ISSN 0 309-8451 Vol 117 Spring 2018

Environmental Education

NAEE
NATIONAL ASSOCIATION FOR ENVIRONMENTAL EDUCATION (UK)

Science Education & the Environment

STEM activities with Woodcraft Folk | Award-winning young environmentalists | Finding science in Shanghai

The Journal of the National Association for Environmental Education (UK)

National Association for Environmental Education (UK)

NAEE supports a wide range of professional educators to help them improve the quality of their teaching and their students' learning, in relation to environmental and sustainability issues.

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NAEE is a Charitable Incorporated Organisation [Charity No. 1166502] that is run by its members and volunteers who care passionately about environmental education and education for sustainable development. Our charitable object is to provide a public benefit by advancing environmental education within early years settings, primary and secondary schools, and institutions responsible for teacher education within the UK and elsewhere. Teachers are encouraged into the Executive; for more details contact *info@naee.org.uk*.

GROUP COLLABORATIONS: NAEE is very much interested in doing things alongside others with the same or very similar missions/goals. Some of these groups include:

United Kingdom: Archeology Scotland; Association for Science Education; Birmingham Botanical Gardens; British Council for Archaeology; Black Environment Network; Council for Learning Outside the Classroom; Geographical Association; London Environmental Educators' Forum; Martineau Gardens; Mount Pleasant School Farm; National Savers; Rotary International (Britain & Ireland); Think Global; TIDE~global learning; Women's Environmental Network; Youth Hostel Association.

Overseas: Australian Association for Environmental Education; Children and Nature Network USA; Forest and Bird New Zealand; Green Teacher; New Zealand Association for Environmental Education; Nature Club of Pakistan; North American Association for Environmental Education; Roots & Shoots Shanghai.

GET INVOLVED: If you are a teacher with experience in environmental or outdoor education, especially in pre-school or secondary school, and would be interested in writing an article for our termly *Environmental Education* journal, contact *info@naee.org.uk* or *Henricus.peters@gmail.com*.

BURSARIES: Thanks to the generosity of the late Hugh Kenrick, NAEE offers bursaries of up to £400 for schools in the West Midlands to take their pupils to visit an environmental education centre. Visit *naee.org.uk/apply-for-a-school-bursary* for more information.

Environmental Education | Volume 117, Spring 2018
Editors Prof. Justin Dillon, Juliette Green
Proof Readers Alona Sheridan, Henricus Peters
Publications Coordinator Dr Elsa Lee

ISSN 03098451

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All photos within articles by the author, unless otherwise stated.

Paper: cover 170gsm Regency Silk paper (FSC mix); pages: 100gsm uncoated recycled paper (FSC recycled)

Editorial

Faced with the task of editing this issue of *Environmental Education,* I chose the topic of science education and the environment. A number of friends and colleagues have kindly provided articles based on their work. Several things strike me having read them all. The first is that we are not short of teaching approaches that are engaging and informative, as well as being enjoyable. The second is that there are so many individuals, organisations and institutions working in the field who themselves are supported by another layer of funders, supporters and businesses. While this diversity is commendable, it's not always a strength. A number of funders and government agencies find it extremely difficult to engage with the sector because it is so diverse.

Part of NAEE's job is to try to encourage sharing of ideas as well as celebrating success. So, this issue sets out to show how science and, in some cases, engineering, technology and mathematics (the STEM subjects), are essential to environmental education. That's not to say that other subjects aren't important; indeed the links between science and geography seem far more obvious than those between science and mathematics, particularly in the school curriculum.

Each of the articles shows the human side of environmental education as well as the science aspects. We all have our stories to tell and *Environmental Education* provides a forum for sharing wisdom. Sometimes a story about something that failed is more useful than a success story; so do, please, get in touch and write something for a future edition of *Environmental Education.*

Professor Justin Dillon, NAEE President

Using the farm environment for teaching science with Early Years, Key Stages 1 & 2

Nina Hatch

"Sheep are herbivores and can't bite you." You discover this when you have a chance to feed them safely through a fence. (Year 1 Science: Animals, including humans.)

Children from Northfield Manor Primary Academy on a Kenrick Days funded visit to Mount Pleasant School Farm. Image: Nina Hatch

For almost 30 years, I have been in the fortunate position of being able to develop National Curriculum Science targets through observation, investigation and hands-on experiences in an outdoor environment. To be exact, I teach school groups on a working livestock farm. Thanks to a Cadbury family trust, I now have a purpose-built sustainable structure classroom on the suburban fringe of Birmingham and Worcestershire. For many years this was part of Birmingham City Council's Outdoor Learning Service.

One reason for developing science through a farm visit is the 'WOW' factor. From the moment that children get off the bus, we have a starting point of curiosity and interest. This can engage pupils who do not always react so confidently inside a classroom.

If you visit a livestock farm, the smells might produce sensory overload for some children. No worries, as a teacher you can develop this into Learning Outcomes – so why **NOT** visit a farm if possible?

The current English science national curriculum has a requirement to introduce children to significant scientific content at a much younger age than in the past. EYFS and Key Stage 1 teachers naturally tend to be inventive and prefer practical, fun, literary-based activities to develop their science concepts. I have noticed a significant increase in requests from teachers of this age range to now focus on science targets. Trying to explain to 5 and 6 year olds about grouping different types of animals according to what they eat is more fun on a farm with cows and sheep (*herbivores*) and pigs and hens (*omnivores*) than from a book.

Lambs at Mount Pleasant Farm. Image: Nina Hatch

For Year 2, who have to learn that animals have offspring which grow and have basic needs for survival, there is plenty of first hand observation. They can also look at living things and their habitats. English winters mean that our herd of dairy cows have to come indoors into a cow shed in October – but how are the sheep adapted so that they can stay outside in the field all winter, except at lambing time?

There are natural links between any sector of farming and the science curriculum. All it takes is some initiative and resources. Sadly, as 21st century living is predominantly in urban environments, we have many misconceptions about the connection between our food and farms. A survey of more than 27,500 children conducted by the British Nutrition Foundation (BNF) found that nearly a third believed that cheese came from plants, tomatoes grow underground and fish fingers are made from chicken! Many teachers who bring their pupils to my farm do not even realise that a cow *(mammal)* has to have a calf before she can produce milk for the next 10 months.

This is being partially addressed through food preparation and cooking in the design & technology curriculum. Many schools combine this unit with their science targets. As well as the principles of a healthy and varied diet, at KS1 pupils are required to understand where food comes from. KS2 broadens to an understanding of seasonality and where ingredients are grown, reared, caught and processed.

Bellfield Junior School pupils feeding hens during a Kenrick Days funded farm visit. Image: Nina Hatch

At KS2 and beyond, teachers can extend into considering some of the local, global and environmental issues involved in food production. This should help pupils to make informed choices in later life. But basic understanding needs to be established from the time that children start in formal education (or even before).

I will give just one example which is a standard part of my teaching day. The children's first activity is to collect eggs from the free-range hens. Pupils also collect rainwater from water butts on the side of the hen houses, carry the buckets of corn and ensure that gates are safely opened and shut. Through their actions, they have considered the basic living requirements for the birds. Back indoors, they are asked to consider the hypothesis: '*All hens lay the same colour eggs.'* As we have a variety of hen breeds, the evidence for the answer is clear to children of any age. Another hypothesis: '*All eggs are the same size'* is equally easy to conclude, and later in the day some children can weigh and grade the eggs so that they appreciate the sizes on the boxes they buy from a supermarket.

Children weighing eggs collected from the hens. Image: Nina Hatch

We discuss a chicken's welfare requirements since they are a bird, and an omnivore. (Children from many cultures and countries are very used to poultry.) Eggs are also a good subject for practical work on forces and reversible and irreversible changes; not forgetting their part in a healthy, balanced diet. While respecting both religious and dietary beliefs we cannot ignore their value as a meat source.

Resources and support

countrysideclassroom.org.uk connects schools with food, farming and the natural environment. A termly newsletter provides information, resources and courses from a consortium of farming and food related organisations.

face-online.org.uk is the website for FACE (Farming & Countryside Education) and is packed with guidance on planning a farm visit with resources on many different aspects of farming. FACE is now operating in conjunction with LEAF (Linking Environment and Farming) who operate the 'Open Farm Sunday' programme. Their website **leafuk.org** has a section on Open Farm School Days in June which can be searched by geographical area.

Coincidentally, as I was finishing this article, the NFU (National Farmers Union) has just launched a new range of teaching packs which are linked specifically to KS1 & 2 English science curriculum targets. View these at **nfuonline.com/back-british-farming/nfu-education**. Downloadable resources including video clips, printable worksheets and lesson plans have been designed to show children what happens to some of their favourite ingredients from farm to fork.

Three basic units are available. Pupils can find out how carrots are produced, the food chain of a school dinner and explore a farm through their five senses. While I am advocating getting children out of the classroom into a real-life farming environment, this is often not feasible. The NFU have realised this and so have developed adaptable and fun ideas readily available to any teacher. They are using all the terminology which would help a non-specialist to cover all that is required by the science curriculum.

Nina Hatch is Chair of the NAEE Executive Committee and Teacher/Centre Manager at Mount Pleasant School Farm **mountpleasantschoolfarm.com**

Contact: mountpleasantschoolfarm@btconnect.com

The Woodcraft Folk: Our approach to STEM and environmental learning

Deborah McCahon, Margaret Fleming, Bob Todd, Paul Fleming & Ann MacGarry

Woodcraft Folk (WCF) is a UK charity with 400 local groups and 6 residential centres. Woodcraft Folk groups are run by volunteers who seek to deliver an interactive programme which supports children and young people to explore issues of equality, children's rights, international understanding and sustainable development.

