A meeting place: The Science, Art and Writing initiative

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Specialism in different disciplines inevitably leads to the use of specialized language and jargon. This is important in order to enable rapid and specific communication within focused fields of activity. It is important, however, that specialists do not lose the ability to communicate with the 'real' world – or if they do lose this ability that they should be nurtured and supported in re-gaining it. Scientific images offer a meeting place for people from all walks of life, regardless of age and experience. The Science, Art and Writing initiative is a cross-curricular science education initiative in which images from science provide the starting point for adventures – adventures that involve exploration through scientific experimentation, art and creative writing (www.sawtrust.org). This union of science, art and writing around a central scientific focus represents a powerful way of bringing science into everyday lives and learning.

Keywords: CP snow, Science, Art and Writing initiative, science education, scientific images, specialization.

Background

THE rigid divisions between science, the arts and other subject areas are clearly evident at high school level, where a different teacher teaches each subject. However by the time young children leave primary school they are already acutely aware that the curriculum is compartmentalized into different disciplines and they tend to regard these disciplines as isolated from one another, rather than recognizing the synergy between them. By the time we reach adulthood and become specialists in science or in other subjects our ability to recognize this synergy has often diminished even further. We become the smallest of branches on an ever-dividing tree. And if we become too specialized we are in danger of snapping off and falling to the ground. Of course specialists must maintain the highest standards in their respective disciplines in order to do their jobs effectively – and inevitably this involves the use of specialized language and jargon. However if we lose the ability to communicate with non-specialists, then our value to society as specialists becomes questionable. A further divide – one that is perhaps of even more concern than the perceived divide between science and the arts, for example – is the divide between academics and those who have not been subjected to higher education. The tendency of academics to 'tell' people things, often in inaccessible language and with an air of arrogance, is disrespectful. It is not the way that children would like to learn. It is not the way that we would like to be taught.

Children explore the world around them through personal adventure and discovery when they play. In schools in the UK and elsewhere children all too often sit at desks and learn facts, and there is very little opportunity for hands-on work – learning through personal experience. Learning through personal experience is a critically important part of productive learning and enables children to have supervised ownership of the learning process. Hands-on work also brings in elements of play – questioning, exploring, experimenting, risk-taking-skills that children need to develop to realize their full potential and creativity as they grow into adulthood. Artists, writers, scientists and other professionals are unlikely to make important contributions to their fields if they lack the ability and/or confidence to take risks and to be adventurous.

Exploration of a chosen theme through complementary cross-curricular activities is an effective way of engaging learners. Teachers are under pressure to deliver the curriculum, which compartmentalizes subjects in a way that stifles inquisitiveness and quells creativity. They must also satisfy the requirements of children with different interests, learning styles and 'abilities'. I have put the word 'abilities' in inverted commas here because this refers to abilities as defined in the conventional educational sense. Children who are not regarded as high achievers are often capable of producing work of the most remarkable quality if their interest can be gained and their potential untapped. Providing children with different ways into the learning process makes learning more accessible.

I am a biologist, and my area of specialization is that of plant-derived natural products. My research is concerned with trying to understand how and why different plants make different kinds of natural products – the scents, colours, flavours, drugs and other commercially valuable compounds that we associate with different plant species. My parents both have arts backgrounds. My father has written authoritative texts on the Victorian writer and

