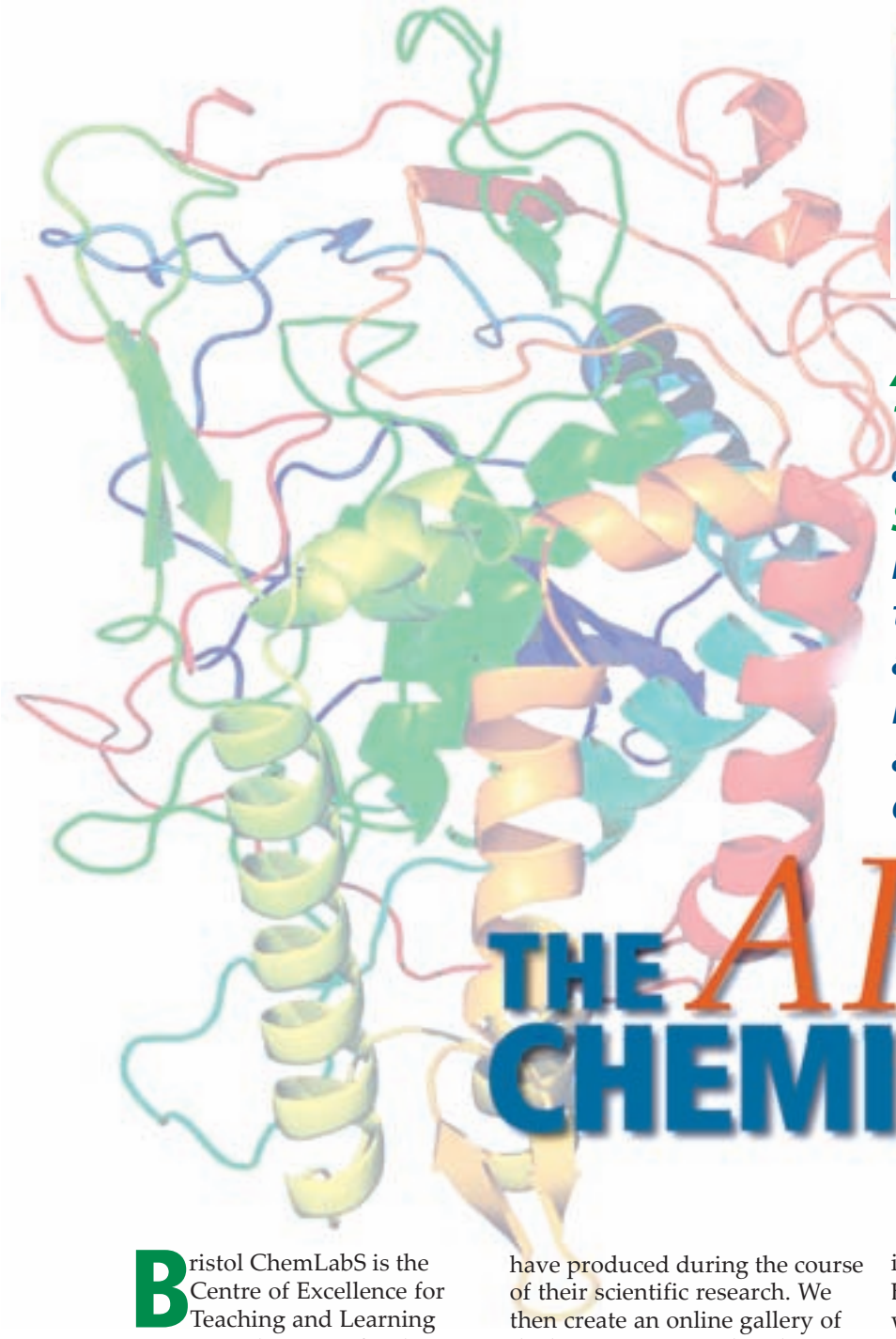


CURRICULUM CHANGE AND ICT

***Alison C. Rivett**, **Tim G. Harrison** and **Dudley E. Shallcross** share*

how bringing together chemistry, art and literacy can inspire creativity and provoke curiosity

THE ART OF CHEMISTRY

Bristol ChemLabS is the Centre of Excellence for Teaching and Learning (CETL) in Chemistry for the UK, based in the School of Chemistry at the University of Bristol; its extensive outreach programme has been described previously in this publication (Shallcross *et al.*, 2006). The Chem@rt initiative brings chemistry into the classroom and at the same time stimulates literacy and imagination, using a series of dazzling and intriguing images drawn from current chemical research.