Woodcraft Folk's main purpose is described in the strapline 'Education for Social Change' and in the following core principles:

- Co-operative approach to life
- Children's rights
- One world

Building the Leicestershire Eco-trailer. Image: Margaret Fleming

Woodcraft Folk's aim is to empower children and young people, equipping them with the confidence and skills they need to make a positive contribution to their community and the wider world. Since 1925, local Woodcraft Folk groups have engaged children and young people aged 0-21 years in a wide range of activities including co -operative games, craft, discussions, social action, camps and outdoor adventures. These activities support children and young people to learn about global issues in age-appropriate ways, exploring the change they can make.

The following summarises some of the range of environmental education activities undertaken by WCF with its partners over the last 15 years. It describes how we have used our core values to develop an award-winning peer learning methodology that can be applied from this informal context to more formal learning sectors. Our large international camps have been a great opportunity to trial activities and apply for funding for bigger projects.

Sust'n'able (2001)

Planning for *Sust'n'able* coincided with the lead-up to the World Summit on Sustainable Development (WSSD), or ONG Earth Summit 2002, which took place in Johannesburg, South Africa, from 26th August to 4th September. Sustainable Development Education was the theme of this camp, attended by 4,000 young people. Activities were planned and delivered by and for children from the ages of 5 to 25, around the WSSD themes.

At the camp, a simulation game took place called *World on a Tight Rope*. It ran the length of the camp and involved people working for credits to create a more sustainable world. The simulation included two 'Earth Summits' held at the camp to come up with a declaration to the world's leaders at the WSSD in Johannesburg. The Earth Summits had 'action stations' where people debated the issues to be included in the declaration. The declaration created as part of the simulation game was presented by a delegation of eleven young people. The delegation attended the United Nations' WSSD including both the civil society and the official political areas of the summit. The group worked with the International Falcon Movement – a Socialist Education International delegation attending the summit. Young people from Woodcraft Folk continue to attend and play an active role in all the Commission on Sustainable Development meetings which are follow-ups to the annual WSSD.

Funding was also secured from the Energy Saving Trust to engage young people in practical activities such as building solar electricity systems and solar showers to use at the camp. The camp inspired local groups to develop further sustainability activities. Funding from Awards For All and the Scottish Executive enabled young people to design and build two solar energy trailers; the 500W eco-trailer in Leicester and the 1,000W Powerpod in Edinburgh. Both continue to provide light and power for a range of Woodcraft Folk events.

*Global Village (*2006)

The next international camp continued this sustainable development theme – with the *Global Village 2006 International Youth Festival* integrating sustainability into its activities. It engaged young people with Millennium Development Goal 7: *Ensuring Environmental Sustainability*. De Montfort University (DMU), with the Centre for Alternative Technology (CAT), secured funding from the Engineering and Physical Sciences Research Council **tinyurl.com/ya5n4rtl** that allowed a wide range of peer-led practical activities to take place. These included building solar water heaters, thermal storage systems, solar electricity systems, wind turbines and electrical storage. A focus on the importance of insulation was delivered via a camp shed that was turned into a sauna.

Building the solar showers on camp. Image: Margaret Fleming

C-change and *Face Your Elephant* (2006-present)

Young people from WCF, many of whom attended the Global Village festival, were trained as 'Peer Educators' to communicate climate change as Woodcraft Folk and partners CAT and DMU delivered the 2006/07 DEFRA Climate Challenge Fund project *C-Change*; the overall winner of the 2009 National Energy Efficiency Awards.

A series of engagement events were developed by the young people, based on what appealed to them. These included forum theatre, club nights, a 'battle of the bands' competition, a peer-led school conference, and an exhibition at Glastonbury Festival in 2007. The young people involved saw the music festival element as one of the most effective parts of the *C-Change* project, as it was easier to engage with people one-to-one, in a leisure environment. They also successfully operated the *Face Your Elephant (FYE)* exhibition for the first time at festivals during 2007. Further EPSRC support **tinyurl.com/ybbvqqom** was secured to deliver this project at music festivals and WCF events from 2009-2011.

This led to monitoring and evaluation of electricity consumption of diesel-powered generators. *Ingenious* funding from the Royal Academy of Engineering (RAEng) enabled the project to continue with more of a focus on the role of engineering and electrical smart grids in 2014 -15 at the Latitude Festival. Other Woodcraft camps, including *Co-camp* (2014), which was "*created by each participant who brought their own skills and ideas",* have continued these themes with sustainability becoming embedded into many aspects of camp daily life.

The 'Face your Elephantt' graffiti wall, Glastonbury 2007. Image: Margaret Fleming

What we have learned

This work supported peer educators to raise awareness of climate change amongst 11-25 year olds with the aim of changing their behaviour and reducing their carbon footprint. The longitudinal evaluation carried out by De Montfort University showed:

- 75% of young people were aware of carbon emissions, although many of them felt powerless and believed that *"there was nothing they can do",* or they felt lost and *"didn't know what to do".*
- 85% of young people told researchers they had changed their behaviour after attending a peer education workshop, e.g. used cotton bags, used less water, walked more, switched off appliances.
- Young people can be very passionate and persuasive, and successfully took the CO_2 reduction message out, both formally and informally, to a range of networks.

The RAEng *Ingenious* report also found:

> *The project had an impact on the young engineers, increasing their knowledge and awareness of public engagement, in particular that of electricity use at off-grid events. It increased the knowledge and awareness of smart grids amongst festival organisers and power providers using minute by minute data gathered from electricity generators on site. Finally, festival goers increased their knowledge and awareness of the role of engineering of both an outdoor event and in terms of the role of engineering in moving to a low carbon society.*

Our approach to environmental education and STEM learning shows that such complex issues when addressed in a practical fun way, from their own perspective using peer learning techniques, are readily understood by young people.

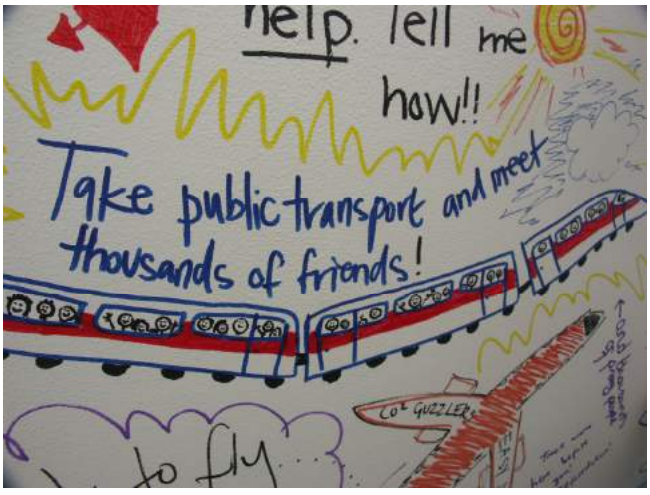
Complicated energy issues related to insulation became simple when touching single, double and triple glazed windows in an insulated hot shed (sauna). Young people were able to design and build mobile renewable energy power systems to help them have electricity for light and power in off-grid camps, utilising calculations that ensured their lights didn't go off!

These young people were readily able to communicate these ideas to their peers at mainstream festivals such as Glastonbury and Latitude, transferring lessons learned from their Woodcraft camps.

What we would like to do next

There is still much work to do. Our volunteer youth workers tell us that they lack the confidence, knowledge and information needed to engage children and young people in exploring the sustainable development goals. They tell us that they are aware that some educational material exists, but they don't know where to find it or don't think it is tailored for an informal education setting. We would like to address this need, by producing signposting resources with new session plans to fill gaps in current resources.

During consultation with our young members, they have shared concern about the environment as a high priority for them. Their concern for the environment impacts on their aspirations for the future and emotional wellbeing. We hope by being better informed they can become more proactive in finding solutions rather than weighed down with worry.



More 'Face your Elephantt' graffiti. Image: Margaret Fleming

As a dynamic charity, Woodcraft Folk is always working with children and young people to find ways of sharing our aims and principles, we are currently:

- Working with the RSPB and a team of young researchers to find ways to better engage 16-25 year olds in Sherwood Forest.

- Taking on the management of a 20-acre camping site in the Forest of Dean **biblins.org.uk**, seeking to increase visitor numbers whilst reducing the environmental impact of the site. The site has no mains electricity and we will support campers to experience different renewable energy services during their stay.
- Co-operating with international organisations to plan our next international camp *Common Ground 2020* in Kent.
- Rehousing our archive with the Institute of Education at UCL whilst working with volunteers to plan our 100th anniversary celebrations in 2025.

Woodcraft Folk continues to work with key partners to deliver young person led, exciting, fun, practical projects where sustainable development is fully embedded and where complex science and engineering concepts are explained via peer education and practical use of sustainable energy at camps.

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Deborah McCahon is Director of Development at Woodcraft Folk; **Margaret Fleming** and **Bob Todd** are Woodcraft Folk Volunteers.

Paul Fleming is Professor of Energy Management at De Montfort University.

Ann MacGarry is Education Officer at the Centre for Alternative Technology.