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critic Walter Pater. As a young English graduate my mother was drawn to the works of Walter Pater through his writings on art and aestheticism and consequentially met my father, who became her supervisor for her masters dissertation. I am therefore a product of specialism myself. In 2004 I was fortunate to be awarded a Dream Time Fellowship by the UK organization, NESTA (the National Endowment for Science, Technology and the Arts), which gave me the opportunity to take an interdisciplinary sabbatical in the world-renowned School of Literature and Creative Writing at the University of East Anglia, where I wrote poetry for a year. This intense experience led me to think hard about the nature of specialism and whether or not science and the arts are indeed separate, as so loudly mooted by C. P. Snow in *The Two Cultures* in 1956 (ref. 1). My conclusion, based on my own personal experiences, was that there is no such divide[2]. In fact, there are many commonalities between science and the arts. Creativity and excellence in science and the arts depend on real insight – on the ability to focus, to observe, to note detail. They require the ability to define a problem, to enquire, to extract the essence of the problem in hand, the best possible truth. This truth must then be communicated – shared with an audience. Sharing may take the form of oral, visual or written communication. The process of observing, enquiring and communicating is not particular to science and the arts. It is a generic life skill. This kind of insight – the humble seeking of the truth – can only come about when the truth-seeker has a genuine empathy with his or her subject that stems from a hunger, from an insatiable need to explore and understand. An individual that is equipped with such empathy and commitment will lead a more fulfilling and rewarding life than one who lacks interest, focus and curiosity.

While exploring different strategies for writing poetry I found myself drawn to scientific images as inspiration for my own creative writing. This led me to explore the potential of such images for supporting science education activities in schools, and ultimately to the development of the Science, Art and Writing (SAW) initiative, a cross-curricular initiative for science education in schools (www.sawtrust.org). SAW has a solid foundation of science at its core. Each SAW project has a scientific theme. Each theme is supported by a collection of carefully selected visually striking scientific images. The theme and supporting images provide the starting point for adventures – adventures that involve exploration through scientific experimentation, art and creative writing. This union of science, art and writing around a central scientific focus represents a powerful way of bringing science into everyday lives and learning. It breaks down barriers between science and the arts while demanding the highest standards of each individual discipline. Importantly, the exploration of the theme through different approaches, along with the central role of the images, enables children of different abilities and with different learning styles to find their own way into learning. The truth-seekers are inspired to strive to find the best possible truth for each of the activities that they undertake and in doing so, through integrity, effort and tenacity, many of them will reach new personal heights of achievement. SAW projects can be run by teachers working on their own. However many of the projects that have taken place so far have involved teams of scientists, artists and writers working with teachers to design and deliver projects.

The process

The potential of scientific images can be illustrated by considering the image shown in Figure 1. The observer may have some idea of the subject matter without looking at the legend. However, if the naïve observer gazes at the image and allows the imagination to run riot then all kinds of remarkable ideas emerge. There are worlds within this image. A group of children age 4–6 looked at the image and saw a whale swimming in an underground cave, and a cliff with a lighthouse on top (Box 1). Figure 2 shows artwork by a five year old, also inspired by this image. This boy worked unaided, printing with pieces of