How does Chem@rt work?

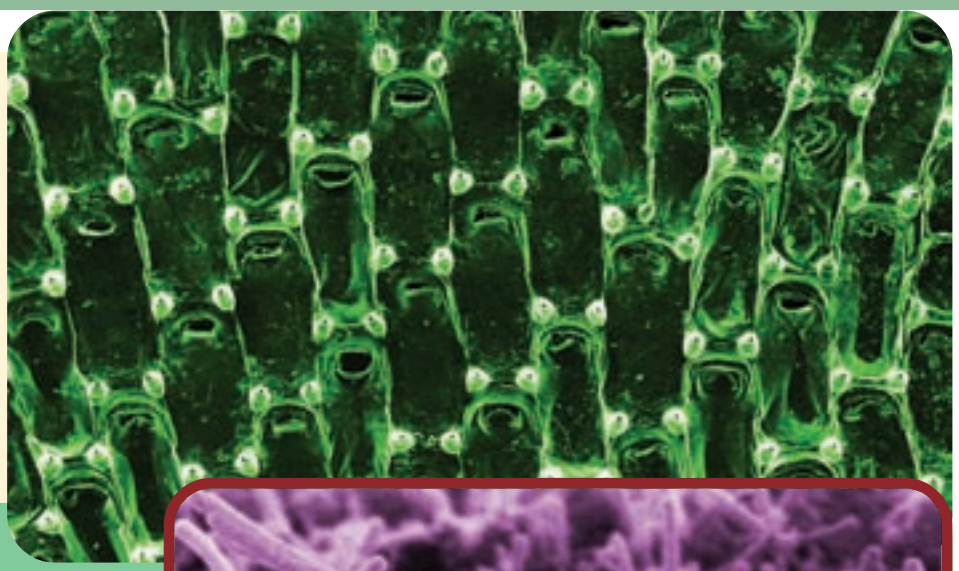
Every year researchers working in the School of Chemistry submit images to us that they have produced during the course of their scientific research. We then create an online gallery of the best pictures on the Chem@rt website (see *Websites*). Schools can download them to use with their pupils as stimulus for poetry and/or prose writing competitions.

The Chem@rt initiative started in 2006, when the first collection of 16 images was mailed to nearly 50 primary schools in the local area. The schools received reproductions of the images with simple explanations of what they were. They were invited to display the images and run a poetry/prose-writing competition within the school. Teachers or governors decided on the best piece of literature, either per image, per class or per year, and Bristol ChemLabS certificated the winners. Schools also received a visit from a professional chemist who talked about the images and presented the winners with prizes.

Since then a new gallery has been produced every year, with the images ranging from the totally abstract to the very unusual. The pictures range over the whole gamut of research that takes place in the School of Chemistry, from materials to the environment, as well as the outreach activities.

The images

Although the Chem@rt images are the product of what can seem quite esoteric scientific research,



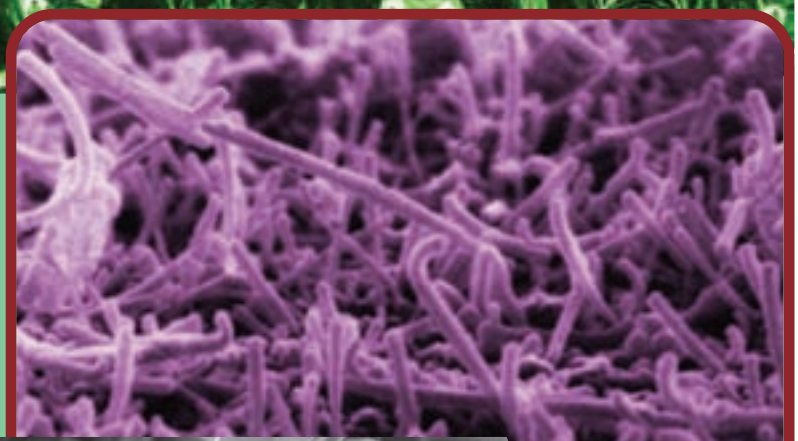


Figure 1 (top)
Frog chorus

Figure 2 (right)
Carbon spaghetti

Figure 3 (below)
Crystal kebab

Figure 4 (below right)
Bacterial scrapheap challenge

they can still have meaning for, and spark interest in, people who have no concept of the in-depth science behind the picture.

