can as long as there is enough pressure above the water. Once an equilibrium is formed between the pressure in the liquid and the external pressure, the CO₂ will not escape. When the pressure is dropped, such as when you crack open a can of fizzy drink, effervescence is observed as the carbon dioxide is released from the liquid. If you look closely, you can see the bubbles forming on the sides of the bottle or can due to the imperfections on the surfaces.

Satisfying a ‘Sweet Tooth’

Many of us enjoy fizzy drinks due to their sugary nature. Sugars are short chain carbohydrates and therefore provide us with calories. However, too much sugar can lead to major problems such as obesity. Action on sugar found that in an average 330ml can of carbonated drink, there are more than SIX teaspoons of sugar. As the recommended daily intake of sugar by the World Health Organisation (WHO) is 25 g per day, just one can of fizzy drink is a whopping 24% of our recommended allowance.[1]

As consumers have become more aware of the problems with high sugar intake, drinks manufacturers started using sweeteners such as aspartame as a substitute.

Aspartame was discovered accidentally by a chemist called Jim Schlatter who was investigating treatments of stomach ulcers. He noticed a super sweet taste whilst licking his finger to pick up a piece of paper.

Aspartame is a dipeptide protein containing two amino acids. As amino acids are building blocks for proteins, our body can easily metabolise them, providing us with 4 calories per gram. Aspartame is broken down into three components in the body; aspartic acid, phenylalanine and methanol.

Methanol is toxic to the body, making aspartame potentially dangerous. Nevertheless, methanol content in soft drinks with aspartame is about the same as in fruit juices. The European Food Safety Authority have established that an average woman would have to drink around 15 cans of aspartame sweetened, carbonated drink for it to be unsafe.

180 times sweeter than sugar, only minute quantities are needed to achieve the sweet taste we all crave. With 99% of all the calories in sugar being replaced by a calorie free alternative, no wonder so many of us opt for ‘diet’ or ‘sugar-free’ options.

Whether it be at home, or on a night out teamed with a strong spirit – carbonated drinks are an essential to many. With the British Soft Drink Association uncovering the carbonates consumption in the UK being 6,380 million litres in 2014 [2], it seems highly unlikely that we will be giving up our cans of fizzy drinks anytime soon.

Figure 1: Methyl L-α-aspartyl-L-phenylalaninate or aspartame

By Aylin Ozkan

Ever wondered what ingredients are in a can of your favourite fizzy drink and their effects? Carbonated water, sugars or sweeteners, flavourings, colours and acids are the main ingredients, all of which play different roles in your enjoyment of the drink.

Science policy is an area of public policy focused on the conduct of the science and research enterprise. This can range from addressing funding of science and health care, to promoting technological innovation, and producing and analyzing scientific reports in response to directives from lawmakers. However, only a small percentage of scientists engage in policy-related issues, leaving legislative procedures stripped of scientists. In an ideal society, the overall goal would be for policymakers and scientists to work together in order to achieve the best possible results for the society, based on current scientific findings.

The first and most important step in order to engage with policy is to effectively communicate with national governments, local organizations and, ideally, with the public as well. Sir Mark Walport (Government Chief Scientific Adviser and Head of the Government Office for Science) argues that “Science isn’t finished until it’s communicated. The communication to wider audiences is part of the job of being a scientist, and so how you communicate is absolutely vital”. It is, however, extremely challenging to effectively communicate research findings and advocate on relevant scientific issues. Most of the time, the scientific “ignorance” of the public leads to misconceptions and misinterpretations of well-known scientific facts. Scientists can often feel that they are arguing against the public, media and interest groups. So how can these gaps in knowledge, skills and communication between scientists and policy-makers be bridged?

Focusing in the scientific aspect, scientific work is mainly presented through peer-reviewed publications; an inaccessible means of communication to anyone outside of a research institution. Furthermore, papers are not approachable by a non-specialist, due to the nature of research and specialty and nomenclature as well as lack of background knowledge on the topic. This gap between in-house science communication and public perception of science needs to be addressed by scientists of all levels. Reinforcing the channels of scientific communication is the first and most crucial step in reaching out to policy-makers.

In order to provide a clearer route into policy careers for scientists in the Faculty of Science at the University of Sheffield, and to practice science communication at different levels, the Science in Policy (SiP) group was established in 2013. SiP is a group of early career researchers (PhDs and postdocs) interested in how science shapes policy, at the EU, national and local level. SiP wants to bridge the gap in knowledge, skills and communication between scientists and policy-makers.

