Chapter 11
The Science Art and Writing (SAW) Initiative

Jenni Rant

Abstract The Science Art and Writing initiative is a cross-curricular education approach exploring scientific themes through practical science activities underpinned by visually striking images which are used as a creative stimulus for extension activities in art and writing. The images encourage inquisitiveness and offer a nonthreatening starting point for exploration of diverse scientific topics. Practical science activities aid understanding, and creative investigation improves the confidence of children with varied learning styles in communicating science through varied media.

Keywords Science • Art • Writing • Poetry • Scientific images • Creativity • Learning • Cross-curricular

Introduction

Being a scientist requires curiosity and creativity; it requires imagination, observation, experimentation and communication. The term scientist in this opening sentence could easily be replaced by 'artist' or 'writer', and the subsequent requirements would still hold true. The Science Art and Writing (SAW) philosophy is based on this principle: disciplines are interwoven to maximise understanding and create a learning environment where there are no boundaries to thinking.

Confidence to explore science is abundant in young children who are constantly questioning the world around them, without labelling the act as being a form of scientific enquiry. The use of scientific images as a stimulus for introducing scientific topics offers a rich and diverse platform for children to begin their own journeys of understanding. From the educator's perspective, images give a starting

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point that is accessible to children of all learning styles and an opportunity to make leaps across the curriculum and the different disciplines as topics are explored in a holistic manner.

The SAW philosophy evolved from an idea that the world-class scientist Professor Anne Osbourn from the John Innes Centre had whilst on sabbatical in the School of Literature and Creative Writing at the University of East Anglia in 2005. Anne had been awarded a Dreamtime Fellowship by NESTA (National Endowment for Science, Technology and the Arts) and wanted to explore ways of bringing science into language through creative writing and was exploring the use of scientific images as a stimulus for writing poetry. It was during this experiment that her children became inquisitive about the images. Anne decided to take a selection of images into her local primary school to see if the children responded in a similar way – they did! What was equally intriguing was the response of the teachers to the process, all keen to get involved, resulting in a whole school Science, Art and Writing project, extending to the local high school. The resulting creative output was published in a book entitled *SeeSaw* (2005). Local schools who heard about the project began contacting Anne to ask for 'SAW projects', hence the naming of the initiative and the founding of the SAW Trust (UK registered charity no. 1113386). Teachers weren't the only ones asking for projects; scientists, artists and writers wanted to be involved so the SAW Trust began running sets of projects, bringing together professional scientists, artists and writers to work with teachers on topics chosen by the schools, relating to the science content of the curriculum.

During this time the logistics of SAW projects were varied, some projects involved whole schools and some just one class, some schools invited many visitors to run sessions whilst in other schools teachers led many of the sessions themselves. What emerged from this developmental phase was a flexible model for delivering novel and diverse, cross-curricular activities with accessible links to visitors with real-life examples. In the years that followed, the scope of the SAW initiative has been tested across all school years and beyond to groups of adults and on basic scientific topics from the curriculum to the most abstract and cutting-edge research topics, consistently producing fantastic results. The SAW philosophy provides a framework for creative pedagogy where students are encouraged to take a personal approach to learning and seeks to nurture the next generation to be open-minded citizens, able to confidently engage across society, form opinions and be included in future developments.

Method

As alluded to in the introduction, one of the strengths of the SAW initiative is that it offers a flexible approach to delivering cross-curricular activities and as such there is no single prescriptive method. The SAW Trust has developed a range of training courses for teachers and SAW practitioners and will be translating them to e-learning packages to make them more accessible globally. SAW training courses provide an

in-depth introduction to the SAW philosophy together with practical activities and resources and result in SAW accreditation with membership to the online community. For more information on the training packages, visit the SAW website (www.sawtrust.org). The following guide to designing and delivering a SAW project shows the key steps required and combines examples from a variety of case studies to illustrate the scope of design options available.

Step 1: Project Logistics

Firstly, schools need to decide how many classes will participate in the SAW project and how many days the project will run for. A SAW project with just one class is easier to organise, can take place in 1 day and offers the teacher an opportunity to experiment with the approach on a small scale. However, a whole school approach means a shared learning experience, where teachers are able to support each other through the process and divide the tasks. Whichever approach is taken, the steps to designing a successful project remain the same!

