

School Science Review

The ASE's journal for science education 11–19

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This edition of *SSR* celebrates the fact that the Association for Science Education (ASE) has been in existence in its present form for 50 years – a golden jubilee. When thinking about how this milestone should be recognised, I took some background from the official anniversary book which was then being compiled and asked the same editors, Edgar Jenkins and Valerie Wood-Robinson, to help with this special edition of *SSR*. Some authors are also contributors to the book, some are not.

For many of our themed journal issues, we seek contributions from elsewhere in order to bring ideas and knowledge into the Association. In this case, we can truly say that the theme has been produced in-house.

What the theme authors have in common is that they have all contributed significantly to the life of ASE (some of them throughout the entire half century) and that, over the years, I have come to know every one of them personally. One fact that does come out of their articles is that they all started this developing involvement by attending local meetings and then joining section or region committees. The ASE Annual Conference is an impressive event but it is not always easy for teachers to attend. However, opportunities exist for members to meet colleagues in their own areas, share ideas or learn new techniques and generally feel that others experience the same problems and concerns.

I did consider including an article about managing a region, but is there a typical region? People are closer together in urban communities but in other areas the population can be very thinly scattered and, no matter how attractive the programme for an event might look, the thought of a 20 mile journey on a dark evening (after doing a day's work and with more to prepare for tomorrow) can be off-putting. Travel is generally easier than it used to be and yet three years ago, when planning for the 75th anniversary of the establishment of the branch of the Science Masters' Association in Yorkshire, we discovered that in 1934 nearly 120 people from a wide area turned up to an event that lasted from 10 am to 4 pm on a Saturday in November. Determination!

I will leave Edgar and Valerie to introduce the theme on page 29. For older members, this special issue will be a piece of nostalgia. For younger members, I hope it will provide an insight

into how the Association is run and what it has achieved. I think that every contribution is easy to read and offers a fascinating story; and much more could have been written.

Another fascinating story is told by Simon Young, who has, through a connection with charity work, monitored lichens on tree trunks on journeys between Britain and Russia. Superb photos illustrate the evidence which can provide indication of atmospheric pollution. Helen Barley and colleagues give a reflection of participation in the 'Researchers in Residence' scheme, which is now closed, and they make it clear that there are benefits to be obtained from bringing postgraduates into school to work alongside teachers, and express the hope that similar schemes will be established again. To complete the content, Bev Goodger describes a CPD opportunity for teachers to study plant science alongside undergraduates. The purpose is to raise awareness of new ways to study plants and their uses, recognising the fact that human and animal biology tend to be more popular among teenagers.

Christopher Talbot can always be relied upon to offer thought-provoking accounts of theoretical chemistry. Along with Lydia Yap, he starts off the *Science notes* with an explanation of the values of the melting points of aluminium and magnesium oxides. Peter Borrows, a long-serving member of the *SSR* Board representing safeguards, describes a simple activity that can simulate forensic investigation, and Sohan Jheeta offers students the chance to design their own investigation with a challenge intended to develop the understanding of friction.

In the *Clubbers' Guide*, Sue Howarth and Linda Scott introduce an extensive account from Liz Carter, whose excellent article in our September 2012 edition is now followed by a description of a summer school offered during August to the incoming year 7 students. You only have to read it to realise why there is no shortage of children willing to take part.

Any journal mostly relying on items written by members needs items to be submitted but there is often a lack of courage or a fear of rejection. Alaric Thompson had his first *Science note* published in our December 2012 issue and at my invitation he has described the process from his viewpoint.

Geoff Auty

Editor, School Science Review

Health & Safety

For all practical procedures described in *SSR*, we have attempted to ensure that:

- all recognised hazards have been identified,
- appropriate precautions are suggested,
- where possible procedures are in accordance with commonly adopted model risk assessments,
- if a special risk assessment is likely to be necessary this is highlighted.