Through monthly events, SiP provides apolitical workshops, talks, discussions and debates that address a series of policy-relevant points. In the past, these gave included:

- The way European and UK Government interact through political processes
- Routes through which science becomes incorporated into Governmental policies (evidence-based policymaking)
- Ways to engage with societies that offer science policy fellowships (such as the Royal Society of Chemistry) or within the government (such as Parliamentary Office of Science and Technology – POST).

Recent events have included a trip to London where the group attended a Select Committee session, a workshop with Parliamentary outreach, a lively debate on the fact, fiction, collaboration and conflict of science and policy, and an interactive workshop on EU Research Policy by Dr. Martin Penny, head of Unit for Physical Sciences and Engineering in the Executive Agency of the European Research Council.

If you are interested in SiP, there are many ways to get involved!

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Have a look at our events page for details of upcoming events www.sheffieldscienceinpolicy.com/events.html

“Science isn’t finished until it’s communicated. The communication to wider audiences is part of the job of being a scientist, and so how you communicate is absolutely vital”

By Stella Kritikou
An interview with Jim Thomas

By Abigail Sinclair and Juliette Craggs

Professor Jim Thomas has been an academic in the Chemistry Department at the University of Sheffield since 2004. He started his chemistry career at Reading University, where he obtained his BSc in 1982. He went on to study a PhD at the University of Birmingham before spending a year at the Université Louis Pasteur in Strasbourg as a Royal Society European exchange fellow. He then returned to the UK and came to Sheffield in 1994, first as postdoctoral researcher, then becoming a lecturer, senior lecturer, reader and finally professor in 2015. As well as leading a research group looking into the use of active metal centres in functional molecular architectures, he delivers a number of undergraduate lecture courses and is an active member of the department, as both ChemSoc president and head of the staff student committee. Abigail Sinclair and Juliette Craggs interviewed Prof Thomas to find out a bit more about his research and his other roles in the department.

What first sparked your interest in chemistry?

To be honest I quite liked thinking that I could make explosives and rocket fuel and stuff like that! Chemistry just seemed like making bangs which, when you’re 13/14, seems quite exciting.

What brought you to Sheffield and what do you like most about it?

I was originally working in France and I was looking for jobs in the UK, not specifically in Sheffield.

I came to work with Chris Hunter as a postdoc, and there was a job opening at this university in my area of chemistry, so I came here more specifically to work alongside Chris due to his good reputation in the area of chemistry I was working in. So I came to Sheffield and I loved it; it’s a great department and there are lots of other things going on. I also love walking in the Peak District, which is an added attraction.

Could you give a brief summary of your current research?

I am interested in molecular recognition – being able to assemble molecules that recognise interesting substrates, such as biomolecules. These will have a readout when they bind to a biomolecule such as DNA. We normally use one that changes in luminescence or phosphorescence; when something gets bound it isn’t emissive until the substrate we’re trying to detect binds to it. I am also interested in the idea of devices based on electron transfer,
where the electron transfer in the system is triggered by a type of host or recognition event. This leads to cell imaging and theranositics – a molecule which can be therapeutic and also have diagnostic and imaging capability.

**What sort of applications does it have?**

Cell and tissue imaging, theranositics, and sensors among others. We’ve got a couple of things which are rapidly developing to the point where they could be anticancer therapies so the next step may be going into animal models.

**What first made you interested in this area?**

I don’t like doing synthesis for synthesis sake. I quite like making things that will have some function at the end but also measuring the function ourselves – we like to do the whole thing rather than just be there as a middle man. This attracted me towards things which are redox active, have luminescence or some photophysical excitation state.

Then, when I was doing a postdoc, I was making materials that I really thought could be interesting. It was for molecular wires, things where your shine light one end and energy or the electron goes to the other, but I kept on saying to the guy I was working with “These look like things that could bind to DNA” (because there was quite a lot of work being done in that area). He just said “I’m not really interested in that, you just carry on doing this” so when I got the chance to do some research I resurrected the same sort of idea but not the exact molecules.

**What are your future research plans?**

To take over the world! We’ve got a number of things that are just getting to the point of being really interesting. At the moment they haven’t been published so it’s difficult to say but we have a number of systems particularly in the therapeutic end of things which are really novel and have effects like, for instance, being cytostatic (they don’t actually kill cells classically). There’s a lot of work on these drugs, which stop rapidly growing cells and it’s been found that in many cases when you stop the rapid growth of cancers then the bodies own defensive systems can actually cope with attacking the cancers. So we’ve developed along with a group in India some cytostatic compounds, which is quite a novel thing, it’s the first metal complexes which show these kind of behaviours, and its a big area in pharmaceutical science. Some of the compounds, which we haven’t published yet show this similar behaviour, but they are rapidly taken up by cancer cells, so this long term is quite an interesting thing.