Schools then need to decide if they wish to invite practising scientists, artists and/or writers* to join them in the design and delivery of the project or if they will do it as an 'in-house' venture (*science, art and writing are at the heart of SAW, but other disciplines can be included such as maths, music, history, drama and dance). There are many benefits to children associated with inviting visitors to work in schools such as the inspiration of working directly with practising scientists, artists and writers, the insights it gives to these careers and their relevance in the real world. In addition to this, it is a valuable opportunity for teachers designing a SAW project to work with professionals from other backgrounds to build confidence in designing novel activities whilst getting an insight into current practices and renewing their enthusiasm for the different disciplines.

The network of SAW-trained experts continues to grow, and a member's section of the SAW website is being developed to include details for locating SAW practitioners.

Step 2: The Scientific Theme and Keywords

Themes generally fall into three categories:

1. A theme from the school curriculum such as living things, sound, magnetism or senses
2. A special theme (e.g. extreme sports during sports week or evolution on Darwin's Day)
3. An area of current scientific research – this generally comes with the visiting scientist!

Once a theme has been decided, assembling a list of keywords begins to shape the project in terms of learning outcomes and also aids in searching for appropriate images (Step 3). For example, let's say you decide to theme the project on the senses, a good selection of keywords might be nerve cells, smell receptors, taste buds and antenna.

If you choose to work with a scientist and theme the project on their area of research, then it is a good idea to talk to them about their research before you begin to assemble your keyword list. This gives the teacher an opportunity to familiarise themselves with the scientists research and make links with topics covered on the school curriculum. For example, a SAW project themed by a scientist who researches the soil bacterium Streptomyces can provide links to living things, habitats and microorganisms.

Step 3: Choosing a Set of Images

Once the theme of the project has been decided, the teachers (and the scientist) search for a set of intriguing, high-quality scientific images that relate to different facets of the theme. These will be used as a creative stimulus and link the different sessions of the project.

Scientists may have images produced in their research that are suitable and there are many excellent images on the Internet that can be used. A selection of website addresses are listed in the resource section which offer a good starting point for image searching.

The terms and conditions of use of image collections can be found on the respective websites. It is a good practice to record the source, legend and credit of images as you find them, so when you come to short-list a final set of 6–8 images for your project, it's easier to obtain permissions for use if required.

Using the theme of 'senses' as an example, try typing 'taste' into the search box on the Science Photo Library database (www.sciencephoto.com). This yields over 30 pages of mixed images, many of the tongue but also many of people eating, so refine the keyword to 'taste buds'. This reduces the number to 10 pages of more contemporary and surprising images (Fig. 11.1); click on ones that stand out to you or compel you to know what they are. This can become very addictive and reading the bite-sized information that comes with the images is a fantastic learning experience that prompts you to type new words into the search box. Avoid obvious images (like people eating) as children are used to seeing them but they will be intrigued by close-up images of the tongue's surface and could easily embark on a creative journey, perhaps imagining what it would be like to take a stroll across the tongue's surface!

Searching for images related to the theme can be included as part of the SAW project if children have access to computers as this will enable them to personalise

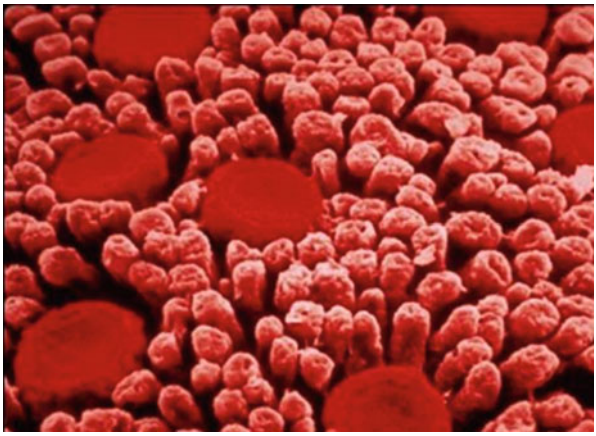


Fig. 11.1 Surface of the tongue (Image credit: Omikron, Science Photo Library – Human tongue)

the images they wish to use. This proved to be particularly effective during a SAW project at a special school where the children have complex physical/sensory difficulties. The theme of temperature was explored and the children delighted in finding thermogram images of all sorts of things.