A great example of this appeared in the first gallery: *Frog chorus* (Figure 1) shows a colony of tiny Bryozoa microorganisms, coral-like animals which live underwater on seaweed and rocks. The picture is actually of the complex chalky shells in which each animal lives but, as its name suggests, reminds everyone of a group of little frogs singing their hearts out.

Like *Frog chorus*, many of the Chem@rt images are produced using very powerful electron microscopes. These huge machines use beams of electrons (tiny particles from within an atom), rather than light, to create images and can magnify objects up to 10 000 or 100 000 times to show objects that are a million times smaller than a one-pence piece. At this magnification nanotubes (very strong tubes made of carbon atoms) might look like spaghetti (*Carbon spaghetti*, Figure 2), scale deposits on clothes like a big kebab (*Crystal kebab*, Figure 3), or bacteria like tightly coiled springs (*Bacterial scrapheap challenge*, Figure 4).

As powerful as electron microscopes are, they still cannot image individual atoms and molecules and this is where computer models come in. *Smooth operator* shows a colourful computer-generated image of a protein – *Botulinum toxin* (Figure 5) – more

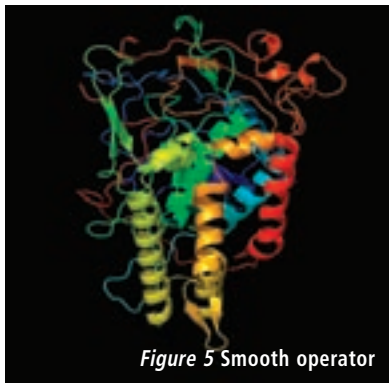


Figure 5 Smooth operator

commonly known as Botox. Computer programmes are commonly used to predict the behaviour of new molecules or to calculate whether a chemical reaction will proceed or not.

Other images show objects at scales we are more used to, like the droplets of water on a leaf in *Don't get wet* (Figure 6). Although this looks like a simple, everyday image, it illustrates quite a complicated concept, that of hydrophobicity – the reason why water forms round droplets and does not just spread over a surface.

On the other hand, *Chemical zen garden* (Figure 7), which looks amazingly complex, is actually just the bottom of a reaction flask in which the solvent had boiled away, leaving a residue coating the bottom. This illustrates nicely the serendipity

Figure 6 Don't get wet

that often occurs in scientific research: many ground-breaking discoveries were made entirely by accident, many of which are detailed in a useful *Wikipedia* entry (see *Websites*).

The Chem@rt images do not just feature mysterious chemicals and impersonal or abstract notions: they also illustrate the human side of science. Images have included the wonder of young children

Figure 7 (top) Chemical zen garden

Figure 8 (lower) Cool chemistry

seeing clouds of liquid nitrogen for the first time (*Cool chemistry*, Figure 8), some of the amazing demonstrations carried out in the School of Chemistry (*A demonstrator's de-light*), and a scientist contemplating the possibilities of an empty laboratory (*The scientist in their lab*).

Poems and prose

The creativity and imagination shown by children of all ages in primary school has been marvellous and many of the entries received have been outstanding in their originality. The use of language and imagery can be extremely sophisticated, as the poem by year 6 student Esme, inspired by *A nano-brush for a nano-dog* (Figure 9) by Mike Ashfold, shows (Box 1). The image is not perhaps the most exciting at first glance, but nevertheless has sparked a whole raft of ideas in the writer.

Sometimes the poetry also includes science concepts, as illustrated by the poem *The eclipse* by Chloe (a year 4 pupil), inspired by *Some kind of eclipse* (Figure 10) by Judith Brown (Box 2).

Some pupils even manage to ingeniously combine the image, the title and its description in their poetry, as illustrated in this one by Harry (a year 6 pupil), inspired by *Life spring* (Figure 11) by Adrian Mulholland (Box 3).