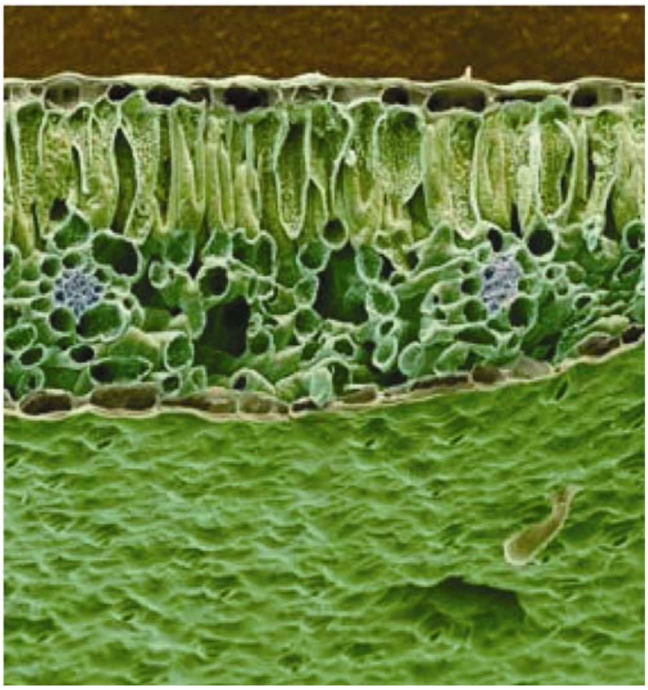

Figure 1. Coloured electron micrograph of a section through the leaf of a Christmas rose (*Helleborus niger*). The upper surface of the leaf is at the top. The long cells just beneath this are the site of photosynthesis, the process by which plants use sunlight to turn carbon dioxide into sugars. The blue spots are vascular bundles, part of the network of veins which carries water and nutrients to and from the leaf. Stomata (pores regulating gas exchange) are seen towards the bottom. Magnification approximately ×200. Image: Eye of Science/Science Photo Library.

sponge. The epidermal cells and the palisade layer of the leaf are clearly visible. These children may or may not grow up to be scientists but they are clearly observant and attentive to detail. They are also able to communicate their interpretations of what they see very effectively. Figure 3 is an image of nerve cells visualized using histochemical staining. This may seem like a rather challenging image to put in front of young children, but it is amazing how receptive children are to such images (Box 2, Figure 4).

Box 1.

Thoughts on a Christmas Rose Leaf

Bumpy,
a tadpole,
looks like a mountain,
rough, oval shape,
a coral reef,
a whale swimming in an underground cave,
a picture taken under the sea by a diver,
a cliff with a lighthouse on top.

Collective thoughts from children age 4–6,
Rockland St Mary Primary School, Norfolk, UK

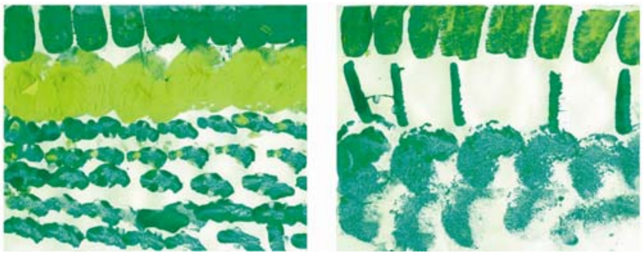

Figure 2. Christmas rose leaf. [By Ryan Smith, age 5, from Rockland St Mary County Primary School, Norfolk, UK.]

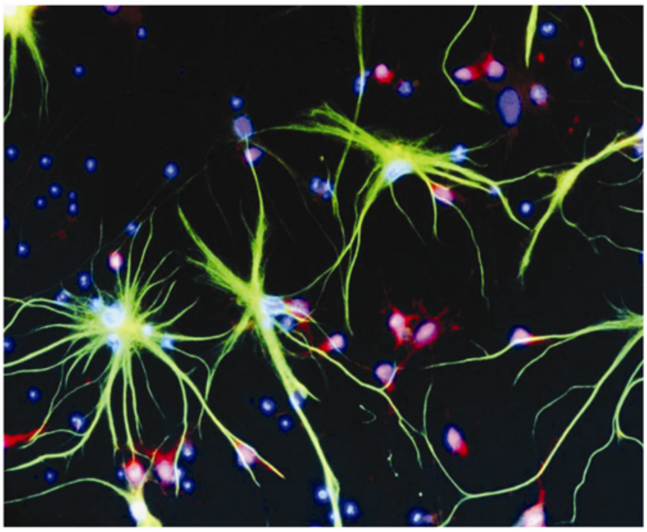

Figure 3. Nerve cells. The image shows nerve cells (pink) and star-shaped astrocyte cells (green) inside the spine. Astrocyte cells provide support and nutrients for the nerve cells and it is thought that they may store information. The blue dots are the nuclei (the control centers) of other support cells. Magnification approximately ×600. Image: Nancy Kedersha/UCLA/Science Photo Library.

Box 2.

Nerves

Bursting with colour,
Like fireworks filling the sky.
Nerves sending messages to the brain,
Sparks flying around the body,
Bright colours floating through
Arms and legs.
Flashes magnified thousands of times,
Planted seeds sown in the night.