More example images chosen and used by teachers and scientists for a diverse variety of SAW projects can be seen on the SAW website (www.sawtrust.org/classroom.html).

Step 4: Designing the Activities

Now you know how many children will be participating in the project, if you are inviting visitors to join you and have chosen your theme and a selection of exciting images, it's time to share the images with any invited artists/writers and design the activities.

You may have activities that you already use in science, art and writing and just want to experiment by linking them with scientific images, but you might like to take the opportunity to design new activities or improve existing ones. If visitors are joining you in designing the project, then they will be able to design their sessions and provide a range of ideas and techniques that can be adjusted using the expertise of the teacher to shape the activity into one that is challenging but achievable for the age of the class. If visitors are coming from high schools or universities, it is worth investigating the activities used by them as they can often be adjusted to suit a younger group. The Internet provides an ideal place to search for ideas that are either posted as a complete activity or being showcased by others that have used them. SAW projects work well with structured activities but equally SAW offers

the scope to have open-ended sessions where children are able to take the lead in the direction the activities take.

The following examples show images chosen to hook children into the theme and the activities used for a variety of age groups.

Example 1: Mundesley First School

Theme: The Sea *Age group*: 4–8 years *Visitors*: 3 scientists, 3 writers, 1 artist (Fig. 11.2)

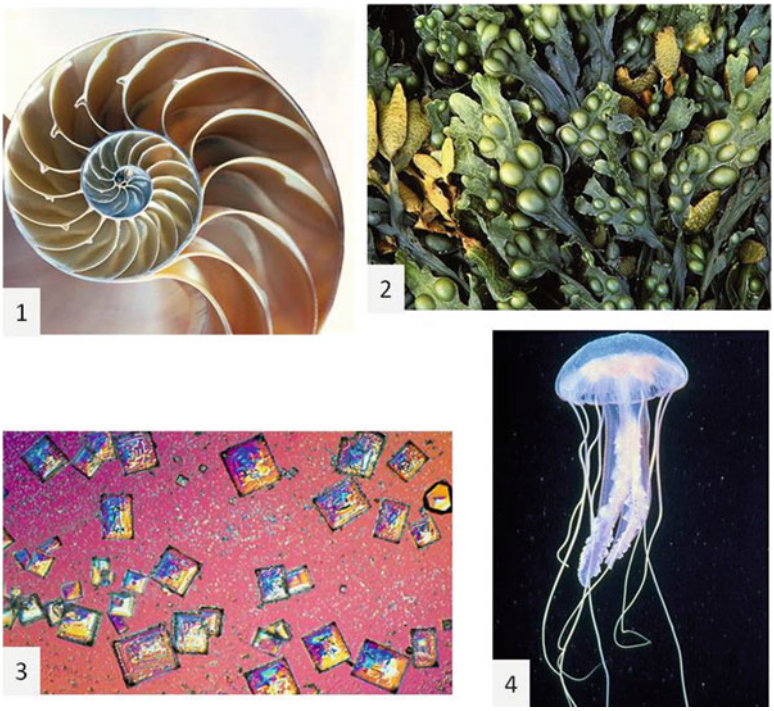


Fig. 11.2 Images used for a SAW project on the theme of 'The Sea' (1. Lawrence Lawry, Science Photo Library – Nautilus shell, 2. Simon Fraser, Science Photo Library – Seaweed, 3. Astrid & Hanns-Frieder Michler, Science Photo Library – Salt crystals and 4. Pascal Goetgheluck, Science Photo Library – Jellyfish)

This was a whole school project (135 children).

The younger children visited a local beach where they beachcombed, collecting materials in bags and buckets to observe and use back in the classroom. The objects were used alongside the images as a stimulus for Science, Art and Writing activities.

Science

The items collected on the beach were used for a sorting exercise by the 4–6-year-olds. Two tables were labelled with different names such as living (or once living) and nonliving, smooth or rough, hard or soft and natural or man-made, and the children had to sort their collection, placing items onto the tables that seemed to be the best fit. The sorting process required the children to study each object and think about what details were important for classifying items into groups.

The children were able to look in more detail at objects using magnifying glasses and microscopes. The bladders on the seaweed were investigated under a digital microscope and used to study floating and sinking and adaptation to habitat.