However errors and omissions can be made, and employers may have adopted different standards. Therefore, before any practical activity, teachers should always check their employer's assessment. Any local rules issued by their employer must be obeyed, whatever is recommended in *SSR*.

Unless the context dictates otherwise it is assumed that:

- practical work is conducted in a properly equipped laboratory,
- any mains-operated and other equipment is properly maintained,
- any fume cupboard operates at least to the standard of Building Bulletin 88,
- care is taken with normal laboratory operations such as heating substances or handling heavy objects,
- good laboratory practice is observed when chemicals or living organisms are handled,
- eye protection is worn whenever there is any recognised risk to the eyes,
- fieldwork takes account of any guidelines issued by the employer,
- pupils are taught safe techniques for such activities as heating chemicals or smelling them, and for handling microorganisms.

Readers requiring further guidance are referred to:

Hazcards (CLEAPSS, 2007 and updates)

Topics in safety, 3rd edn (ASE, 2001)

Safeguards in the school laboratory, 11th edn (ASE, 2006)

Safety in science education (DfEE, 1996)

Preparing COSHH risk assessments for project work in schools (SSERC, 1991)

Hazardous chemicals: an interactive manual for science education CD2 (SSERC, 2002)

Be safe! Health and safety in school science and technology for teachers of 3- to 12-year-olds, 4th edn (ASE, 2011)

Contributing to *SSR*

We welcome contributions for all sections of *School Science Review*.

These can be emailed to The Editor, ssreditor@ase.org.uk, or posted to The Editor, *School Science Review*, ASE, College Lane, Hatfield, Herts AL10 9AA.

Detailed advice on the submission of articles and Science notes is available on the ASE website at: www.ase.org.uk/journals/school-science-review/submissions.

A problem with mass

The letter from John Baker (2012) raises some difficulties. It is stated that, if a particle were accelerated to a high speed, ‘its rest mass would increase, the thickness along the line of motion would decrease and any clock it might be carrying would start to run slow’. These assertions express the tentative views of Fitzgerald and Lorentz in a period in which there was a belief in an absolute standard of rest in the hypothetical ‘ether’.

Einstein cleared away these pioneers’ speculations by proposing that there is no such standard of rest.

In Einstein’s system, an observer in uniform relative motion with respect to an object will detect apparent changes in mass, length and time in that object but there are no actual changes. There can be an infinite number of observers each making his or her own determination but obviously none can affect the object in any way. The ‘rest mass’ – that is, the mass (inertial and gravitational) determined by any observer at rest with respect to the object – is not affected by the existence of any other observers.

Einstein showed that electromagnetic radiation transfers both mass and energy, these being directly proportional to each other. Hence he found the equation $E=mc^2$, which he argued was applicable to *all* kinds of energy, contrary to much popular interpretation (Warren, 1976). To describe

radiation as ‘massless’ is as absurd as to describe it as ‘energy-less’ or ‘momentum-less’. The transfer of momentum was known to Einstein from previous theory and experiment. It did not depend on de Broglie’s ideas, which came 20 years later.

It is important to remember that such quantities as mass and energy are mathematical quantities, invented to aid analysis of the results of experiment. We cannot put an object or a phenomenon into an equation, but only an abstraction that describes it. Thus, for example, we speak figuratively of energy in space, but this means that there is some object or radiation that we analyse in terms of energy. Strictly, energy only exists in our minds.

Finally, there is a separate issue for which most readers will regard me as a heretic. I contend that a *photon* is an *event* of the inelastic interaction of radiation with matter and is not a particle in any sense. The quantum rule $\Delta E=hf$ results from the nature of matter.

References

- Baker, J. (2012) Light, gravity and black holes. *School Science Review*, **94**(347), 7–8.
 Warren, J. W. (1976) The mystery of mass and energy. *Physics Education*, **11**(1), 52–54.