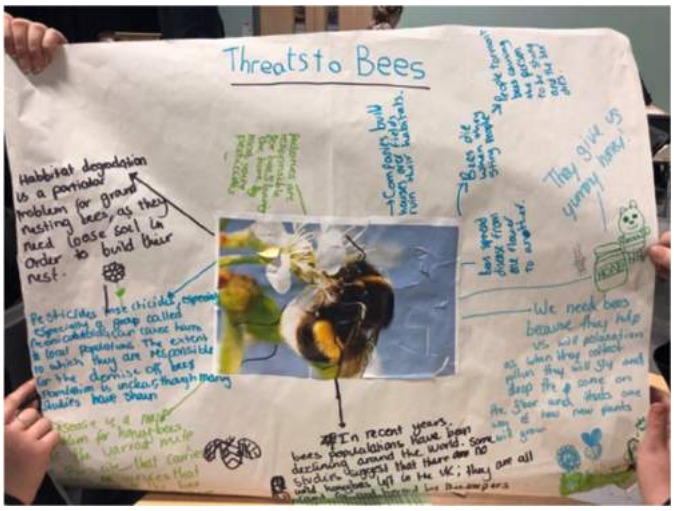
Contact: info@woodcraft.org.uk

Big Ideas: Engaging with engineering

Solutions for the Planet

Solutions for the Planet is a social enterprise working nationally with hubs in North England (North-east England, West Yorkshire); Scotland (Falkirk, Glasgow); the South East (East London, North Kent, Portsmouth); and the West Midlands (East Birmingham, Solihull, Wolverhampton). Our vision is for "*a generation of young people ready and able to respond to 21st-century sustainability challenges".*

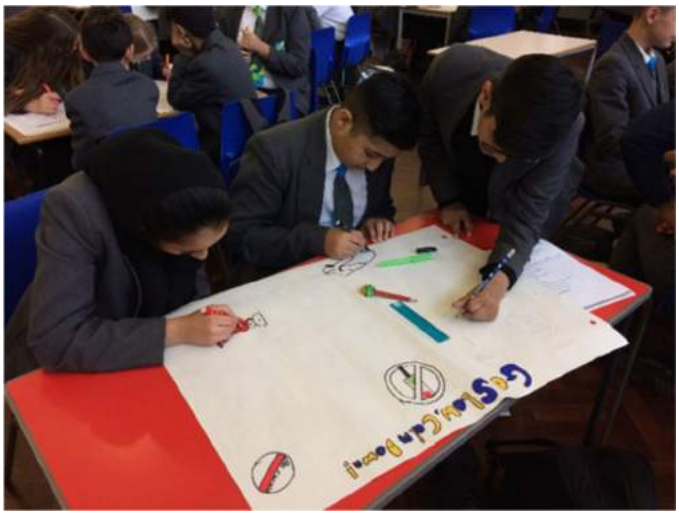
We achieve our vision by engaging young people with the STEM (science, technology, engineering and maths) skills they will need to succeed in future employment, education and training, and to make the world a better place. This happens through our 'Big Ideas' competition where young people work in teams to come up with a solution (a Big Idea) to solve a sustainability problem of their choice. This idea is then honed into a business plan for entry into our competition. We work with students in Years 7 to 9, or S1 to S3 in Scotland, and deliver our initial Big Ideas Day in schools, with the support of teachers and business mentors. Those students who wish to take their idea forward, to enter the competition, do so in weekly development sessions led by teachers and supported by our business mentors.



An example 'Big Idea'. Image: Solutions for the Planet

"*It's great being able to take part; helps me to give something back and encourage the children with some enthusiasm towards STEM subjects and careers.*"

James Clarke, Tarmac, Yorkshire Mentor



Students working on their presentation.
Image: Solutions for the Planet

Big Ideas need to be **A**chievable, **B**eneficial, and **C**reative, meaning teams need to draw on multiple skillsets to come up with a solution to their sustainability challenge. We use the four themes of energy, water, waste, and biodiversity to highlight sustainability issues and engage our young people with key environmental challenges. Teams are introduced to processes involved in energy production, recycling, water treatment and food production, to name a few. They are challenged to think about the consequences of these processes and what environmental issues they may cause.

We then encourage teams to think of new ways to solve these problems and, in doing so, make our planet a better place. We want to raise environmental awareness and empower young people to feel that they can make a difference to these issues. To do this, we encourage practical solutions through the championing of STEM skills. We illustrate how exciting STEM skills are and how they are used in careers spanning multiple industries and academic disciplines. We also reach out to the wider STEM and environmental education community to support our programme.

We are partnered by Tarmac at a national level and have regional support from Arcadis, Brammer, Buck & Hickman, IGEM, Mears Group and SGN. All business partners support our programme financially and by providing their staff to be trained as mentors. Mentoring develops communication skills for both staff and students, and gives local businesses the chance to engage with their communities, as well as to meet and influence their future workforce.

"*I would definitely recommend taking part in this process to other engineers to give them assurance that the next generation are being shown how much opportunity is available to them. How they would otherwise be made aware I really don't know, so it's vital information you are delivering here.*"

Kate O'Hara, SGN, Scotland Mentor

We provide training for all teachers and mentors and pride ourselves on delivering a high-quality programme which manages the needs of students, expectations of teachers and allows industry professionals to gain experience of mentoring in a supportive environment.

Staff at a training session. Image: Solutions for the Planet

"I really enjoyed the Big Ideas Day. The school was very warm and welcoming and it was a pleasure to be part of it. I think it really helps being involved from the very start of the Big Ideas (programme), I feel invested and it makes me want to attend as many development sessions as possible. The day was very well organised and ran very much to timings, I am looking forward to seeing the big ideas develop further over the coming weeks."

West Midlands Mentor, Tarmac

Another important aspect of the mentoring is that it gives our young people much-valued experience of engaging with employers in an informal manner. This helps to develop career aspirations, ask questions about the world of work, and see how STEM skills are used by a wide range of industry professionals. 74% of our 2016-17 cohort of students say that as a result of taking part in a Big Ideas Day, they now understand more about the job opportunities available using STEM skills; whilst 73% say talking to mentors has helped them to understand the range of career opportunities available to them.

Trophies awarded to winning schools. Image: Solutions for the Planet

Our 2017/18 Big Ideas Competition began in September 2017, and we are working with thirty schools nationwide. The majority of the teams are currently well on the way to developing their Big Ideas into business plans with the support of their teachers, Solutions for the Planet and the business mentors. Not to give too much away, we have a range of ideas in development including barn filters to reduce methane emissions from dairy farms, robots to remove plastic waste from the ocean and specialist apps to tackle social sustainability issues such as gender equality and mental health. If you want to find out more, follow us on social media and on our website for updates!

This year, we are also pleased to be working with two Special Educational Needs (SEN) schools for the first time. Our decision to branch into the SEN sector was driven by demand for our services and interest from schools in both the North East and Portsmouth. We have collaborated with teachers to modify some of our resources but are proud to say that overall our programme content is unchanged and SEN students will compete alongside teams from mainstream schools. Our SEN teams are also supported by mentors from our partner companies who are keen to show these students that there is room for them in the STEM workforce.

"We have some budding entrepreneurs and, in my opinion, a number of teams could make it to the final!! Bring it on!!!"

Debbie Kerr, Mears, North East SEN Mentor

At the end of March, we will collect the Big Ideas and shortlist teams to present at our Regional Finals in May, held at local universities, science parks and even Holyrood House! The winners of each of these events will then take their idea to the National Final at the Palace of Westminster in July. At all events, teams present to a panel of judges including business leaders, MPs, academics, and entrepreneurs from across the country.

Students with their certificates. Image: Solutions for the Planet

Holding Regional and National Finals at such iconic venues (teams also receive a tour of the Regional Final venues and of the Palace of Westminster) helps build the aspirations of our young participants and allows them to see first-hand the places their STEM skills could take them. This aspiration development is a key impact of our programme, as we champion transferable softer skills such as team work, confidence and resilience. 74% of last year's finalists say their confidence has improved as a result of the programme and 78% say the programme has increased their interest in school.

"Solutions for the Planet is a great programme to inspire and develop students into independent confident individuals. It has made me more aware of the issues surrounding our planet and how amazing our students are! "

Mandy Tucker, Alderbrook School, Solihull

"*The S4TP team empowers young people and women like us and encourages us to really think big. Solutions for the Planet has encouraged me to go into the STEM fields."*

Member of Vitaliite, 2015-16 Big Ideas Competition winners from Quwwat-Ul-Islam School, Newham

"The programme is great, I have grown in confidence and it has improved my knowledge."

Finalist from 2016-17

"(I learned that) losing isn't bad because you can take feedback and come back stronger next time."

Semi-finalist 2016-17

Big Ideas Day in a school. Image: Solutions for the Planet

This year has been a hugely exciting time for Solutions for the Planet, seeing us expand into Scotland, the North East, Portsmouth and increase the number of schools we service in existing regions. Based on last year's feedback, all of the teachers involved say the Big Ideas programme helped their students understand more about the relevancy of sustainability and the role they can play. They also said it supported students across the curriculum and encouraged students to think differently about their future career options. Any teachers or schools interested in gaining such benefits by joining our programme can contact us via the website to find out how to get involved.

The winners of last year's competition. Image: Solutions for the Planet

Solutions for the Planet: Sarah Milburn is the West Midlands Programme Coordinator and Communications Lead; Dr Jess Mitchell is the North England & Scotland Programme Coordinator and Impact Lead; Jen Baughan is the CEO.

solutionsfortheplanet.co.uk

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Hugh Kenrick Days: Art and science at Birmingham Botanical Gardens

Rohina Akram & Ann Hillier

Year 9 science focus – rainforest plants

In October 2017, Year 9 students were given a unique opportunity to consolidate their understanding of plants and their processes with a visit to Birmingham Botanical Gardens. This experience allowed students to appreciate the diversity of plants found throughout the world and their various uses. The habitats in the tropical and subtropical glasshouses allow lush plants to thrive – some were so tall that they touched the ceiling. There was also an opportunity for students to observe plants adapted to arid regions, such as cacti and other succulents.

The main teaching activity led by the Botanical Gardens Education staff included the 'Rainforest Backpack Challenge'. Students were given a range of clues and worked in small teams to explore the glasshouses, finding out about some key rainforest plants from around the world . These included plants with everyday uses, such as cacao (cocoa) and banana plants, and carnivorous plants such as Venus flytraps and pitcher plants, which the students found fascinating.

Students working in the Subtropical House.
Image: Anne Hillier

The main activity was followed by a plenary session, which enabled students to give feedback on their newly-found discoveries. They were also given the opportunity to handle a range of unusual rainforest seeds – both small and large – and informed of their uses.

This funded visit enabled students to appreciate the huge diversity of the plant kingdom and its importance. Key concepts were addressed, such as how photosynthesis is the main reason why oxygen levels remain constant rather than running out. The focus linked well to the learning objectives for the Year 9 curriculum unit on photosynthesis, which the students had recently covered in class. Furthermore, an early introduction to GCSE content was made – the impact of deforestation on habitats such as the Amazon rainforest was easier for students to appreciate after observing the rich growth found in the tropical environment simulated in the glasshouses.