Millie Crouch (age 8)
Rockland St Mary Primary School, Norfolk, UK

Nerve cells

Twisting, tangling, tossing
Turning
In their black abyss.

Trees of power
They could change your life
Spinning up your spine.

Dancing, laughing
Twisting, spinning

Gossiping with your brain.

Alex Marshall (age 11)
Framingham Earl High School, Norfolk, UK

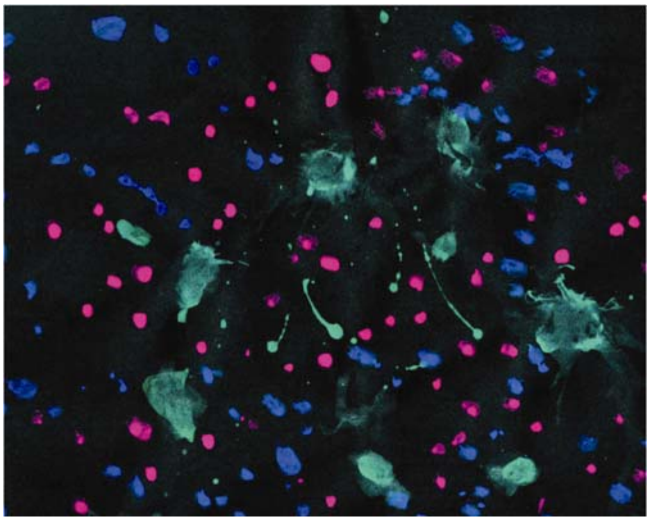

Figure 4. Nerve cells. [By Max Allinson, age 7, from Rockland St Mary County Primary School, Norfolk, UK.]

