Project Report

Crop Diversity and Evolution

With Dr Mahwish Ejaz at Hevingham Primary

Introduction

SAW workshop team (left to right) Chris Hann, Mike O'Driscoll, Mahwish Ejaz and Jenni Rant

About SAW

The Science, Art and Writing (SAW) initiative is a cross disciplinary engagement approach that invites people to explore scientific themes through practical activities, underpinned by visually striking images.

SAW projects in schools have proved immensely popular with children and teachers alike, breaking down barriers between the arts and sciences as participants move from scientific experiments to poetry and visual arts, all linked to a science theme.

We have covered numerous cutting edge research topics bringing real science into schools. A typical SAW project involves a team of a scientist, artist and writer developing a one-day workshop and then delivering it in school with the support of the class teacher.

This report documents a Crop Diversity and Evolution SAW workshop developed by scientist Dr Mahwish Ejaz (John Innes Centre), Mike O'Driscoll (writer), Chris Hann (artist), Jenni Rant and Sami Stebbings (SAW Trust) that was delivered at Hevingham Primary school with Mr Sam Gibbons and his year 5 and 6 class (children aged 9 – 11 years).

The workshop began with a 'who's who' guessing game activity aimed to uncover and challenge stereotypes and promote the diversity of people and roles within science and the arts.

The class were introduced to the SAW team and asked to vote on what they believed their profession to be, a scientist, artist or writer. The results of which weren't dissimilar to other SAW projects, with the male individuals Chris and Mike, receiving most votes for being scientists, while the female individuals Mahwish, Jenni and Sami, receiving little or no votes for being scientists (photo of results table).

The Science

Dr Mahwish Ejaz led the science activities and began by giving an introduction into evolution and natural selection.

The class were first shown the example case study of the Peppered Moth (*Biston betularia*), a temperate species of moth that were light grey in appearance in the 1800's but post-industrial revolution, appeared black in colour. It was explained that this was due to the fact that soot and pollution produced during the revolution created a change in the moth's habitat, where the once light-coloured trees and lichen-covered bark that offered camouflage to lighter coloured moths, were now dark in colour. This led to an increased predation of light grey moths, leaving higher numbers of darker coloured moths to breed, which led to a change in the moth populations colouring.

The class were then introduced to artificial selection and selective breeding by discussing the way in which humans have bred plants that looked or tasted better than others and how this selective breeding process has led to the divergence in crop species that we see today. A key example used to demonstrate this was that of *Brassica oleracea*, the ancestor of the familiar plant commonly known as cabbage, which also includes many other important vegetables including cauliflower, broccoli, Brussels sprouts, kohlrabi, and kales. All these vegetables belong to a single species and show an overwhelming range of 'morphological diversity'.

The class then undertook a pairs game, where they were given images of ancient and modern plant varieties, such as tomatoes, bananas, aubergines, broccoli, and corn. Children discussed in groups which ancient plant could be an ancestor of each modern plant, considering the characteristics of their morphology, such as size, shape and colour. Many were surprised by some of the correct matches and the fact that cabbage, broccoli and cauliflower matched to the same ancestor which led nicely into the next part of the session.

Mahwish had a range of familiar crops including broccoli, cabbage, kale, cauliflower and Brussels sprouts that she held up one by one and explained how larger growth on different parts of the plant had been selected for over time. For example, kale

plants had been selected for larger leaves and broccoli, for a longer stem and many flower buds.

This helped the class understand how early farmers had selected for different traits in a single ancestor leading to a huge amount of diversity, showing how evolution can be driven by natural selection (as in the peppered moth example) or by artificial selection by humans.

Mahwish then went deeper into how plant cells can take on so many different forms by introducing the class to the Shoot Apical Meristem (SAM) of a plant which is the growing tip of a plant shoot. It was proposed that SAM can be likened to a bank account for the plant's cells, the plant can use them to make new structures, just like we can use money stored in a bank account to buy anything we need or wish. The SAM is an area of cells with an unknown fate that can make different plant organs like leaves, flowers and stems, as a plant grows.