Year 8 art focus – environmental art

In November 2017, Year 8 students visited Birmingham Botanical gardens on an art-based visit to support their in-school learning.

On arrival at the Botanical Gardens – many of them not having visited before – the students were awe inspired by the beauty of the surroundings and relished the opportunity to explore the grounds and the natural environment.

The workshop we completed was based on Andy Goldsworthy. Students were familiar with his work and the practical session enabled them to embed and develop this knowledge. Students worked in small groups to collect a range of natural objects to create transient artworks inspired by nature and Andy Goldsworthy. All students engaged fully with the activity; some groups even became a little competitive! They enjoyed exploring the grounds and sourcing the objects; they worked as teams to create colourful and imaginative art works.

An example of the students' environmental artwork.
Image: Anne Hillier

After an outdoor lunch, we carried out some teacher-led activities. The students used the surroundings to develop drawing skills, focusing on sketching techniques. They made good use of the cactus house, greenhouse and tropical house. We developed these sketches into larger, more formal, pieces of artwork back at school.

Our day gave the girls completely new experiences: they were able to relate their work directly to an artist; they used natural objects outdoors; they gained first-hand experience of drawing and sketching. The work carried out on this visit will enhance their current work but also enrich their future learning.

Comments from some of the students:

"Today has been fun because we were learning in a different environment and created natural art."

"I enjoyed the atmosphere outside."

"It was great, as we used nature to learn – not electronics and books."

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Rohina Akram is a science teacher and **Ann Hillier** is Head of Art, both at Bordesley Green Girls' School & Sixth Form, Birmingham.

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Thanks to the vision and benevolence of the late Hugh Kenrick, who had a great passion for birds and wildlife, NAEE's Kenrick Days project offers bursaries for schools to visit environmental centres for curriculum-focused activities. Since the project began in 2012, over 3,000 students have benefitted from these bursaries.

A letter to my younger self: Reflections on a career in ecology fieldwork

Dr Steve Tilling

Little did I realise when I set off for a week's A level biology field trip to FSC Dale Fort in 1971 that the course of my life was about to change. In those few days my ambition turned from wanting to be a helicopter pilot to becoming an 'ecologist' and 'fieldworker'. My announcement on returning to home and school was met with equal mixtures of incomprehension and incredulity. Few people understood what I was talking about, and even fewer thought it was a sensible decision. At that time, it would have been useful to learn from the experience of somebody who had followed a similar career path. So, here is the letter I would have written to my younger self…..based on the intervening 40 years of experience.

Dear Steve,

I hear you are planning to become an ecologist, fieldworker and environmental educator. Forgive the self indulgence of somebody just approaching retirement but I thought some words of encouragement and advice might be useful to you.

First and foremost, you will have no regrets. The places you visit and the people you meet will continue to inspire you throughout your working life. You'll never stop learning new things, and hopefully you'll work with communities in the UK and overseas and witness how environmental education can make a huge difference to the quality of people's lives. You will get great job satisfaction as a result.

But, it won't be plain sailing. There will be some tough challenges for you and your new colleagues, but they will need to be overcome if global environmental threats such as climate change, desertification and pollution are to be reversed. Here are some tips that I hope you will find useful:

***Tip 1. Try to be inclusive**. We need to reach beyond a narrow and relatively privileged section of our society. Otherwise, we'll remain irrelevant to the lives of many disadvantaged and inner-city communities. Try to focus on positive aspects of lifestyles and build on sources of community pride. You'll find them everywhere.*

***Tip 2. Don't preach.** You'll need to be sufficiently sensitive and empathetic to appreciate that your ideals and targets aren't shared by everybody. Don't assume that others are wrong. If you listen, you might learn a lot, including about yourself.*

***Tip 3. Don't make extravagant claims**. EE really can make a positive difference to people's lives, but it can't do everything. For example, I have seen many EE projects that have claimed to raise children's 'self-esteem' or 'broaden their horizons'. In many cases, they are hollow statements with no real evidence to back them up.*

***Tip 4. Be flexible.** Under no circumstances should EE be treated as an off-the-shelf franchise. I have encountered more EE models and frameworks than I care to remember. Most work some of the time, but they are all dangerous in the hands of pedants.*

***Tip 5. Never be afraid to try out new ideas.** If you keep your eyes and mind open, EE will always provide you with happy surprises. Make the most of them. For example, I never imagined that 'inventing' fold-out identification charts at an FSC staff training course in 1993 would lead to 2.5 million copies in 20+ languages being sold worldwide (and still counting).*

***Tip 6. Don't forget the young adults.** EE has been doing really well with early years and primary school children. However, we tend to run away from teenagers and young adults, blaming all sorts of things like school curricula and timetables, or lack of support from teachers and parents, or bad behaviour. But we can't keep on ignoring them. Otherwise, we'll just remain an irrelevance to an important group of people that are making choices about careers, families and future lifestyles.*

***Tip 7.Continue associating EE with health and well-being.** I've worked with politicians for long enough to know that local, regional and national policy in the UK is dominated by three priorities: health, wealth and security (borders, defence, democracy etc). That's particularly true in times of stress and austerity. 'Environment' struggles to make an impact unless it ties itself to one or more of those political buttons. The recent moves by EE to associate itself strongly with health and well-being is pushing at least two. That's a very astute political move.*

***Tip 8. Do more high quality research**. One big change in recent years is that politicians and civil servants will ask for 'real' evidence to back up your arguments, and that's true even if you manage to push all three of the political buttons highlighted in my previous tip. So, if phrases such as 'mixed methods' and 'randomised control trials' are unfamiliar to you I suggest you do some reading, or find an educational researcher that can help you.*

***Tip 9. Don't treat gaming and screen time like the enemy**. Gaming, virtual and augmented reality applications are here to stay. Don't waste energy fighting them. Use them to showcase 'authentic' outdoor experiences including the visits to stunning locations in the British Isles which still have the power to inspire and change lives….just as they did with me 40 years ago.*

***Tip 10. Try to get grassroots support for your environmental projects**. 'Citizen Science' projects have provided some of my career highlights. Several have been a great success nationally, often providing scientists with really useful data which has allowed them to plot national trends in water quality, air pollution, biodiversity and environmental health. However, very few communities (including schools) have continued the work after the project finished, probably because in the majority of projects they were not involved in the original project design and its objectives.*

***Tip 11. Don't rely on school science to teach ecology or environmental education properly.** If you go to a Field Studies Council field centre these days you will be twice as likely to meet a geographer compared to a biologist. That is a complete reversal of the situation 50 years ago. Whereas geography fieldwork (and environmental geography) has been in ascendency in recent decades, ecology fieldwork (as taught in biology) has been in decline. So, if you are trying to influence environmental education activity in a secondary school in England, head for the geography department first!*

***Tip 12. Don't try doing everything by yourself**. When I first started, fax machines and photocopiers had just been invented. Desktop computers, mobile phones, Skype and social media were still pipe dreams. It was much harder to stay in touch with each other. Communicating is much easier now and you'll find that your*

influence and voice will be amplified if you use this technology to combine your efforts with like-minded EE colleagues.

Lastly, I hear that your parents and teachers aren't really sure what an 'Environmental Educator' is. Don't worry. When they see your job satisfaction and the opportunities that you have to make a genuine difference to the lives of young people and their families they will understand.

However, don't expect them to decipher all the acronyms associated with EE. That is something that is still defeating me after 40 years.

Good luck.

Steve

…….your soon to be retired alter ego. 

……

Dr Steve Tilling has recently retired after working for the Field Studies Council for 35 years, latterly as the charity's Director of Communications. He now intends to dust off his collection of identification guides and revisit some favourite haunts in the UK, as well as doing some research as an Honorary Senior Research Associate at UCL Institute of Education.

A lasting connection with nature begins at home

Laura Colman

Humans need nature – our health, wellbeing and survival depends on it – and now, more than ever, nature needs us. As populations become more urban and more pressure is put on green spaces, there is an urgent need to find a better balance between people and wildlife in our cities.

The city of Bristol sits at the heart of the West of England and, with close links to the Severn Estuary, North Somerset Levels and Moors, and the Cotswold Hills, it plays a key role for wildlife in the region. Within the city, wildlife is supported by a network of local wildlife sites, nature reserves and parks but, as resources are stretched and the city grows in size, our natural environment faces increasing challenges.

Bristol is the largest city in the south west, with a population expected to reach half a million in the next 20 years, making it part of the fastest-growing core city region in the UK. This year, it was awarded the title of 'Best Place to Live in Britain'; wouldn't it be great if the same were true for hedgehogs, swifts and pollinators? How can we ensure that it remains a great place to live – for people and for wildlife – for generations to come?

Experiences of nature and knowledge about the environment

"If a generation becomes detached from the natural world, it is in danger of becoming indifferent and whilst some skills are learnt in the classroom, others only come from being knee deep in mud and elbow deep in frog spawn."

Chris Packham (BBC, 2009)

Every year, thousands of children visit Avon Wildlife Trust's learning centres at Folly Farm and Feed Bristol, which offer rich opportunities for hands-on experiences in nature; from pond-dipping to bug hunting, bat walks to owl pellet dissection. We also deliver in-school programmes, which allow students to learn about and care for some of our amazing local wildlife, including pollinators, hedgehogs and critically-endangered European eels. These experiences create lasting memories and can inspire an interest in nature – not just for students, but for teachers, parents and the wider community.

"The project got everyone in school buzzing about it – office staff, teachers, all ages of children, school meal assistants at lunchtimes (asking if they could sit and watch the eels), visitors…so many people gained insight and interest in the species and their plight."

Teacher, 'Spawn to be Wild' project

Attitudes to nature

"If the present generation of parents and educators don't engage children with the natural heritage they are unlikely to do so when they become parents. This is an extinction of experience."