**One of your other roles is Chemsoc president; do you enjoy this and what does it involve?**

Yes! I was really chuffed to be asked again, because I’ve done it a couple of times before. I’m running out of things to talk about so that’s why my presidential address was about myself, a bit egotistical but I’d run out of topics to talk about. help towards that, that’s great. We’ve got quite an active Chemsoc compared to some places that I’ve been to and I think that’s really nice. It’s a good way to develop a community and it’s nice to see young people who are interested in chemistry. If I can do anything to

**You also lead the staff student committee, again what does this involve?**

The staff student committee is quite important as it’s the main mechanism by which students can voice their opinions and things actually do get changed because of it. There are a number of quite big issues that have been addressed. A reading week came up through staff student committee about 6 or 7 years ago. We ran one and through the committee, the students said “You know, this isn’t working”. It was good because the students brought it up and it was tried and it was the students who then fed back. There are other things like the structure of the course, projects and the way things are marked. All these things have been changed because of student involvement. Things get taken up by teaching committees because they see the meetings minutes and me or the chair get them involved.

I think it’s the sort of activity that produces results and it’s the fastest way the students can feed back. At the moment I’m looking for first year students because of that.

“We would like to thank Prof. Thomas for his time and enthusiasm answering our questions.
A Chemical Romance

It’s that time of year again when loving thoughts and feelings are abundant thanks to cupid’s annual Valentine’s Day visit. Heart rates increase from a stolen smile, and butterflies flutter in the stomachs of those whose eyes have met across a crowded lecture theatre. But why do our bodies have such a profound (and uncontrollable) reaction to the object of our desires?

A report from Rutgers University[1] broaches this subject, outlining the numerous chemicals involved in influencing the rather complex affection that is love. It is suggested that humans exhibit three primary emotion categories (lust, attraction and attachment), each associated with their own discrete stimuli.

The commonly known hormones oestrogen and testosterone play their part in the category of lust and motivate humans to seek affection. Attraction (better known as ‘romantic love’), however, is as a consequence of a series of chemicals known as catecholamines (Figure 1).

Those lucky enough to have experienced romantic love have described feelings of exhilaration, an increase in energy, sleeplessness and a reduced appetite. These feelings are not too dissimilar to those brought about by taking the drug amphetamine. Research conducted found that in both cases these intense sensations are brought about by an increase in the levels of dopamine and norepinephrine in the body, which may explain the addictive effect that love can hold over a person.

But once the initial excitement starts to fade what drives us to form an attachment to our partner? At this point it is the turn of the neuropeptides oxytocin and vasopressin to take action. Both chemicals are responsible for the sense of security, comfort and reduced anxiety felt when close to the loved one.

So next time your crush makes your heart pound, or you find peace from a cuddle with your significant other, think about the numerous chemicals surging through your body which are all working together with the aim to make you feel good. And for those still searching for love? Watching a good comedy flick with your favourite bar of chocolate can be just as effective at releasing dopamine and all the loving feelings that come with it.

The University of Sheffield have committed to a 43% carbon emission reduction by 2020—but how do we plan to do this? The University is dedicated to minimising its environmental impact in many different ways including introduction of renewable energy sources, increasing thermal efficiency of buildings and planting gardens around campus to increase biodiversity. These positive changes, through which the university is becoming more ‘green', have been brought about by ‘The Green Impact scheme'—a rewarding and fun sustainability accreditation scheme that is in place in more than 50 Universities across the country.

Both staff and students can voluntarily take part in this scheme to learn more about sustainability issues and solutions.

However, it isn’t just the university as a whole that are trying to make improvements, there is also a strong focus on reducing our impact as a department. You may be surprised to know that one of the largest uses of energy in the Chemistry department is fume hoods! Most of us don’t realise that as fumes are extracted, warm air is removed and cold air which requires heating is pumped in from outside. Unfortunately, turning them off simply isn't feasible due to the smells and vapours that could be left behind. After conducting a survey of chemistry undergraduates we discovered that one third of us forget to pull down fume hood sashes when they’re not in use. Did you know that doing this can reduce the flow of air into the fume hood and therefore decrease our energy usage?

We know that fume hoods are the main culprit, but it is tricky to reduce the impact of these, so what are the other areas in which the department is making changes? The lights contribute significantly to our energy usage, although are not the main drain on electricity. Therefore, the department are in the process of trying to minimise the impact of the lighting by replacing halogen bulbs with LEDs. This not only gives a longer lasting, better quality of light that does not yellow, but means that we could reduce the number of lights in the building by one third. Some lights are being connected to motion sensors, which can be done by simply re-fitting the switches without rewiring. Ultimately, this will save a lot of energy in corridors, stairways and toilets, which are often empty, yet still lit.