The 6–8-year-olds investigated the properties of salt in a variety of ways starting by examining different types of salt under a microscope. They compared the foaming properties of fresh water and salt water by grating a bar of soap into jars, adding different samples of water and then shaking them to compare the foam produced. The immiscible interaction of oil and water was explored by mixing dyed water with oil in clear beakers and watching them separate. Salt was then dropped into the oil/water mix, travelling through the top layer of oil, dragging droplets down through the water layer until the salt dissolved in the water, releasing the droplets of oil which travelled back up to the top.

The nautilus image was used to discuss the concept of movement by organisms adapted to live in the sea and how this differs from the familiar swimming technique used by mammals. To swim, the Nautilus uses jet propulsion created by drawing water into and out of its living chamber. This allowed the introduction of Newton's third law of motion; for every action there is an equal and opposite reaction. To explore this, the children built pop-pop boats which are powered by simple heat engines.

Art

The younger children spent lots of time looking at the textures and colours of all the items collected on the beach under the microscope and then, with help, made

seaweed templates for painting. A class of 5- and 6-year-old children explored shapes and textures.

Different species of jellyfish and flounder fish were researched in books, the nautilus spiral shell structure was observed and the children noticed similarities with shells they had collected from the beach.

The salt crystal image was compared with different types of salt that the children had studied under the microscope. The children worked collaboratively using materials collected from the beach to make collages and worked independently on painting techniques to represent the textures and shapes of the things they had observed.

Older children also examined textures under the microscope and then created sea habitat pictures using bubble wrap for printing with paint and stuck sand onto their paintings with glue. Sea salt was also sprinkled over the wet paint to create spots of bleaching.



Writing

The images along with the objects collected on the beach were very much the root of inspiration for poetry where the children were encouraged to feel and observe objects and think about how it would feel being the objects and the journeys they may have made to end up on the beach. The children worked on class poems and were then encouraged to write their own poems. The reception class worked on group poems and took photos of things they had collected from the beach using a digital microscope and then put descriptive words on them. The teacher put all the photos into a movie that was set to music and presented by the reception class at a school celebration assembly. Another class formed an orchestra to set their poems to music which worked particularly well for children with special needs and a group poem entitled ‘What we know about ourselves’, where all the class were sea anemones was acted out spectacularly in the assembly!

Seaweed like a necklace
Long enough for me to wear
With squidgy bits for me
To squeeze.

Victoria Ing (aged 5)

SEA

Steps sucker
Rock crasher
Fish crasher
Sand stroker
Sea stroker
Pebble washer
Rock smoother
Steps stamper
Boat beater
Boat crusher
Sand soaker
Foam maker.

Class poem (aged 6-8)

WHAT WE KNOW ABOUT OURSELVES

Amy lives in water.
Martha blows herself up
Like a puffer fish.
Sam T has no skeleton.
Ben pulls his tentacles in to eat.
Eleanor sucks up seaweed.
Guy looks like a flower plant.
Callum has a tail to push himself.
Fish hide in Jake.
Sarah hides when the tide goes out.
Yvonne looks hairy.
Sally has a lot of tentacles.
Joe can sting you and leave
A red mark.
Alex has fluffy babies.
Caitlin is smooth.
Ben is wobbly.
We are all Sea Anemones.

Class poem (aged 6-8)

This whole school project ran over 3 days and involved many visitors coming into school. The knowledge, techniques and session ideas that the visitors brought to the project injected energy into the teaching staff, and the celebration assembly on the third day meant that all the children could benefit by sharing their experiences with the rest of the school. Working towards a presentation to round up a whole school project also gave the staff the opportunity to extend activities with the children beyond the science, art and writing disciplines nicely into music, drama and ICT.

Example 2: Costessey Infant and Junior School

Theme: Sound *Age group*: 6–7 years *Visitors*: 2 scientists, 1 writer, 1 artist (Fig. 11.3)

This project took place over one school day with one class of 30 children aged 6–7 years. The day began with introducing the visitors by getting the children to guess who the scientists were; this is a fun warm-up exercise that challenges the