Richard Louv (2008)

Parents, teachers and other professionals play an important role in supporting curiosity and learning about nature; however, many feel that they lack the knowledge, capacity and confidence to support learning in natural environments (Waite et al., 2016). Our 'My Wild Child' sessions, family events and professional development programmes provide opportunities for parents, carers and teachers to share experiences in nature with their children and support exploration of their environment through wild play and outdoor learning.

"[My son] is nearly three and he knows already there are certain plants he can pick and others he can't. That for me is very important. He's got a certain respect. He knows he can't trample on certain things because they're special. I think that's come from spending time outdoors."

'My Wild Child' parent

A nature-rich city

Creating a nature-rich city is only possible if people are connected to nature, value it and put it at the heart of decision-making, individually, locally and nationally. Sympathetic planning and improved management of existing green spaces, as well as creation of new habitat, are vital if we are to support abundance and diversity of species in the city and bring people closer to nature.

We know that contact with nature in childhood can strongly influence positive environmental behaviour (Bird, cited in National Trust, 2012) and studies have identified that experiences of nature, knowledge about the environment, access and attitudes to nature at home are key factors in establishing a lasting connection (Wildlife Trusts & RSPB, no date).

Experiences of nature and knowledge about the environment can be supported in a variety of settings; however, access and attitudes to nature must be addressed where people live. If we want people in urban areas to have a connection to nature, then it follows that we must make that connection – not just on reserves and in learning centres – but in the city. We must value 'everyday' experiences of nature as well as 'special' ones and we must work with families, schools and communities to create a better future for people and wildlife in Bristol.

Access to nature

"The outdoor child [should] be seen as an 'indicator species'…just as with salmon or house sparrows, the presence of children out of doors should be seen as a measure of the quality of neighbourhoods."

Tim Gill (2011)

Nature near the home and engaging everyday experiences with nature are particularly important for children and have been shown to have a positive correlation with cognitive function and ability to manage stress (Wells, cited in The Wildlife Trusts & The RSPB, no date). We are working with schools, children's centres and youth clubs to support everyday nature experiences and improve local spaces for wildlife. We want to introduce people to the wildlife on their doorstep, so that they can connect with nature every day and help to support their natural neighbours in the city.

"We love being outdoors anyway and these sessions are affordable. We could never afford forest school sessions. To have this literally two minutes up the road from my house is great. It's full of local parents who I know anyway, so I like the community idea of it. You don't get this anywhere else."

'My Wild Child' parent

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Laura Colman is the Learning Development Manager for Avon Wildlife Trust.

Contact: mail@avonwildlifetrust.org.uk

Chelsea Physic Garden: Shelf Life

Michael Holland

When working with visiting school groups, one of the first questions I ask of them is "Did anyone eat any plants for breakfast?" Often, the response is laughter and disbelief that a grown man would ask such a silly question. However, when I fetch the box of Weetabix with *Triticum aestivum* (wheat) growing out of it, or a tin of coffee powder containing *Coffea arabica* the penny starts to drop. These plants and products are relevant to their lives and this is a visual way of pointing this out. It is also useful for demonstrating the concept of biodiversity – both within and between plant families. Other educational offshoots include nutrition; labels and their typography; multiculturalism and geography (some of the items might only be used by specific cultural groups and the countries of origin of the plants are diverse); and, of course, recycling.

Lycopersicon esculentum in a pot of tomato soup. Image: M. Holland

Solanum tuberosum in a potato crisp packet. Image: M. Holland

The initial idea came after seeing an old Hovis bread baking tin for sale in a Chelsea antique shop several years ago and thinking that growing wheat plants in it would be both visually stunning and educationally effective. I've had an interest in growing everyday kitchen plants from seed since I was about 8 years old, when my parents gave me Keith Mossman's *The Pip Book,* which is a must for anyone interested in saving and germinating seeds from kitchen 'waste'.

In March 2003, I began collecting food packaging as well as material to propagate (seeds, cuttings, rhizomes, runners and tubers) of a selection of foods and food plants. The plan was to use the product packages (jars, boxes, bottles, wrappers and bags) as containers in which to grow those plants that make up the products' ingredients. It is a bit of a mouthful, but two simple examples include a potato plant growing in a bag of potato crisps and wheat growing in a bag of bread. This collection of plants is something that will be expanded upon in various directions as an educational resource aimed at all visitors to the Garden.

At the 2004 Royal Horticultural Society (RHS) Chelsea Flower Show, we created a small 'shop' with shelves showing 90 different 'living' products, including a top shelf booze selection, cleaning products and a medicine section. Cotton was growing from the cash register, since our bank notes are woven with it. We were awarded a Silver-Gilt medal for this display.

Other non-food products include cotton wool, pine cleaner and printing ink (soya and linseed) as well as many plant-based medicines (morphine, taxol, aspirin, hyoscine, and various essential oils).

Grow your own *Shelf Life* display

Part of the purpose of 'Shelf Life' was to encourage recycling, so collect seeds from the food you eat and save relevant packaging that would otherwise be thrown away. Fill the packaging with soil or potting

compost and plant the seeds (or rhizomes) inside. When planting, remember that drainage is important, so fill the bottom of any packaging that you are using with gravel or horticultural grit. This will provide drainage and also weight the plants and stop them from toppling over.

When deciding what to grow, remember that choosing foods and products that are relevant to the lives of the people who will be seeing them is the key to success.

We still have an ongoing Shelf Life display at the Garden and have recently commissioned an extensive set of accompanying learning resources which can be viewed on the CPG website: **chelseaphysicgarden.co.uk/teaching-resources**

Michael Holland is Head of Education at Chelsea Physic Garden.

How green was my sports pitch?

Dr Phil Murphy

The one time we all definitely got to touch nature at high school was our sports lessons. Whatever the weather, football and rugby dominated the PE department's offerings throughout the autumn and winter terms. Getting truly filthy was an unavoidable part of the experience. My school did have a state of the art all-weather hockey pitch surfaced with a material called 'redgra' made of lumps of red ash which, as I found out in my one and only hockey lesson, could strip the skin from your knees if you fell over. For most of the time this facility was reserved for the young gods who played in the hockey team and seemed to be exempt from the rules for us mere mortals where being tripped/pushed/thrown into the mud was an unavoidable thrice-weekly ritual. There was no chance for escape from regularly getting covered in mud for those of us at the bottom end of the school sports pecking order.

When I visit high schools now, one of the major physical changes I see are the sports facilities. Where once an area of grass and soil was enough, now there are high tech fixtures with all-weather surfaces. The uniform bright green of synthetic grass shines all year round. These are often fenced and are designed to be usable for multiple sports. The fully drained surfaces mean no one gets covered in mud anymore and the fencing means the ball doesn't disappear into hedges and ditches thus needing retrieving at regular intervals. I suspect there are many advantages to these modern facilities – they can be used in any weather, don't need constant maintenance and dog walkers can be kept away (finding you had been rugby tackled into a pile of dog faeces was not an uncommon occurrence).

The antiseptic appearance of these facilities leaves me wondering if young people are losing a little more contact with the natural environment. We all knew what soil felt (and tasted) like. We knew that if you used one pitch too much the grass would die off, leaving a mud bath in winter, which turned into a rock hard dust bowl in the summer term. We knew that soil was necessary for the grass to grow and that the land needed people (the groundsman and his assistant) and equipment (the tractor towing the big mower, the line painting machine etc.) to maintain it. When today do young people actually come into contact with soil and mud? Or appreciate that vegetation needs maintenance / is damaged by use? I am sure if I was a young person today I would applaud the arrival of these new facilities and age can give a rosy glow to the small periods of hell that were most winter PE lessons but at least we were fully familiar with some of the dirtier aspects of our environment.

Dr Phil Murphy is a Lecturer in the School of Earth and Environment, University of Leeds. He is also an NAEE Fellow.

Building citizenship through community engagement

Dr Bob Coulter

Teachers and schools today face an enormous challenge when they seek to develop students' capacities beyond a slate of grade-specific academic skills. Much of this challenge emerges from pressure applied by school managers and data crunchers who conflate increased test scores with meaningful learning. In too many places, what isn't tested isn't valued, but instead is reduced to vanishing traces in the school day. Beyond the school, many informal institutions feel pressure to offer programs designed to appeal to teachers by meeting specific – and often quite narrow – curriculum goals. In doing so, opportunities for more holistic and organic learning are shortchanged.

As responsible educators, we need to be sure our programs – in school and out – focus on a broad range of skills and dispositions, not just what's on the menu for this year. To be clear, academic competence is essential, but it can't be the only goal. If we hope to fledge citizens who are lifelong learners ready to participate in a democratic society, and who are equipped both to earn a living and to contribute to a creative economy, we need to engage them in more adventurous learning. Far from being a Utopian dream, we need just a few changes in our approach. Environmental educators are well positioned to make this possible. By being sure that our work is deeply embedded in the world around us and set up for student engagement, we can make learning come alive for students.

The core challenge before us as professionals is to take on a creatively assertive identity. Too often, environmental education is seen as a peripheral aspect of the curriculum. Slotted in its niche, it has to fight for attention. In the end, it co-opts time from traditional school subjects. Instead of engaging in a curricular turf battle over how many minutes are allocated to each subject in the timetable, I invite you to make a figure-ground reversal that positions environmental learning not as a niche background element, but rather as the connecting tissue that integrates a mix of academic and social learning opportunities. In the pages ahead I'll be sharing work my team and I are doing in partnership with local teachers to create learning opportunities that are both academically rich and that promote character and citizenship. One proven strategy I'll be focusing on is to reclaim local, community-based investigations as rich learning spaces.

Urban gardening at an old gas station site. Image: Bob Coulter

To offer one example, I recently worked with a local school which was focusing on a year-long, cross-grade theme of 'home'. As part of that, students aged 10 to 12 decided to build bee homes in response to growing concern about declining pollinator populations. Each student designed and built an original home based on what they learned in their research about what makes a good bee home. Academically speaking, they read non-fiction to learn about bees and other pollinators as well as related ecological concepts. They also used mathematical skills in the design, construction and placement of the homes. They kindly offered to donate three homes to

our ecology center, which led to site visits where students worked in teams to decide which locations would best meet the bees' needs. This of course gave opportunities to practise oral language and listening skills as they engaged in democratic decision making.