The class then concluded the science session by creating their own plant SAM models and viewing plant cells and structures under microscopes.

Science images used during the SAW workshop.

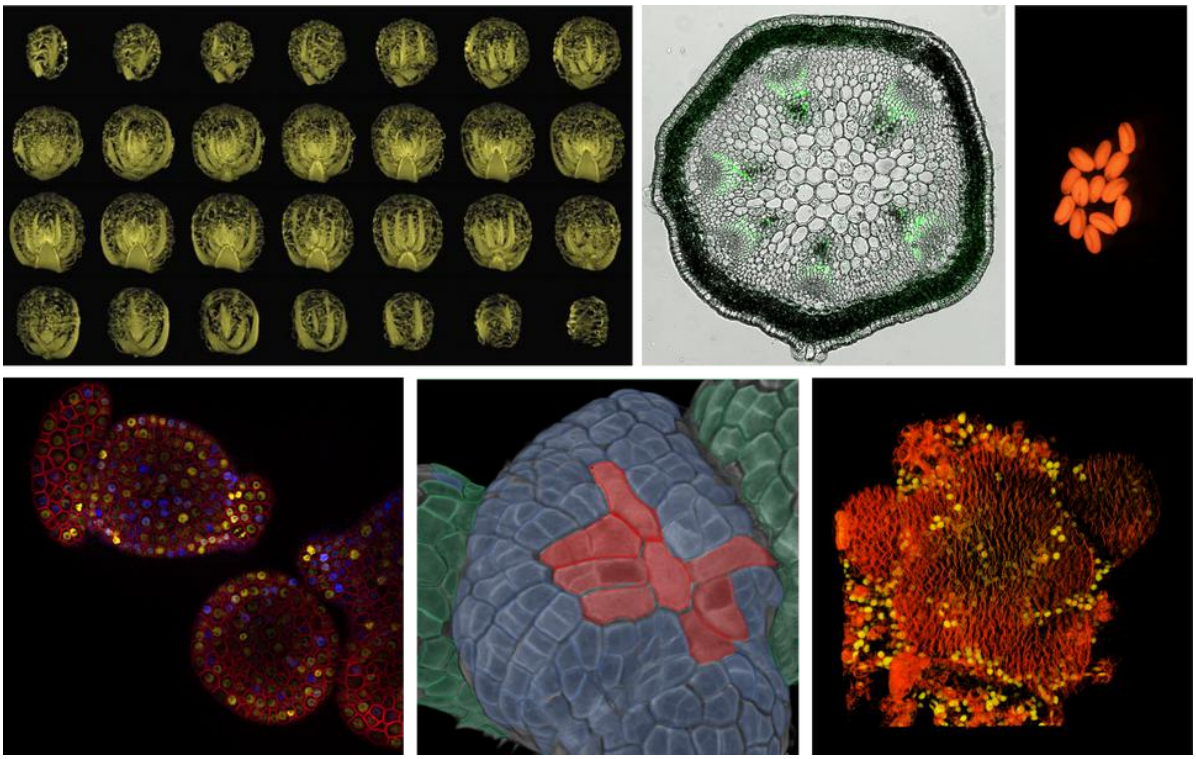


Image credits (top left to bottom right): (CC BY 4.0) *Cabbage, sagittal view, MRI.* Alexandr Khrapichev, University of Oxford . *Arabidopsis stem slice*, Dr Max Bush, John Innes Centre, Norwich. *Genetically modified Arabidopsis thaliana seeds*, Dr. Rafael Tavares, Cell and Development Department, John Innes Centre. *Developing Flowers*, Marco D'Ario, John Innes Centre. *Shoot apex comparison*, Marco D'Ario, John Innes. *Genetically modified Arabidopsis thaliana seeds*, Dr. Rafael Tavares, Cell and Development Department, John Innes Centre Centre.