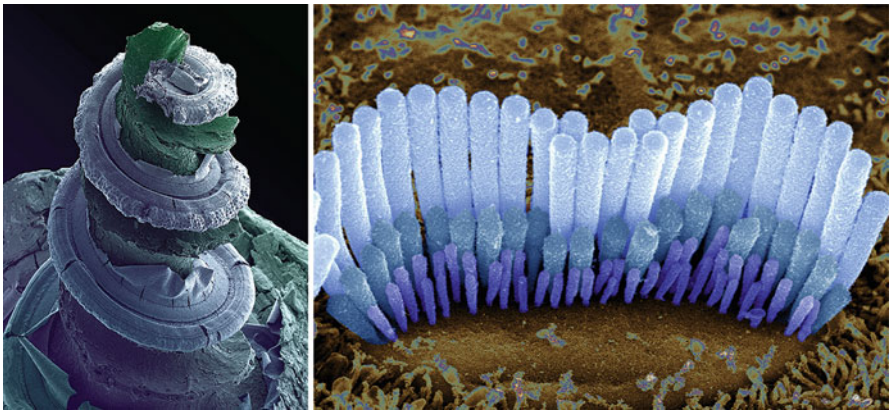


Fig. 11.3 Images used for a SAW project on the theme of 'Sound' (1. Dr. David Furness, Wellcome Images – Cochlea of the inner ear and 2. Dr. David Furness, Wellcome Images – Sensory hair bundle from inner ear)

children's predetermined stereotypes of what scientists, artists and writers should look like. The science activity took place first from approximately 9 a.m. until 10.30 a.m. when the children stopped for their morning break. After break the writing activity began and ran from 10.50 a.m. until the lunch break at 12.15 p.m. The art activity took place over the afternoon session from 1.15 p.m. until 3 p.m. The teacher, scientists, artist and writer are involved in all sessions as a team but the experts from each discipline lead their respective sessions supported by the rest of the team.

Science

We started the science by asking the questions – How do we know sound travels? Can we see it? Does it travel at the same speed everywhere? The images were used to help the discussion along. Then we started the first of three activities – bottle xylophones. The children were taught to tap a glass bottle with a pencil or blow across the opening of the bottle to make a sound. Then water was added to the bottle and the children noticed that the pitch of the sound had changed. Once they were familiar with the concept that the amount of air in the bottle determined the amount of vibration possible and in turn the pitch of the sound, they were challenged to work in teams of 4 and 5 to make a musical scale with 8 bottles per team. The children noticed that when you blow across the top of the bottles, lots of water and a little air gives a high note, whereas a little water and lots of air gives a low note, but when you hit the bottles with a pencil, the reverse is true! Some time was spent playing with the xylophones, trying to play familiar tunes.

Then, we moved on to the second activity which would test the concept that sound is made when something vibrates, causing the air around it to vibrate and we hear it when our ear drum vibrates. Firstly, each child had a plastic cup, a length of string and some masking tape. The children had to stick a length of string in the bottom of the cup so that it hung out of the bottom like the centre of a bell. The children were given small squares of slightly damp cloth and asked to hold the string close to the point of attachment and, whilst holding the cup upside down, slide the cloth tightly down the string. This makes a noise a bit like a chicken clucking! Then, we produced a massive bucket and did the same thing… it created the biggest noise, more like a cow mooing!

Finally, the children were taken outside to play a game called bat and moth. This involves standing in a circle and nominating one child to be the bat and a few children to be moths. The bat is blindfolded and then the moths have to move around the circle constantly saying 'moth, moth, moth', and the bat has to try and catch them. The children can take turns playing the different roles so that everyone gets a go at being something and explores the concept of using sound to locate prey instead of sight.

Writing

The writer decided to introduce the children to the 'word monster'! The monster follows the sound of our heart beat, boom-boom, boom-boom (using image number 4) and lives in this strange place (image numbers 5 and 6) – inside our ears. The monster likes to eat sounds and can gobble up parts of words making them sound different. The children all took turns saying their names and the word monster ate some of the letters of their names; the word monster ate the R, the E and the B of Rebecca's name transforming it to 'ecca'! The children really enjoyed this and soon wanted to practise with all sorts of words. They suggested what the word monster might look like and then wrote some poems about it.

The Word Monster
By Thomas Richardson (aged 6)

The word monster

The monster took my name.
I am now called adison.
The monster ran away.
I am not seeing him again.

Madison White (aged 6)

Art

The artist asked the class what happened when they listened to sound. The children said it depended on the sounds they heard. If it was music, they may dance; if it was someone talking, then they would hear information and maybe respond; and if it was the fire alarm, then they would run outside! The artist asked them what they thought it would be like if they could smell, see or even taste a sound. The children found this idea very amusing and offered up lots of suggestions of how different sounds could be perceived by the other senses.