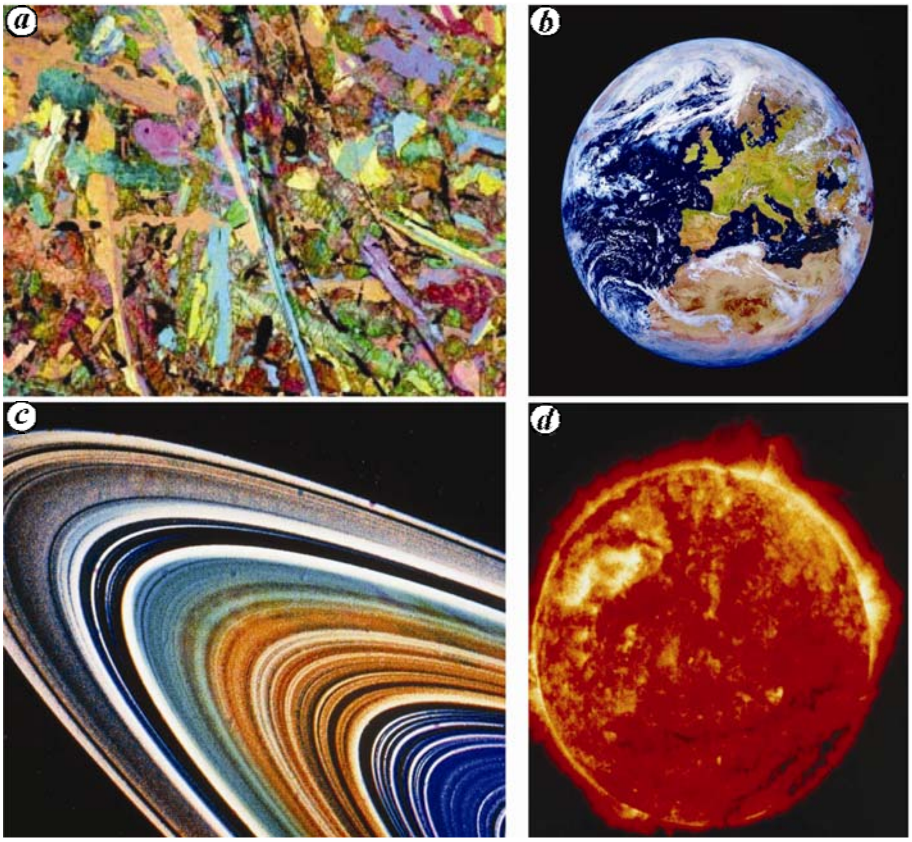

Figure 5. Images used for the ‘Outer space’ theme. ***a***, A thin section through moon rock, viewed by polarized light microscopy. Image: Manfred Kage/Science Photo Library. ***b***, Satellite image of the Earth from space. Image: PLI/Science Photo Library. ***c***, Voyager 2 photograph of Saturn’s rings. The rings are made of ice, dust and gas and reflect different wavelengths of light. Image: NASA/Science Photo Library. ***d***, X-ray image of the Sun. Image: NASA/Science Photo Library.

The above are responses to individual images on different topics. A logical next step is to assemble collections of images on particular scientific themes. For example, images on the theme of ‘Outer space’ could include close-ups of moon rock viewed by polarized light microscopy, a satellite image of the Earth from space, the rings of Saturn, an X-ray image of the Sun and so on (Figure 5). The criteria for selection of images will depend on the nature of the SAW activities that are planned as the core of the SAW project (see below). Inclusion of the moon rock image along with images of the Earth and Saturn opens up opportunities to think about scale. The methods used for generating the images may also provide a forum for discussion. A good source of scientific images is the Science Photo Library (www.sciencephoto.com). This image resource has an excellent search engine, enabling the searcher to move from one keyword to another around a chosen theme. A search for ‘photosynthesis’ may lead to ‘chloroplast’ which in turn may lead to ‘starch grain’ and to molecular models of the electron transport chain. The possibilities are infinite. It is important to ensure that the images are intriguing and surprising – representations of things viewed in unusual ways. For example, when considering light and diffraction an image of a prism would be far more effective than one of a rainbow. Children are used to seeing rainbows.

The nature of the SAW activities will depend on the age of the children. So far SAW projects have been run with children ranging in age from 4 to 15. However there is no reason why this approach would not work with older students and with adults. School projects can be run with a small group of children or a class. They can also be run as large-scale whole school projects. The ‘Outer space’ theme was explored in science with children aged 11–13 by planning and making a scale model of the solar system on the school playing field, having chosen or made correctly sized objects to represent the planets (e.g. marbles, plasticine, tennis ball, football). For the writing part of the project the image of the Earth from space provided one means of generating evocative poetry. Children were asked to imagine that they were astronauts exiled in the clinical austerity of their spacecrafts, looking back at Earth. What do they miss? How do they feel? After reading one or two poems by way of example, the children were then asked to write their own poems in which the astronaut dreams, sensually, of home (see Box 3). The images of moon rock and the planets were also used to good effect in the art session, which involved groups of children working together to make collages inspired by images of different scale (see Figure 6).

Box 3.

Earth memories

I miss my ponies in their winter fluff
as they click their hooves
in the air on the wall,
the fluff of their fur
curled against me.

Ruth Gayton (age 7)
Rockland St Mary Primary School, Norfolk, UK

Earth-sick astronaut

I long to see a face other than my own in the
sleek surfaces of space.

I long to hear a sound other than the
occasional crackle of the static on the radio.

I long to smell sizzling bacon on a hot stove,
not the cold metallic odour of loneliness.

I long to feel clear, white water trickling
through the tiny gaps between my fingers.

I long to be in my warm home,
to wake up from my dreams in a place
where I'm not roped down by the blackness

of Space.