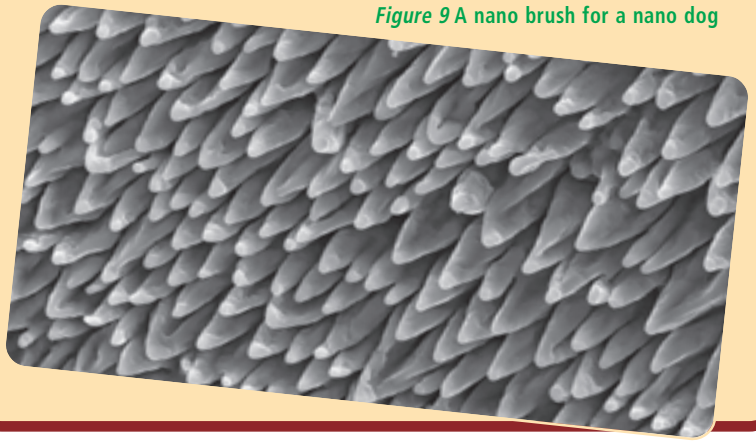
Pupils often compose longer pieces of prose. Perhaps surprisingly, the archetypal 'mad scientist' rarely features in these, but science being used to save the world or solve a particular problem, does. Many also write fantasy stories about magical adventures or voyages of discovery. This contrasts with the writing produced when the images were used in township schools in South Africa during a Bristol ChemLabS international outreach visit, where the stories the young students wrote reflected the serious issues many of them face, including HIV,

Box 1

A hazard of pencils
Dance in under water caverns,
Prickly pears point
At passing pomegranates,
Razor sharp teeth bite the breaking waves,
Mushy mushrooms move magnificently,
Scales of a trout swish
Chalky cues
Go for the eight ball,
Transfixed crowds
Gather for the Moon landing,
Penguins huddle
Facing icy winter,
Spiked triangles
Weep the beating vibe,
Rockets depart the Earth's warming embrace.

Esme

Figure 9 A nano brush for a nano dog



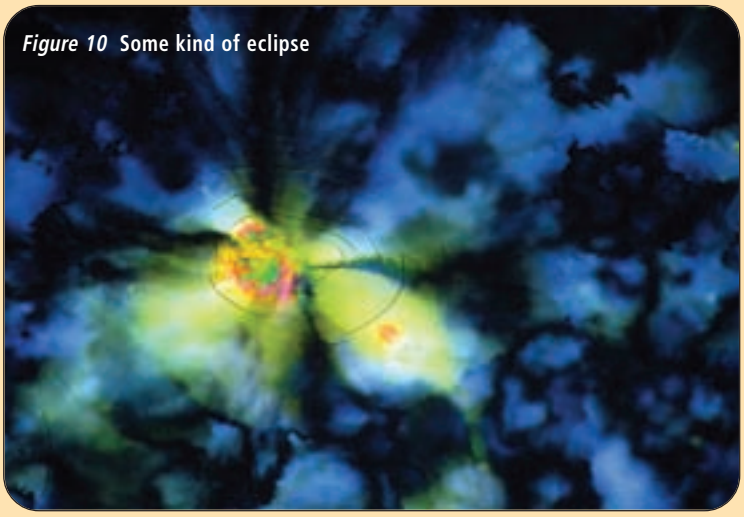


Figure 10 Some kind of eclipse

Box 2

The eclipse

Black, blue, green, yellow and orange the eclipse can be seen.

When the Moon covers the Sun a flash can be seen

Black clouds go boom like a big brass band. What is happening people ask the eclipse?

We need to wait a long time until the next one. What colours will it be?

Everybody waits to watch the news wow, it's going to be fun!

Chloe

family separation and racial discrimination.

Feedback from teachers

The response from schools and their enthusiasm for running Chem@rt poetry and prose competitions have been very encouraging. In the first year of the project alone it was estimated that between five and six thousand pupils made use of the images in one way or another and over a thousand poems and pieces of prose were submitted. Since then, many of the original schools have continued to take part, with around one-third of entries being repeat registrations.

Information given by schools on registration shows that generally the images are used with more than one class – often with a whole key stage or the entire school. The images have also been used in ways that were not envisaged when the project was first considered. Several teachers have told us that they have found them useful in stimulating science investigations in their classes, proving how versatile they can be.

Comments from teachers have been extremely positive and give an insight into the impact a Chem@rt competition can have. Mary Howard, science coordinator at Winford CoE Primary School (North Somerset) wrote '*The 16 images ... were displayed in the library so that all children could have access to them. The discussion the images provoked was very good, allowing all abilities to participate*'. Annabel Glassby, the science coordinator at Hillcrest Primary School in Bristol commented '*This is really an innovative approach to encouraging children to relate to the science curriculum. It will have enormous benefits for our children*'. Hillcrest is already actively engaged with the Qualifications and Curriculum Authority (QCA) in developing new strategies for engaging children in learning (see *Websites*) and, as a result of their participation in the project, they are planning to include other such activities in their teaching.