Writing

Having been introduced to the abstract science images during the science session and a host of new scientific vocabulary and concepts, the children were guided by Mike to create their own poem in response to the science topic.

The SAW team provided support to any students struggling to find a starting point or poem structure. All members of the class created their own poem and had time to create a neat version, with many moving on to create their own acrostic poem afterwards.

Those who felt confident enough were then encouraged to read their poem aloud to the class.


Look down through the microscope,
What do you see,
A world of evolution,
That created glee.

From furry ape,
To proud standing humans,
From shrimp like potatoes,
To our Sdll grown favorites.

Evolution changed the world,
And it will keep on changing.

By James Sinclair-Russle

Below and right: selection of poetry created by students during SAW workshop.

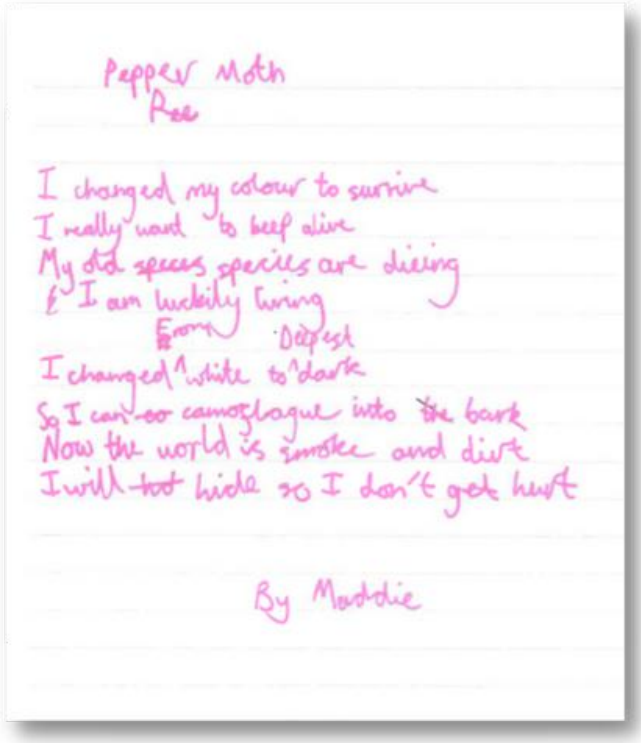

Lucy Look at them seeds

bright, glowing and mistirous

Look at them seeds
maybe they're a tree seed,
or maybe a mistirious seed.

look at them seeds,
are they a plant seed,
yes.

look at them seeds,
brigh, wonderfull and also colorfull.


Pepper Moth
Rae

I changed my colour to survive
I really want to keep alive
My old species species are dieing
& I am luckily living
From Deepest
I changed white to dark
So I can camouflague into the bark
Now the world is smoke and dirt
I will hide so I don't get hurt

By Maddie

Art

The final part of the cross-disciplinary day was dedicated to art, where students took part in a wide variety of activities using different techniques, inspired by the images and the theme of evolution, brassicas and natural selection.

The first of the activities introduced by Chris, was to create an 'unsighted' drawing of a cross-section of a Brussels sprout, where students were asked to draw the contours of the sprout without looking at the paper. The class enjoyed this immensely and found it quite challenging! Students then went on to use the cut sprouts for printing with ink to create a picture inspired by one of the science images.

One of the most popular activities was ink bubble blowing, used to create colourful art pieces based on a Scanning Electron Microscope SAM image they had seen earlier in the day. Chris left the class with the task of completing their own wax-resist images of plant cells, with many looking bright and colourful already.

Feedback

SAW's main objective is to encourage curiosity, enable scientific exploration and inspire creativity.

Feedback was collected throughout the workshop by conversations with students and the teacher as well as with a short feedback questionnaire.