Jack Sutton (age 11)
Framingham Earl High School, Norfolk, UK

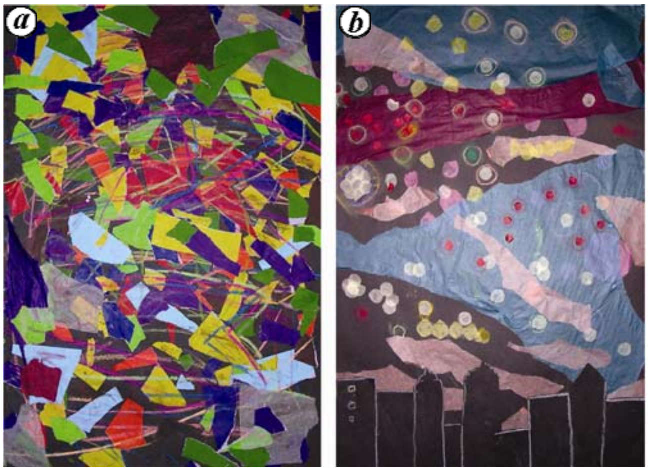

Figure 6. 'Outer space' artwork. ***a***, Moon rock, by Megan Simmon, Amelia Fibretti, Marie Barlow and Beth Andralojc. ***b***, Galaxies, by Will Milner, Alex Blakemore, Josh Clarke, Greg McVey and Harry Finney. This artwork is by children age 12 from Harrogate Grammar School, Yorkshire, UK.

The core of SAW relies on the staple trio of science, art and writing – hence the name SAW. The writing is usually poetry since poetry must be crystal clear and concise, but again there are no rules – prose could also be used. It is also, of course, possible to supplement the staple trio with other approaches. At the time of writing, informational technology (IT), music, movement, drama, sport, design and technology (DT) have all been used in SAW projects and the list of complementary approaches continues to grow. Although images around the chosen theme are usually the starting point for SAW projects, there is no reason why the project could not progress to include objects. For example, a SAW project on 'The sea' with 135 children aged 4–8 at Mundesley First School, Norfolk, started out using pictures of salt crystals and seaweed under the microscope, camouflaged flounders hiding in sand, and X-ray imaged cross-sections of ammonites, and progressed to using objects found on a visit to the beach (Figure 7).

Is there a need for SAW as a new cross-curricular educational initiative?

Is there a need for SAW? The first SAW project was run in March 2005. Since then (just over three years later) around 60 projects have been run in primary and secondary schools in the UK in response to demand. A further 30 projects have taken place in elementary schools in the US, led by teachers from the School of Education, Salem State College, MA. A project on shells and diatoms has also been run by a primary school in Turin, Italy (see Figure 8 and Box 4). Highlights of these projects and evaluation information can be found on the SAW Trust website (www.sawtrust.org). Examples of children's work can also be found in *See Saw*, an anthology of children's poetry and artwork on scientific themes from the first SAW project[3]. Is SAW any different from other cross-curricular initiatives and has it had impact?

Figure 7. Moving from images to objects. Children taking part in a SAW project on the theme of 'the Sea' used things that they found on the beach as inspiration for science, poetry and art.

Figure 8. Diatom. Coloured scanning electron micrograph of the *Navicula didyma* diatom. The diatoms are a group of photosynthetic, single-celled algae containing about 10,000 species. They form an important part of the plankton at the base of the marine and freshwater food chains. The characteristic feature of diatoms is their intricately patterned, glass-like cell wall, or frustule. The frustule often has rows of tiny holes, known as striae. Image: Steve Gschmeissner/Science Photo Library.

Box 4.

La missione

Diatomea assomigli ad una ciaspola
Ti hanno usato scalatori, equimesi, alpinisti.
Fai lunghe camminate
Negli spazi immensi dell'Artide,
Sulla neve e sul ghiaccio
Ma non ti arrendi mai.
Riesci a compiere qualsiasi camminata,
Per questo ti chiami 'missione'.

The Mission

Diatom you look like a snowshoe
Used by climbers, Eskimos, mountaineers.
You go for long walks
In the immense Artic spaces,
On snow and ice
But you'll never give in.
You'll accomplish any walk,
That's why they call you 'mission'.