From an academic point of view, engaging students in authentic, community-based projects like this helps them value and make sense of the concepts and skills they are expected to learn. The need for mathematical and language skills, and an understanding of relevant science and social science concepts, animates learning in ways that aren't possible if the work is motivated only by a vague promise of university admission or a good job down the road. We don't have to get too deep in the learning sciences to realize that if we want to learn something we are more likely to learn it, and to retain what we learned. Phrased colloquially, learning that is 'just in time' to be useful is often more engaging than learning that is to be mastered 'just in case' you need it some day. My experience has been that once students see the value of strong mathematical and language skills, they want to learn more. Well-chosen, these skills give young people the power they need to make a difference in the world. Similarly, developing understanding of a selective suite of well-chosen concepts also gives power that can't be realized if learning is scripted to meet a list of topics that someone, somewhere decided it was important for young people to learn on schedule. As educators, we need to curate students' experiences to give as much time as we can to the skills and concepts that have the most value.

Time to explore is an essential part of building an ecological identity. Image: Bob Coulter

Complementing the academic value of authentic work, students engaged in community-focused projects have opportunities to learn social skills as they interact meaningfully with each other, their teachers, and community members. Instead of a teacher-driven exercise where students respond to a teacher's prompt, communication flows back and forth. As they do this, they gain the benefit of meaningful interpersonal experience characterized by a rich give and take, offering, receiving, and responding to ideas that emerge from first-hand experience and through dialogue with others. In a word, they are practising citizenship. With this, they develop a sense of agency as they see their efforts pay off in projects they value. Also, to use a trendy education term, they develop 'grit'. While this term has rightfully drawn criticism for its more vacuous interpretations, there is a lot of value in Angela Duckworth's original formulation of a grit that focuses on smart persistence. Rather than just bull-headedly sticking with something, a smart approach to grit involves being strategic in reading the situation, trying out a strategy, assessing the results, then, as needed, developing a new plan. In many ways, this runs parallel to John Dewey's classical approach to experience where a person undertakes an action, experiences the reaction, and plans an intentional next action. The key is to place students in a position to be intentional in their acts, with our support as they build competence and commitment.

Pulling all of this together, students engaged in well-crafted community-based learning can meet academic expectations as well as (and likely better than) if they are locked in a prefabricated curriculum. With regular engagement in meaningful and authentic community-based projects, students gradually develop a broader suite of skills and conceptual understandings. Along with this approach, there is the added benefit of experience, which nurtures the citizens we need to sustain democratic ways of living. Earlier, I suggested that the changes were small. They are small in a sense, but they are profound. The change from scripted curriculum to community engagement challenges us to be creative in designing projects that integrate curricular areas, resourceful in making local connections, and savvy in navigating school politics. Challenging work, to be sure, but one that lets us reclaim our professional identity as educators in a time when many would reduce us to script followers.

To offer a few closing words, in school and out, we need to be sure learning opportunities are focused on fledging young people toward citizenship and not incubating them for future value. Borrowing an image from Marge Piercy's classic poem *To Be of Use*, just as a pitcher cries for water to carry, students – like all humans – yearn for work that is real. To that end, I'll leave you with a few rules of thumb offered by Thomas Princen (2011). He argues that people thrive best when:

- they are faced with a genuine challenge;
- they are creative and productive;
- they find meaning in their own problem solving and in acts larger than themselves;
- they help themselves and help others;
- they self-organize and self-govern;
- they feel they are getting a fair shot at the benefits of their work.

This is challenging but vital work for us to undertake. Instead of shrinking around the edges of the curriculum, we can claim the centre as we take up authentic, community-based work. When we do this, we can meet progressive educator Vito Perrone's (1991) challenge to *"teach toward large purposes".* Not easy work, but well worth the effort both for the professional growth we experience and for the benefits our students realize. Find a peer network, and take the first steps. I wish you luck.

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Dr Bob Coulter is the Director of the Litzsinger Road Ecology Center, a field site managed by the Missouri Botanical Garden. Previously he was an award-winning primary school teacher.

Finding science in Shanghai: Learning about architecture and ecology

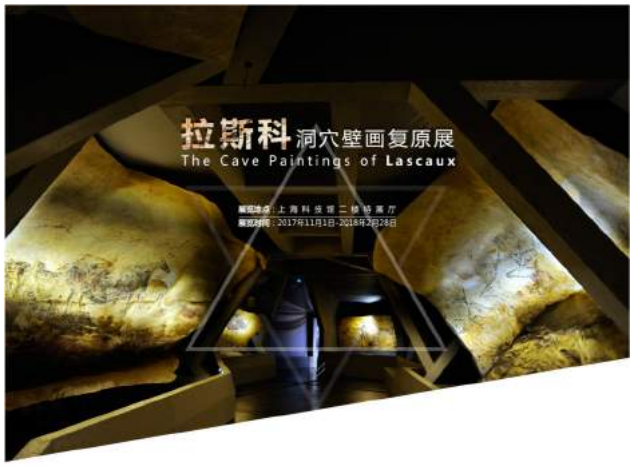
Henricus Peters

Ancient China – the birthplace of papermaking, the compass, gunpowder, and printing – continues as a modern powerhouse of science and technology – and children's learning is coming alongside. An example of modern technical know-how being applied is the Shanghai Tower. At 632 metres (2,073 feet), the 128-storey skyscraper in Lujiazui, Pudong district, has the world's highest observation deck within a building or structure (Level 121, 561.25m), and the world's fastest elevators at a top speed of 20.5m/s (74km/h; 46mph). The Tower is the world's second-tallest building, behind Dubai's Burj Khalifa at 828m; and the world's third-tallest structure, behind Tokyo's Skytree at 634m.

Designed by international design firm Gensler, its tiered construction, designed for high energy efficiency, provides nine separate zones divided between office, retail and leisure use. It has been described as a 'city on its side' – with a huge amount of 'eco-design' within, including being sleek and curved, so the shape actually tricks the wind, which cannot find much, if anything, to grab onto. The base is earthquake-proofed with extremely deep foundations.

The Council for Tall Buildings and Urban Habitat (CTBUH) **ctbuh.org** has a wealth of information about the science and engineering of tall structures. The founder of the CTBUH, Dr Lynn S. Beedle, would have been 100 years old on December 7th 2017. A professor and eventually director of the Fritz Engineering Laboratory at Lehigh University, Dr Beedle founded the Council in 1969 upon the realization that research on tall buildings was not being well coordinated. He quickly wrote to a colleague on the need for an international effort on the dissemination of skyscraper knowledge. Originally called the 'Joint Committee on Tall Buildings,' a collaboration between the International Association for Bridge and Structural Engineering (IABSE) and American Society of Civil Engineers (ASCE), the Council established more frequent information exchanges between tall building professionals. A quick internet search – and a review of some 'tall buildings' documentaries - reveals how complex these structures actually are to 'get right'. The very specific characteristics of these unique structures – extreme height, ability to withstand gale-force winds, severe rains and baking sun – mean that research and development into how they are made, and from what materials, is crucial. This is to say nothing of the costs involved, and the lives that can be saved by doing things correctly and learning from past errors. Interestingly, Shanghai's Pudong district, the location of Shanghai Tower, literally did not exist 20 years ago – it means 'east bank' of the Huangpu River, which flows through central Shanghai. The design and construction of many Pudong buildings required extensive, deeper-than-normal foundations, to avoid the 'sinking feeling' that some older buildings have witnessed. These modifications and the story of Shanghai's buildings, are exhibited at the Shanghai Urban Planning Exhibition Center **supec.org** through collections of old photographs, maps and an exciting scale model of the city centre. These, and displays of future eco-city concepts, attract education groups including schools and cub scouts.

Ecology is certainly one of the many foci of the Shanghai Science & Technology Museum **sstm.org.cn**. SSTM boasts some 14 interactive multimedia exhibits – the most impressive being a rainforest with real trees and waterfalls, which then leads to exhibits on genes, insects, human health and space. Whilst sceptics might suggest these are all 'ordinary' for a museum – the inclusion of English in most areas, plus the hands-on nature of many of the areas, is surely significant – a staggering 3,000,000 visitors per year can attest to this and makes it one of China's most visited modern museums. Of the many times this writer has visited (full disclosure – I am a member), school groups have been component of the visitor number; I have myself taken more than one class there, and there's nothing better than enabling children, who might otherwise not be attuned to science, with some great experiences of the '(Chinese and general) world about them'. The recent exhibition of the famous cave paintings from Lascaux, France, shows how far museums here are reaching out.



Exhibition at the SSTM. Image: Henricus Peters

Whilst science is always better outside, Shanghai skies are so polluted – visit **aqicn.org/city/shanghai** and compare to other cities – that living here, you find ways to have the experience. A drive through the city reveals a place reflected in its own windows, and so the spur for a recent visit to the Shanghai Museum of Glass **shmog.org**. Here, informative galleries display the world as it was, as it is and as it could be; a craftsman created in a workshop and cub scouts undertook the intricacies of applying paint to create their own artwork.

Scouts undertaking a glass workshop Image: Henricus Peters

With China now a leader in the world of science and technology, including the science of climate change, it's good to witness that, not only is science all around us, it's being applied for current and future generations.

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Henricus Peters is Editor of NAEE's e-journal. He lives and teaches in Shanghai.

Sowing the seeds of mindfulness

Emily Vera & Kate Dawson

It was a warm, spring day with a glimpse of sunshine streaming through the trees when we stopped along the pathway to look at the dandelions.