Part of a bigger picture

Many primary practitioners will have combined science with art lessons, especially when teaching topics such as light and shade. Books such as *George's marvellous medicine* (Roald Dahl) or *Harry Potter* (J. K. Rowling) are often used to provide a context for science investigations. Two recent issues of this journal have been dedicated to the topics of science and stories (*PSR* **92**) and science and art (*PS* **103**). At all levels, science can inspire art and literature, as well as the other way around. The Chem@rt images are a simple and easy way of combining these subjects in a classroom, as well as getting the whole school involved in a common project, easily accessible to all ages.

Box 3

Life Spring

Life spring
Is a
Form of blood cells
Everyone has them
Surprising
Purple and
Red
In a pretty
Non-conforming pattern
Girls' ringlets in purple.

Harry

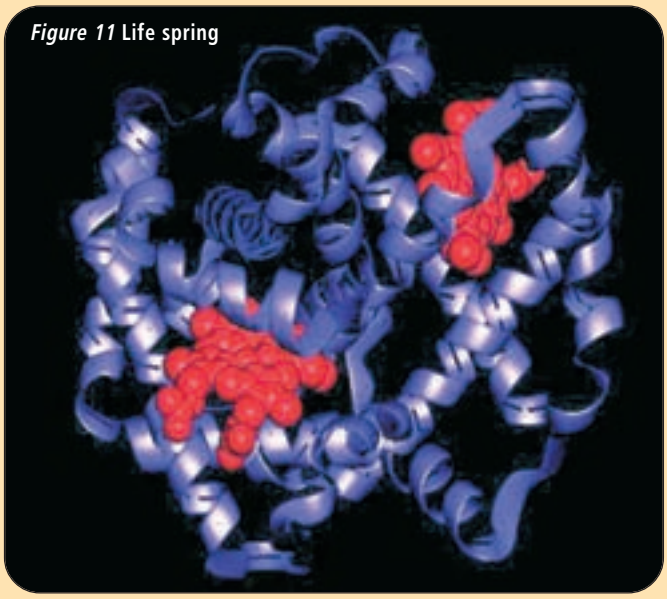


Figure 11 Life spring

Using Chem@rt in your classroom

Schools anywhere in the UK or abroad can access the Chem@rt images online. There are no deadlines for the competition, but new galleries are uploaded once a year. You simply register online to obtain access to the galleries, and then download the images and display them in your school.

Pupils can then be invited to write a story or poem that is inspired by one of the images. Once teachers or governors have judged the entries, special Chem@rt certificates can be downloaded from the website to give to participants and winners.

The final word goes to Adrian Willson from St Bernard's Catholic Primary School, who very neatly summed up the aims and ethos of Chem@rt:

It is a great idea to inspire children towards creativity while at the same time giving them the chance to experience awe and wonder; to understand that science can be beautiful as well as informative.

Acknowledgements

The Bristol Chem@rt galleries have been supported by the Bristol Alumni Fund, the EPSRC Portfolio Partnership LASER, the Royal Society of Chemistry (Bristol Section) and by Bristol ChemLabS. Ms Claire-Lise Braun has provided administrative support since the inception of the project.

References

Shallcross, D., Harrison, T.,Wallington, S. and Nicholson, H. (2006) Reaching out to primary schools: the Bristol ChemLabS experience. *Primary Science Review*, **94**, 19–22. Available at: www.ase.org.uk/htm/members_area/journals/psr/pdf/psr-94/reaching.pdf

Stories and starters special edition (2006) *Primary Science Review*, **92**. Available at: www.ase.org.uk/htm/journals/psr/psr92.php

Science and the arts special edition (2008) *Primary Science*, **103**, Available at: www.ase.org.uk/htm/journals/psr/ps103.php

Alison C. Rivett is the primary science outreach consultant for Bristol ChemLabS. Email: alison_chemlabs@btinternet.com
Dudley E. Shallcross is the Bristol ChemLabS outreach director. Email: d.e.shallcross@bristol.ac.uk
Timothy G. Harrison is the Bristol ChemLabS school teacher fellow. Email: t.g.harrison@bristol.ac.uk.

Websites

Chem@rt: **www.chemlabs.bris.ac.uk/outreach/primary/WhatIsChemart.html**
The QCA 'Big Picture': **www.qca.org.uk/libraryAssets/media/Big_Picture_2008.pdf**
Serendipitous Science Discoveries on Wikipedia: **en.wikipedia.org/wiki/Serendipity#Chemistry**