Federico Galliano (age 10)
Scuola elementare statale 'Giovanni XXIII', Torino, Italia

Examples of comments on SAW from experts in different fields (below) give some idea of this:

Formal education compartmentalizes subjects in a way that stifles inquisitiveness and curiosity. By linking science, art and writing, SAW promotes creative speculation and imaginative possibilities.
– Ann Oliver, School of Higher Education and Lifelong Learning, University of East Anglia, Norwich, UK.

SAW is a great way to get children writing and thinking about science creatively.
– Naomi Jaffa, Director, the Poetry Trust, UK.

SAW – A wholeness of experience, an integration that is both affirming and revelatory.
– Jill Pirrie, poetry teacher and author of *On Common Ground*, a key resource for teaching poetry to children.

This work fires the creative process and makes connections between science and the arts in the children's minds.
– Ken Holbeck, Head Teacher, Rockland St Mary Primary School, Norfolk, UK.

SAW reminded me of why I took up teaching in the first place.
– John Nicholson, science educationalist.

Scientists, artists and creative writers share a common purpose in their attempts to describe, interpret and ultimately to understand the world about them. SAW is singularly successful in drawing these threads together.
– David Ingram OBE, VMH, Master, St Catharine's College, Cambridge, UK; botanist, horticulturalist and conservationist.

I just love these pictures.
– Reuben Braden-Bell (age 8), Rockland St Mary Primary School, Norfolk, UK.

I can do it if I try.
– A seven year old boy from Trowse Primary School, Norfolk, UK, when asked what he had learned during a SAW project at his school.

SAW is an integrative approach to the curriculum with a special emphasis on science, an area of the curriculum that is often neglected or poorly taught. The value of this program is that it develops science concepts using a multiple-intelligence approach to teaching and learning. By using writing and artistic expression as avenues in which children can express their understanding of scientific notions, teachers can address the diversity of learning styles and strengths of their students. It also takes any phobia out of learning about science. The key to the pro-

gram, however, remains in the direct teaching of science through images. This project has a life of its own. It has captured the imaginations of not only my colleagues, but my students and their students and schools.
– Louise Swiniarski, Professor of Education, Salem State College, MA, US.

When I was doing my lesson plan I was struck by how many frameworks I touched upon in this seemingly simple lesson.
– Trainee kindergarten teacher, School of Education, Salem State College, MA, USA.

Initiatives such as SAW address a broad and urgent need for the enhancement of the science taught in schools.
– Richard Davis, educational programme evaluator.

We were introduced to a new and innovative way to develop cross-curricular learning.
– Feedback from SAW workshop for teachers, Primary Science Conference, National Science Learning Centre, York, UK.

We need innovative approaches to helping pupils see that science is a creative way of understanding the universe and ourselves. SAW does this in a way that is both beautiful and powerful.
– Michael Reiss, Professor of Science Education, Institute of Education, University of London, UK.

I personally think that few programs in interdisciplinary education have managed to yield the exemplary quality of work that SAW students produce and am eager to unearth the art and science of teachers' practice behind it. A truly novel feature of this work is that it engages the very young mind creatively across disciplines.
– Veronica Boix-Mansilla, Project Zero, Harvard Graduate School of Education, MA, USA.

Of particular importance is the finding that teachers who have been involved in SAW projects want to continue working with the initiative, as exemplified by the following example comments:

The cross-curricular way of working is not new to us, but starting from a scientific image was a fresh and inspiring idea. We can see many areas that we will continue to work on. We are regarding this very much as a starting point.
– Sandra Barker, Head Teacher, Trowse Primary School, Norfolk, UK.

SAW. We need more, please!
– Ken Holbeck, Head Teacher, Rockland St Mary Primary School, Norfolk, UK.