The artist then told them about people who have a condition called synaesthesia, where stimulus of one of the senses triggers the response of another, e.g. on hearing certain sounds or particular notes, a person may experience a visual representation of the sound such as certain colours or even a firework-type display.

There are different types of the condition and as many as 1 in 23 people may be affected. The artist told the children that people throughout history have used the condition as a stimulus to create literary works, music and pieces of art. The children were given black paper, coloured chalks and crayons then the artist played them a selection of sounds and pieces of music and they had to try and interpret the sounds with colour on the paper.

The project on sound shows how a common curriculum science topic can be approached in a cross-disciplinary way to get the children to play with the things they are learning, gain a deeper understanding and see how sound relates to the world they live in and the impact it can have on people's lives. Planning a one-day, one-class SAW project enables different subject lesson planning to be combined into a project-style plan, and inviting visitors to lead the sessions adds an extra dimension. The scientists that worked with the teacher were not sound researchers, but scientists are confident science communicators that are able to bring the concept of the scientific method and thought processes to the classroom to explore all curriculum topics. Equally, teachers that have participated in SAW projects or are introduced to it during teacher training are finding this method of delivering the curriculum to be a useful tool when used independently as an 'in-school' project.

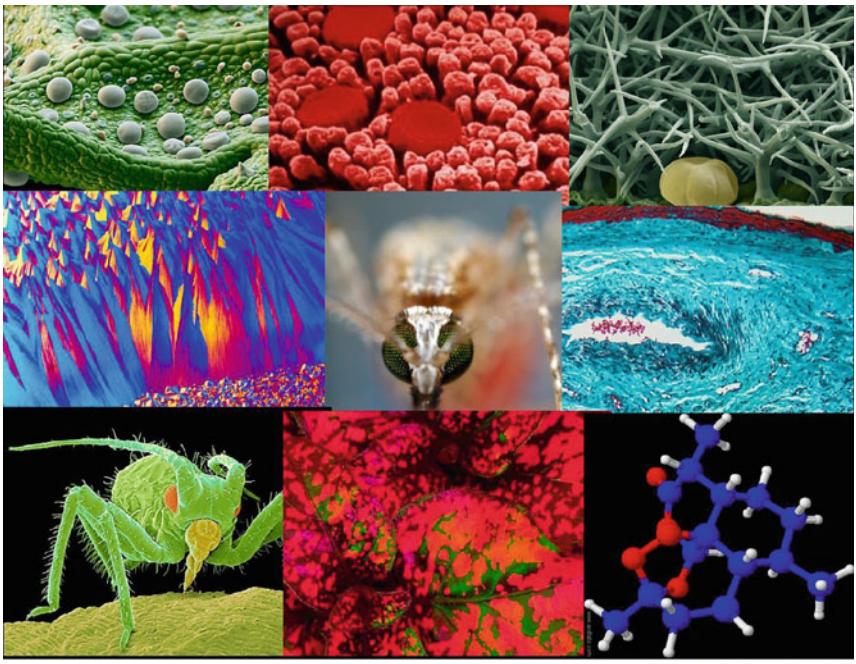
The first example showed how a one-off 'special' topic can be the focus of a SAW project, and the second showed how SAW can be used to explore a science curriculum topic. The final example shows a selection of science research topics that come straight from cutting-edge research labs and demonstrates how even very young children can become engaged in the most abstract of topics!

Example 3: Research Topic Straight from the Lab!

Scientists Sam Mugford and Melissa Dokarry study the synthesis of products made by plants and their functions. Children at Martham Primary School explored chemicals responsible for colours and scents and extracted colour pigments from flowers. Figure 11.4 shows example images, poems and artwork from a case study of this SAW project published in the scientific journal *PLoS Biology* (2008).

The example shown is taken from the book *SAW Showcase* (2009) that celebrates the creative output generated by a set of 15 projects delivered in Norfolk primary schools by scientists from the John Innes Centre and the Institute of Food Research working with local artists and writers.