Ludwig, one of our preschoolers: *"I want to pick one. They are beautiful."*

Brianna, turning to face Ludwig: *"But only one, 'cause we want to leave one for the bees."*

Ludwig: "*Brianna, you too, only one."*

Brianna, blowing on the dandelion head: *"I am planting more dandelions with the seeds. There are a hundred bees and only a few flowers. We need to take the tops off, take the seeds out and that grows more."*

Brianna, blowing dandelion seeds. Image: Emily Vera

The simple act of picking a single flower has sparked many conversations, theories and opinions amongst our students and our staff team. The picking itself is not particularly consequential, but it has forced us to reflect more deeply on our values and beliefs about children, childhood, and our role as educators.

Terra Nova Nature School is situated in a 63 acre parkland located in Richmond, British Columbia. A rural gem in an urban setting, it offers varied sites for play and exploration, including expansive grassy fields; wooded groves; a Healing Garden of herbs and pebbles; community gardens and farm fields; and numerous pathways and bridges. Everywhere there are trees, plants and creatures for the children to investigate and enjoy. As individuals and as an organization, we espouse values of environmental sustainability and stewardship. As educators, though, we wonder how much the children should share in the responsibilities of caring for this land and its inhabitants. What does that look like in our teaching practices? How do we reconcile such weighty concerns with children's day-to-day play and explorations within the park?

The answers are neither obvious nor easy. Inspired by the practices of schools for young children in Reggio Emilia, Italy, we see children as strong, capable, and inherently intelligent citizens of our community (Malaguzzi, p.52). We cannot, therefore, excuse the children, any more than we can absolve ourselves, from acting as mindful stewards of the land.

What does it mean to be a steward of the land? For us, it means considering the needs and desires of not only ourselves, but of the more-than-human (Abram, 1996). As educators, we decide which areas of the park to avoid – tender new seedlings under an oak, or a field where kildeer (for UK readers, this is a type of bird) are nesting – and we share the thinking behind these decisions with the children: *"If we stomp all the grasses down by marching through that field, the vole cannot hide from the swooping barred owl, so we'll stay on this path the coyote made",* or *"I don't know how much birch bark can be stripped from the tree without harming it, let's do some research before we take it."*

We also want to encourage the children to think critically, asking them: *"What else relies on this dandelion to live? If we pick all the dandelions, what might happen to the native bees that are sourcing nectar after such a late, wet spring?"* Inviting questions develops a curiosity of the world around and supports a framework of eco-pedagogy (Freire, 1967).

As well as the dandelions, there are many other edible wilds on the land: salal; salmon, thimble, and blackberries; chickweed and land cress; spruce tips; rose hips; and stinging nettle, to name just a few. There are also tangible reminders of previous settlers: Europeans who planted lilac, apple, cherry and plum trees; and the Japanese families who planted goji bushes and patches of huki that, decades later, continue to flourish. It is wonderful to make use of these abundant 'wild' foods in a soup, stir-fry or tea, or as an inspirational still-life in the art studio. Always, though, we pick mindfully, taking 'just some', while leaving enough for others to survive and thrive. (We know that Coyote loves apples in the fall, we can tell from her scat!)

Recipe for Dandelion Tea

Harvest some lush dandelions, play with the stems in the mud kitchen, and use the leaves in a salad, keeping just the flower heads for the tea. Wash the flowerheads very well and then steep in boiling water. Remove and compost the flowerheads. Add honey to taste. Chill in the fridge for 3-4 hours and serve over ice cubes.

Frazier, creating dandelion artwork in the studio. Image, Emily Vera

Admonishing the children not to pick, or creating rules about 'how often' or 'how many' dandelions/apples/ acorns to pick is an oversimplification that serves no one. Indeed, it seems only to encourage sneakiness amongst the children, and crankiness amongst the adults! We want the children to have the freedoms of childhood: to fall in love with the natural landscape as they explore sensorially, playfully, and with unencumbered joy. Seed heads, petals, and leaves are the loose parts of rich dramatic play and creativity, so the making of dandelion crowns, daisy bracelets and long grass swords is always encouraged!

If, however, a child yanks on a plant, pulling it out roots and all, we feel frustrated that their actions are needlessly violent. When a flower is picked, but discarded on the pathway just seconds later, we feel dismay at how quickly the child's interest, and the flower, are abandoned, and at the apparent apathy for a life so quickly ended. We wonder if such acts, allowed to pass without notice or consequence, might contribute in adulthood to a worldview of oneself as a consumer, living all too comfortably in a disposable world?

While the lens of developmentalism offers some insight into children's impulsivity and egocentric perspective, we think there is a bolder place in our role as educators for the teaching of reverence.

Teaching reverence is in keeping not only with our strong Image of the Child, but with our understanding of Indigenous Ways of Knowing (or Indigenous Knowledge frameworks), that are integral to our place-conscious practice (Greenwood, p.93). An Indigenous worldview sees all creatures living equally as part of a whole, with humans no more important than any other being. All creatures are revered for their gifts. Acting with humility, and offering our thanks, are ways that we can show respect for the more-than-human. In our school life together, we sing a short song before enjoying any harvested foods:

"Oh, the Earth is good to me, and so I thank the Earth, for giving me, the things I need, the Sun and the Rain and the Apple Seed, the Earth is good to me."

(Based on the work of Paul Smith & Walter Kent, 1948)

Ludwig, harvesting. Image, Emily Vera

Enjoy your landscape, but tread lightly and pick mindfully – even the weeds! Take time to address moments of apparent indifference, by teaching children to harvest in a respectful way that considers the needs of the more-than-human. Together, revere the dandelion, offer thanks for its gifts and its place in this bountiful world.

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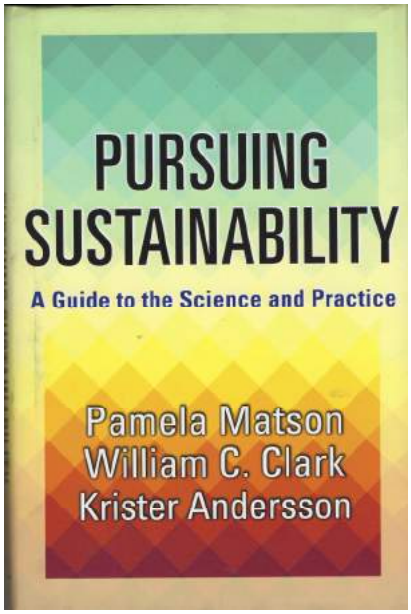
Smith, P. & Kent, W (1948). *The Legend of Johnny Appleseed, Walt Disney Pictures.*

Kate Dawson and **Emily Vera** are the Coordinators at Terra Nova Nature School operated by Thompson Community Association in Richmond, BC, Canada. Their passion for outdoor learning, place-based education and responsive curriculum weaves throughout their work with children and families in the community.

Book reviews

Pursuing Sustainability



The big corporations brand themselves as being 'sustainable' and attempt to build sustainability measures into their business plans and supply chains. Governments and NGOs set targets for the likes of efficiency standards, public transport use, recycling… sustainability challenges look at ways we can improve energy, water and materials use and efficiency.

But, the above beg the (multiple) questions – who are 'we'? What exactly *is* 'sustainability' and 'sustainable development'? What does it consist of / look like? Is there a black and white line of 'yes – this is sustainable', 'no this is no longer sustainable / unsustainable'?

Sustainability is an old idea. Societies for centuries have recognized the importance of demanding no more of the environment than it can supply over the long term…this can be seen in practice in fallowing fields (crop rotation), conserving game, protecting water sources.

In 1987, Gro Brundtland applied the term this way: "Environment is where we live; and development is what we all do in attempting to improve our lot within that abode. *The two are inseparable"* [italics mine]. The Brundtland Commission argued that 'sustainable development 'meets the needs of the present without compromising the ability of the future generations to meet their own needs' and the carefully documented report left little room for doubt that a transition towards sustainable development would have to arrest and reverse the increasingly global and accelerating degradation of Earth's environment and natural resources

Professors Matson, Clark and Andersson go some steps further and focus on the 'human' – as it's us humans that are making things, life, 'unsustainable'.

They aim to *show* what 'sustainability' *looks like* via a 'framework for understanding and pursuing sustainability' which is noteworthy in that 'natural' features only once. The majority of the elements that are included in their flow diagram are about society and hence about human values.

This book wrestles with a range of questions. For example how trophy hunting in Africa is a good (or bad) illustration of the contested nature of sustainability issues. Elly Pepper, of the US Natural Resources Defense Council, states: "Any trophy hunting of an endangered species is, by definition, *unsustainable,* as it cannot *sufficiently contribute* to the survival of the species to justify removing individuals from the population" (New York Times Dec 12th) [italics mine].

Whilst the book does get a tad 'academic' and perhaps theory-laden, I would say it does well to keep its feet on our (unsustainable?) Planet Earth via practical applications of the theory it discusses.

Overall, the book is well structured, including an Introduction; a Framework; Dynamics of Social-Environmental Systems; Governance in Social-Environmental Systems; Linking Knowledge with Action (which includes some really particularly lovely stories of 'unintended consequences'); Next Steps, Transitions. There are two helpful appendices: Case Studies of Sustainability, including London's struggles; and a Glossary with technical terms.

An excellent reader for upper secondary and beyond, capturing everything you need to know about becoming sustainable and how to act on your newly acquired knowledge!

Henricus Peters

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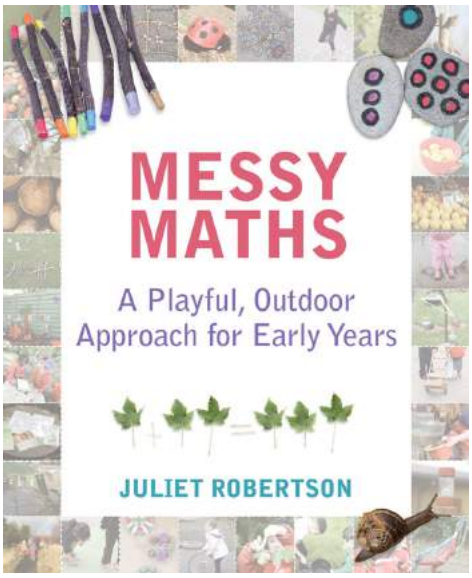
Pursuing Sustainability: a guide to the science and practice. **Pamela Matson, William C Clark, Krister Andersson (2016). Princeton Press, Princeton & Oxford. Hardback, pp248. ISBN 9780691157610. £27.95.**

Available from press.princeton.edu

Messy Maths



Messy Maths is packed full of ideas for incorporating mathematics into outdoor work with young children – *"looking at the outdoors through a mathematical lens".* The book is geared towards those who work with children ages 3 to 6, but many of the ideas could be easily adapted for older students.