John Warren
 Wembley

Correction: A problem with mass

In the letter by John Baker in the December 2012 issue of *SSR* (Baker, 2012), the equation representing Einstein’s law, which describes the energy of particles both with and without mass, was printed as:

$$E^2 = pc^2 + m^2c^4$$

It should have been:

$$E^2 = p^2c^2 + m^2c^4$$

where E is the energy of the particle, p its momentum, m its rest mass (mass when at rest) and c the maximum velocity for anything, which is usually described as the velocity of light.

We apologise to the author for this production error.

Reference

- Baker, J. (2012) Light, gravity and black holes. *School Science Review*, **94**(347), 7–8.

MAKING MATERIALS MATTER

A new initiative to encourage STEM careers in schools

If you look around you today you will find a whole host of fabulous gadgets that have been designed to make our lives more comfortable, our friends more accessible and our homes more energy efficient. From light bulbs to LED televisions and memory foam mattresses to smart phones, all of the advances in technology that we take for granted have one thing in common: materials.

Despite the fact that these technological leaps are driven by improvements in our understanding of materials or the development of new ones, Materials Science and Engineering remains a niche subject that few school students have heard of, let alone consider it as a career. However, pupils have been studying materials since their first day at school. Aspects of materials science and engineering form key parts of the curriculum for science and design technology. Many students enjoy A-levels in Maths, Physics and Chemistry but are unsure of what they can do with this magical triad of subjects other than medicine or straight science courses. Students of Product Design don't necessarily think of engineering as an option either.

The Armourers and Brasiers' Company, Tata Steel and the Institute of Materials, Minerals and Mining have been working together to develop a new initiative which encourages schools to actively support students in pursuing STEM careers. It has been set up to give students structured opportunities to find out more about the importance of the materials used around us, outside of the constraints of the curriculum and normal lessons, and allow them to foster a sustained interest in Materials Science and Engineering, which is vital to the future of the UK economy.

The Armourers and Brasiers' Tata Sixth Form Materials Prize has been designed to run as a competition outside of lesson time. It is open to year 12 students studying at least one STEM subject and they must commit to engaging with the project for a minimum of 18 hours across the whole year (roughly three one hour sessions each half term). At the heart of the Prize is a Portfolio of Experiences based on six short modules on themes which give students a better understanding of the importance of Materials Science and Engineering in society and some knowledge of the fundamental science of materials above and beyond what they might be studying in their lessons. The themes of the modules are as follows:

1. What is Materials Science and Engineering?
2. Materials around us

3. The future is materials
4. Fuelling the future
5. Where can materials take me?
6. Individual research project

Students will gather together the results of their experimentation and discussion in their Portfolio, along with any other useful links, articles and 'materials experiences' that they may have had. As part of the final module they must also prepare a five minute presentation which they will deliver to their peers.

The sessions have been created so that they can be led by staff from the science or design technology department, though in an ideal world the two departments would work together as materials is such a multidisciplinary subject. A full pack of support material will be provided for teachers, including detailed notes, handouts and ideas for activities which can all be done with everyday materials and equipment that most schools already have.

Teachers may nominate up to five candidates for the Prize, judged on the basis of the portfolio and presentation. Six finalists will be selected from all the submitted portfolios and these finalists will be invited to give their presentation at Armourers' Hall. The overall winner will be chosen on the basis of their presentation and portfolio. The winning students and their schools will receive substantial prizes:

First Prize	£1500 for the student and £1000 and IOM3 SAS membership for their school
Second Prize	£750 for the student and £500 and IOM3 SAS membership for their school
Best Portfolio	£750 for the student and £500 and IOM3 SAS membership for their school

Three runners up will received £250 each and IOM3 SAS membership for their schools

If you would like to run the competition in the 2013–2014 academic year you will need to register your school. You can do this by completing and submitting the form at www.iom3.org/A&B-TataPrize. Once you have registered you will be able to access all of the materials that you will need to run the competition in school. The closing date for registrations is Friday 04 July 2013.

Full details of the Prize are available at www.iom3.org/A&B-TataPrize, alternatively you can contact Dr Diane Aston (diane.aston@iom3.org) for more information.



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