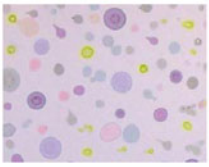
These examples show that even the most abstract and advanced topics can be explored in the classroom with young children in this cross-disciplinary style. The scientist brings in a real-life example of current scientific research that demonstrates the relevance of science and its ongoing need in understanding the world around us. It also shows that scientists don't know the answers to the experiments they are doing and the diverse number of topics being researched.



Spreading colours

Colourful flames, the light looks alive,
Spreading slowly across the paper.
Multi-coloured molecules,
Chemicals mixing together,
Sparkling in the light,
Dancing in the alcohol.

Olivia Hesseltine Age 7



Science nose

As I crush the molecules with my fingers
Cells explode like a bomb.
Chemicals zoom upwards into my nostrils.
Strange smells make my brain dance.

Lloyd Sayer Age 8

Fig. 11.4 SAW project on the theme of plant natural products

Dialogue between children and a diverse array of scientists, artists and writers provides a powerful tool for removing preconceived ideas that children may have about people and gives the opportunity to show that we can all participate and be interested in science, art and writing, even if we don't choose them as a career. The link created between the teacher and the SAW practitioners gives a forum for sharing ideas and learning new techniques. From a logistical view, scientists often have access to equipment that isn't available to schools which opens up possibilities of new practical activities in the classroom.

The images are an important anchor for the topic whilst exploring it through different disciplines and their contribution to a high-quality SAW project should

not be underestimated. How and when the images are used should be decided during the planning stages and children should have access to good quality colour prints of the images throughout the day.

Step 5: Sharing the Experience

To get the maximum value from a SAW project, it is important to celebrate the many creative outputs that will have been generated by the children. Schools are very good at sharing achievements, so there is no great detail here except to say that sharing the output can extend the core Science, Art and Writing activities into a wider set of disciplines such as ICT, dance, drama, music and varied styles of writing, so it makes sense to factor in some time for this final step.

Schools may like to consider the following approaches: a special feature on the school website or newsletter; contacting the local press or television to cover the project; a special assembly, play, presentation or poetry reading in school or at a community venue; and the production of a school anthology or an art exhibition.

Concluding Remarks

Since the very first set of SAW projects, it has been clear that this style of cross-disciplinary approach excites children and adults alike. The inclusive nature of learning a central topic using a variety of methods allows everyone to participate in some way and feel an ownership over their contribution to the collaborative activities. As a scientist, artist or writer, it is very rewarding to see others inspired by your work; it motivates, improves confidence and can provide a source of new ideas.

People that have participated in SAW have made the following comments:

"Much of the school curriculum is taught in fragments, which does little to support an informed view of how the world is organised and how we operate within it. I firmly believe that an interdisciplinary approach to learning is key to developing understanding and is best achieved through creative use of knowledge, hence the need for experts and development of imaginative links. SAW can achieve this and is the reason why I promote SAW in lectures and workshops working with student teachers and teachers in school."

Ann Oliver, Lecturer in Education (PGCE PY M), University of East Anglia

"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 County Primary School

"With respect to educational outcomes, the SAW initiative is in my opinion much more than innovative: it is potentially transformative."

Arthur J. Stewart, Ph.D., Project Manager, Science Education Programs, Oak Ridge Associated Universities

"I was really surprised by the enthusiasm with which the children involved themselves in the

SAW project – and the results were awe-inspiring. I was impressed at how clever the children were at grasping new concepts and how imaginative with their science-inspired poetry. The best part of all was seeing how much they enjoyed themselves, as did my scientific colleagues and I."

Dr Kamal Ivory, Research Scientist, Institute of Food Research, Norwich

"SAW participants undertake real hands-on scientific investigation related to striking scientific images. They respond both in their own words and also in artistic production. This helps to embed knowledge but also makes it pleasurable and specifically earned and owned by the students."

Mike O'Driscoll, SAW lead writer

"SAW week was a fun week because it was a change from the normal lessons, and we also had fun while we learned."

Hollingworth Primary School pupil

Resources

Suggested websites for image searching:

Science Photo Library – http://sciencephoto.com/
SAPS Plant Science Image Database – www.plantscienceimages.org.uk/
Wellcome Images – http://images.wellcome.ac.uk/
NASA – www.nasa.gov/multimedia/imagegallery/index.html
The Why Files – http://whyfiles.org/category/cool-science-images/
Science Image Online – www.scienceimage.csiro.au/

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