After an enlightening introduction, which references plenty of research and literature related to maths and how children learn, the first chapter asks: Where's the Maths in That? This chapter refers to aspects such as developing mathematical knowledge and vocabulary of staff (prompt cards can be a great reminder for adults and a way of ensuring consistency), and contextualising maths so that it matches children's interests – discerned by observing what children do and enjoy outside. I particularly liked the ideas based around wheeled toys (e.g. making their own number plates, washing the bikes and paying for parking); dinosaurs; the use of 'loose parts' such as bread crates; and puddles *("splash all the water out of the puddle – this is volume displacement in action").*

Chapter 2 provides general advice, applicable across different areas of maths, followed by nine chapters each relating to a different area of maths: Exploring Numbers; Number Functions and Fractions; Money; Measurement; Time; Pattern; Shape and Symmetry; Position, Direction and Movement; and Data Handling. Each of these chapters includes a comprehensive vocabulary section which also lists related everyday expressions, for example *"a problem shared is a problem halved"* in the part about fractions. The book is peppered with quotes and case studies from teachers and outdoor education practitioners from the UK and abroad – I loved the one about the children at a Cornish pre-school having a horse jumping competition in the Time chapter!

Chapter 12 is all about the maths of routines: lining up, setting up the outdoor space, sharing snacks, tidying up (hanging up outdoor clothing on hangers is a *"a practical application of equivalence in mass")* etc. Finally, Chapter 13 The Mathematical Garden, provides lots of ideas for how an outdoor space can be organised to make the most of the mathematical opportunities, for example: different levels; places such as sandpits for exploring volume and capacity; inclines; holes; mirrors to demonstrate symmetry; paths and trails; displaying large numbers so that they create shadows; and using tree stumps as seating where the children can count the rings to determine and compare the ages of the trees. There are also various ideas about the maths associated with gardening itself.

The book is well laid-out and easy to navigate – each section is colour-coded, with the ideas numbered and listed at the back of the book, all of which make it easy to find specific suggestions. I would definitely recommend this book, alongside Juliet Robertson's previous book *Dirty Teaching,* and her blog 'I'm a teacher, get me OUTSIDE here!', to fellow teachers and trainee teachers looking for meaningful, engaging outdoor learning ideas. And I can't wait to get outside and try some *messy maths* of my own!

Juliette Green

***Messy Maths: a playful, outdoor approach for Early Years.* Juliet Robertson (2017). Independent Thinking Press. Paperback and e-book, pp242. ISBN 978-178135266-3. £18.99.**

Available from independentthinkingpress.com.

Webwatch

Compiled by Henricus Peters & Bill Scott

All the links shown on these pages relate to STEM (science, technology, engineering, mathematis) and environmental education.

ASE

The Association for Science Education is the largest subject association in the UK. Its role is to support all involved in science education from pre-school to higher education. ASE aims to make a positive and influential difference to the teaching and learning of science throughout the UK and further afield. Membership offers lots of unique benefits including a journal, other publications, teach-meets, resources and conferences.

ase.org.uk

British Science Association

The British Science Association is a charity whose mission is [i] to support, grow and diversify the community of people interested and involved in science; and [ii] to strengthen their influence over science's direction and place in society. Its vision is a world with science at the heart of culture and society.

www.britishscienceassociation.org

Climate Change Curriculum

This is a resource for teachers providing published scientific data on climate change and other atmospheric phenomena, and to help students gain experience of understanding methodology, weather and climate.

ow.ly/RzXDc

DEFRA

DEFRA is the government department responsible for safeguarding the natural environment, supporting the food and farming industry and sustaining the rural economy. It plays a major role in people's day-to-day lives, from the food we eat, and the air we breathe, to the water we drink. DEFRA carries out research and publishes a wide range of scientific studies.

ow.ly/Yc5030hcKm3

Earth Overshoot Day

Global overshoot is when our annual demand for the goods and services that the biosphere provides exceeds what the Earth's ecosystems can renew in a year. Overshoot means we draw down the planet's principal rather than living off its interest. This leads to a depletion of Earth's life-supporting natural capital and a buildup of CO_2 in the atmosphere.

overshootday.org

Enterprising Science

Enterprising Science is an education research and development partnership between University College London (UCL), King's College London (KCL) and the Science Museum. It uses the concept of *science capital* (science-related qualifications, interest, literacy and social contacts) to understand how young people from all backgrounds engage with science and how their engagement might be supported.

ow.ly/cA9P30hcNTh

European Environment Agency

The EEA's role is to provide sound, independent information on the environment. It is an information source for those involved in developing, adopting, implementing and evaluating environmental policy, and also for the general public.

eea.europa.eu

The Grantham Institute

The Grantham Research Institute was established by the LSE in 2008 to create a centre for policy-relevant research and training on climate and the environment. It brings together international expertise on economics, finance, geography, the environment, international development and political economy.

lse.ac.uk/GranthamInstitute

The Met Office

The Met Office is the UK's National Weather Service and has provided science-based data on the country's weather since 1845. In 1990 it opened the Hadley Research Centre into the Earth's climate and how it is changing. It has a research division whose work relates to many aspects of science and our lives.

metoffice.gov.uk/research

NASA

The National Aeronautics and Space Administration is the US government agency responsible for the civilian space programme, aeronautics, and aerospace research. It also has a great interest in what it calls the Earth System Science which includes climate change, and climate change education. It has a wonderful set of data and images.

climate.nasa.gov

The NASA website also has a children's section.

nasa.gov/kidsclub/index.html

OPAL

The Open Air Laboratories (OPAL) network is a UK-wide citizen science initiative that promotes hands-on activities with nature, whatever your age, background or level of ability. OPAL develop activities and resources, including national surveys, which allow you to get closer to your local environment while collecting important scientific data.

opalexplorenature.org

Royal Society

The UK Royal Society is a self-governing Fellowship of distinguished scientists drawn from all areas of science, engineering and medicine. It provides independent, timely and authoritative scientific advice to UK, European and international decision makers. It is particularly interested in education and the development of skills.

royalsociety.org/policy/climate-change

Space.com

Immerse yourself in the world of astronomy, through breathtaking images and videos of outer space. This site provides in-depth articles and studies about science and astronomy, making it a comprehensive source to learn about the Universe. You can also read profiles of famous astronomers and read about the history of astronomy.

space.com

STEM Learning

STEM Learning is a provider of education and careers support in science, technology, engineering and mathematics (STEM). It works with schools, colleges and others involved with young people across the UK. It is supported by a partnership of Government, charitable trusts and employers, and aims to raise young people's engagement and achievement in STEM subjects/careers.

stem.org.uk

UK Environmental Change Network

The UKECN is the UK's long-term, environmental monitoring and research programme. It collects, analyses and interprets data from a network of sites. Its datasets are a national resource that improve understanding of how and why environments change. It provides research updates and online tutorials about a wide range of scientific and environmental issues.

www.ecn.ac.uk

Here are some excellent science websites for children:

Websites with science experiments

explorable.com/kids-science-projects

scienceprojectideas.co.uk

scienceproject.com/index.asp

sciencebuddies.org/science-fair-projects/project-ideas

sciencekids.co.nz/projects.html

exploratorium.edu/science_explorer

American Museum of Natural History

This section of the American Museum of Natural History, is an outstanding science website for kids. It features numerous interactive activities on subjects such as anthropology, archeology, astronomy, climate change.

amnh.org/explore/ology

Mr Nussbaum

Greg Nussbaum has taken his teachings to another level by creating a wide variety of educational games and interactive presentations. In the area of science, his materials focus on living organisms. Use the Mammal Maker or Insect Generator to learn about these types of animals. Explore animal habitats, world biomes, weather and space through other interactive resources.

mrnussbaum.com/science

Kids Know It Network

A family of websites that include animated games and activities for children; news, lesson plans and free online courses for teachers. The network includes:

kidsastronomy.com; **kidsbiology.com**; **kidsdinos.com**; **kidsgeo.com** (geography & geology).

Brainpop Science

Join Tim and Moby as they teach you about science through BrainPop's animated videos and engaging activities.

brainpop.com/science

Space Racers

Online space fun!

spaceracers.com/en

In advance of our feature on eco-literacy that will appear in the next e-journal edition, we draw your attention to this exciting competition for story writing; suitable for secondary school students (and ambitious primary school students), and environmental educators everywhere.

There are some really useful resources provided as prompts for writing on the competition webpage, so if you do not enter but are interested in the ideas being explored, do take a look at the website.

Sustainable Societies Project: Writing a Better Future

Writing competition: write a short story set within a sustainable society.

Free to enter, prizes and publication opportunities.

Deadline 19th April 2018

Details on **greenstories.org.uk**

facebook.com/greenstoriessoton

@GreenstoriesUk

greenstoriessoton

Email: greenstories@soton.ac.uk

Your stories do not have to be about climate change or sustainability directly. They can be any kind of stories, as long as they showcase potential sustainable solutions, as suggested on our website. A rom-com, for example, could be set in a society that replaces ownership with borrowing and the heroine goes to a clothes library to pick up a dress and borrow jewellery for her big date; or the hero in a crime drama could use a carbon credit card and hear the news in the background reporting on the wellbeing index instead of GDP; or the characters in a legal drama could live in a city where everyone has gardens on their roofs, uses the latest green technologies, eats insect burgers and generates energy from their own waste; and so on.

We are eager to read what your imaginations come up with!