Children's feedback

Here are a few responses to the student feedback questions:

What did you learn about science today?

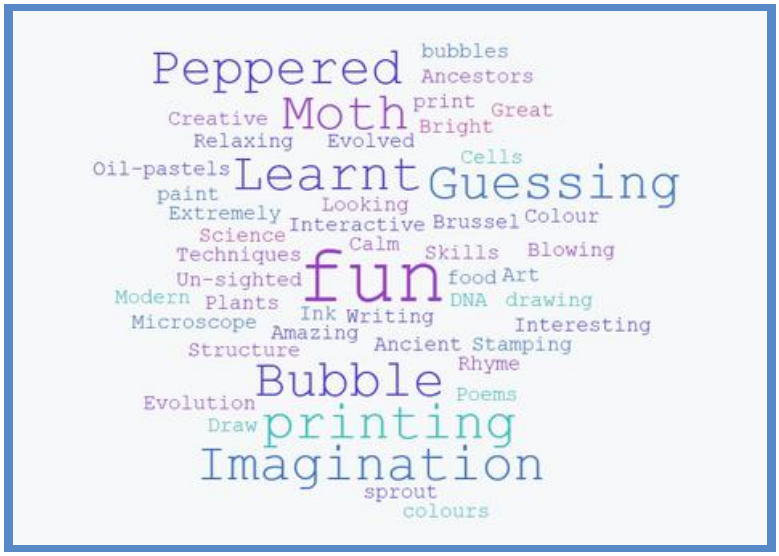
- *That all foods look different in the ancient food compared to modern food.* Leona.
- *Evolution and I looked inside a microscope.* Amiya

Did anything surprise you today?

- *Looking into a microscope, it was very interesting.* Amiya.
- *How bubble printing works and how much plants have changed.* Bella.
- *Guessing who the people were*. Isla.

What did you learn today about art?

- *Look closely at what you are drawing*. George.
- *How to bubble print, ink print and draw without looking*. James.
- *How to draw cells.* Josh.



Word cloud reflecting students response to their SAW day.

What did you learn about writing?

- *How to write a poem. I loved it!* Poppy W.
- *Poems can be short or long. But if its short it doesn't mean its bad.* Isla
- *Poems don't need to rhyme.* Leona

When asked what would have made the day better, many replied with '*Nothing*!', stating that is was an '*awesome*' and '*great day*.

Scientist Feedback

Dr Mahwish Ejaz made the following comments on her SAW experience:

"*Preparing the SAW project gave me an opportunity to expand on my own ideas for the future. Delivering the project to a very young audience, provided me with a unique engaging experience and take-home transferable skills that I can use in future engagement activities.*

During our activities, I could see the children were excited not only for the science part but they also developed original poems about evolution and natural selection, and art skills, motivated by the science.

Altogether, it was a very inspirational and fulfilling experience. I would love to communicate my upcoming science projects to the younger generation to inspire them to do even more exciting science in future."

Teacher feedback

As always, our SAW school workshop would not have been possible without a school welcoming us for the day. Special thanks to Mr Sam Gibbons and his year 5/6 class for engaging with all the activities and being part of jam packed, cross-disciplinary experience.

Mr Gibbons made the following comments on his experience:

"I really enjoyed working with the diverse team and it was an interesting task for children to figure out who the scientist, artist and writer is. The science learning has taken us on to design gardens with their own brassica section (with different types highlighted). Their Shoot Apical Meristem models are on the windowsill ready to be taken home – they love them. They also love the word BRASSICA!

It was nice for them to be able to read things out in front of strangers in the writing session, this is an opportunity rarely created for them. We have since moved on with the poetry started on the day, looking at a Lewis Carroll poem which brought up another metaphor for the children to deconstruct. We will also pick up on the evolution details and the cell structure from some images used to create abstract shapes and patterns to represent real life items/patterns such as in the bubble art work."