The fact that these projects have been replicated and have yet again been a great success further supports the soundness of the SAW project's approach. If teachers find it hooks their students into learning about science and at the same time improves literacy and communications, they will repeat the project with subsequent groups. The value, of course, is that SAW does not become a one shot deal but gets woven or embedded into the curriculum for future classes of children.
– Professor Louise Swiniarski, Professor of Education, Salem State College, MA, USA.

The responses to SAW have been very positive. It is too early to comment on the longer-term effects of participation in SAW projects on children. There are many questions to be answered. For example, do children who have taken part in SAW projects express more interest in, or a better understanding of, science as a result? Do they show greater enthusiasm for art and/or poetry and are their standards of artwork and literacy improved accordingly? What is the impact of SAW projects on children of different abilities and with different learning styles? Does SAW have positive benefits for enhancing creativity, enjoyment of learning and self-confidence? Does participation in SAW projects influence choice of subjects later on? The impact on the personal and professional development of others involved in delivery of SAW projects (teachers, scientists, artists and writers) is also an area for more extensive analysis. What is clear is that those schools that have taken part in SAW projects want to do more of it, and many have run subsequent projects since their first SAW project. The teachers can see the potential and want to work with it. Creative teachers find that they can cover multiple curriculum requirements in a single lesson. A long-term evaluation of the broader impact of SAW will require the establishment of a more robust large-scale framework with the application of SAW across many schools and over a long period of time.

SAW is not just about encouraging children to go into science as a career. It is not just a science education initiative, although it can be badged as such. SAW is about the difference between teaching and dialogue, education and educational goals. It is about confidence and ownership of learning, conclusions, creativity, engagement and personal bests. How does SAW link with the new curriculum for the 21st century? Curriculum entitlement is now seen in terms of personal development and personalized learning. The emphasis is on the curriculum as an entire planned learning experience, not just timetabled lessons. Through the SAW initiative important dimensions are woven into and across the whole curriculum. These include community participation and the involvement of experts; enjoyment and social development; links to the real world and relevant learning; enterprise and independent learning opportunities; transferable cross-curricular skills; differentiated and personalized learning;

creative and critical thinking; use of informational technology and interactive learning; flexibility and use of a range of approaches; challenge and extension opportunities. By treating children as adults insofar as we possibly can we encourage and nurture confidence, self-reliance and independence. A trainee elementary teacher from the School of Education at Salem State College (US) commented that she had not realized just how much young children are capable of until she ran her first SAW project. In the 21st century curriculum schools are viewed as learning communities – everybody learning together, both adults and children. Each child, each adult, looks at things in different ways. Together we can draw on our strengths and differences to build up a patchwork of understanding, a better approximation of the truth. Through this we may hope to develop a deeper knowledge and enjoyment of the world that we live in, and to learn how best to protect, sustain and nurture it.

The SAW Trust

Having completed my NESTA Dream Time Fellowship in 2005 I was very fortunate to secure a Branco Weiss Fellowship, which has enabled me to continue to develop my SAW activities. In 2006 I founded the SAW Trust, a charitable organization (UK registered charity number 1113386) with international objectives, as a means of supporting the development of the initiative. The SAW Trust depends on schools, grants and donations to fund its activities and does not as yet have support in terms of personnel for core functions (for example, administration). The development of teaching resources to support the roll-out of SAW and of a business plan with which to seek further funds are key priorities for the remainder of my Branco Weiss Fellowship.

Try SAW out

So, reader – are you a scientist? Would you like to try out SAW? You may not be working in astrophysics. 'Outer space' may not be relevant to you. But what do you do? And how can you communicate it? Think around your research area, find visually stimulating images, and then approach a school – perhaps the one that your child or a relative goes to – and ask them if they would like to run a SAW project. You can be the scientist and the teacher(s) can provide the input on the creative arts side. Or you might like the idea of working together with a poet, and artist and whoever else springs to mind on creating your own exciting adventure. If you do this then please let me know (or e-mail info@sawtrust.org – which is me!). I would love to hear about SAW projects in other countries and to feature some examples on the SAW Trust website.

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