You may be surprised to know that one of the largest uses of energy in the Chemistry department is fume hoods!

As a department our level of water usage is significant, for example something as simple as leaving water running through a condenser uses an average of 102 litres of water per hour. This means that one condenser in use for an hour every week uses roughly 4000 litres of water per year!

Many researchers in the department carry out reactions under reflux for up to six hours a day, or sometimes even over a whole weekend, presenting an obvious problem.

One investment of interest to the department is introducing “Fin-densers”. These consist of a metal jacket around the condenser, which is kept cool by circulating air in the fume hood so there is no need for any water usage. This is a promising solution, although costly, it could be paying for itself within a year! An other option would be to increase the use of water re-circulators such as the ones currently used for the rotary evaporators in undergraduate laboratories, where one stream of water is repeatedly used.
13. The attractive force between two oppositely charged ions (5, 4).
15. This gives a lilac flame test and a yellow precipitate with silver nitrate solution (formula).
17. A highly electronegative element (formula).
19. These are responsible for the relatively high boiling point of water (5, 8).
23. This melts at zero centigrade and floats on water.
24. This sublimes and, in the vapour state, is comprised of isolated diatomic molecules.
26. The amount of carbon in 12 g of the carbon twelve isotope.
27. Built of ions.
28. This molecule is comprised of two atoms which can be envisaged as being held together by two sigma bonds and a dative bond (formula).
29. Lead is one.
30. This element is a gas. It is relatively unreactive because the atoms in its diatomic molecules are triply bonded and difficult to separate (symbol).
32. Opposite of Ionic.
35. An adjective describing how a piece of graphite feels to the touch.

15. Halide of group I element (formula).
16. A chrysotile halogen (formula).
18. The shape of sodium chloride crystals,
19. This gas boils at 4K.
20. General name of an element in group 0 in the periodic table.
22. An element in the first transition series (symbol).
25. A gaseous diatomic molecule in which the atoms are doubly bonded (formula).
33. An allotrope of oxygen (formula).
34. An element with the electronic structure 2, 2, 8 (symbol).

Across:
1. Weak intermolecular bonds (3, 3, 4, 6).
4. It has the highest melting point of any metal (symbol).
5. He formulated rules helping to decide the degree of covalency of a solid.
6. As a general rule, are organic compounds high melting or low melting?
10. Distort (with respect to an electron cloud).
11. An excellent conductor of heat and electricity (symbol).
12. Exceedingly malleable.
14. The chloride of this element forms dimers and chans (symbol).
17. A highly electronegative element (formula).
19. These are responsible for the relatively high boiling point of water (5, 8).
23. This melts at zero centigrade and floats on water.
24. This sublimes and, in the vapour state, is comprised of isolated diatomic molecules.
26. The amount of carbon in 12 g of the carbon twelve isotope.
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28. This molecule is comprised of two atoms which can be envisaged as being held together by two sigma bonds and a dative bond (formula).
29. Lead is one.
30. This element is a gas. It is relatively unreactive because the atoms in its diatomic molecules are triply bonded and difficult to separate (symbol).
32. Opposite of Ionic.
35. An adjective describing how a piece of graphite feels to the touch.

Down:
1. Number of bonds an atom or group can form.
3. The chloride of this metal has considerable covalent character (symbol).
7. A charged particle.
8. A non-metal structure which has layers of hexagonally arranged atoms.
12. Exceedingly malleable.
14. The chloride of this element forms dimers and chans (symbol).
16. A chrysotile halogen (formula).
18. The shape of sodium chloride crystals,
**Resonance NEEDS YOU!**

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What’s more, if you’re a first or second year undergraduate, getting involved counts towards your Higher Education Achievement Report (HEAR).

Anyone can join, regardless of experience. If you’re interested, contact us on Facebook or drop us an email: chem-news@sheffield.ac.uk

Events Listings

“How scientists can work with Policy Makers”  
by Paul-Pearce-Kelly  
Monday 15th February  
10:15 BMS Conference Room

Chem Soc Book Sale  
Thursday 18th February  
Dainton Building Foyer

“Food Production, Health and Environment”  
SiP Panel Debate  
Tuesday 8th March  
18:00, The Diamond Lecture Theatre 5

Science Week  
13th-22nd March

ChemSoc Bake Off  
Thursday 17th March  
G Floor - time TBC

ChemSoc Ball  
Saturday 23rd April at Royal Victoria Holiday Inn  
Pre Bar at Interval  
Tickets on sale from Week 3.

Various nights out, guest lectures and non-alcoholic socials to be confirmed.

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