Education in Science

Number 288 ■ May 2022

The Association for Science Education
Promoting Excellence in Science Teaching and Learning

THE GREAT 2022 BUG HUNT

An exciting competition for Primary Schools that takes you outside to explore the bug world!

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Nick Baker

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Identify a local habitat, explore and discover the bugs that live there, draw them and record your findings – it's that simple!

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www.schoolscience.co.uk/bughunt

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insect WEEK 20 to 26 JUNE 2022

The Association for Science Education
Promoting Excellence in Science Teaching and Learning

Royal Entomological Society

Editorial

Hannah Russell
Chief Executive

Welcome to May *EiS*.

With so much going on in the news at the moment, it's easy to get the impression that COVID-19 has all but disappeared from the UK. Unfortunately, those of us working in science education know that not only is the virus very much still with us, but the impact of the last two years is still being felt keenly in schools. Practical science is an area that has been particularly badly affected. Reports such as ASE's June 2020 practical science survey (www.ase.org.uk/news/new-ase-report-highlights-concerns-over-practical-science-post-lockdown) have highlighted the challenges facing schools in this regard and we know that many of these challenges have continued. At ASE we have been concerned that the reduction in practical science seen in many schools risks becoming a long-term trend and, so, in this issue we take a look at some positive ways to build back practical work, with articles on microscale chemistry, outdoor learning in primary science, the Science Ninjas project from CLEAPSS, a celebration of practical science from this year's Science on Stage festival in Prague, and an update on ASE's practical support programme for schools in disadvantaged areas of the UK, generously funded by the Wolfson Foundation.

You can also find details on the new format for *School Science Review* being launched in June. We've listened to feedback from our community and, thanks to the support of our committees and editorial boards – and, in particular, of Helen Harden (ASE Chair Elect and Interim Editor for the new *SSR in Practice*) – we are really excited about the opportunity to increase our practitioner support through this flagship journal. We would love to hear your feedback on the new format. And, if you would like to get more involved in supporting the future direction for our journals, why not consider applying to join one of our editorial boards, or even applying to be the new Chair of Publications Committee (more detail on page 7)?

I hope that you've been able to join some of our current webinar series, tackling topics as diverse as teacher retention, environmental sustainability, working with and supporting technicians, and palaeontology in the primary classroom. As ASE members, you can access session recordings through our website . As we look towards Summer 2022, we're delighted to be back face-to-face for our Scotland, Guildford and Futures Conferences, and online for the Northern Ireland Conference. Find out more on page 7 and do sign up if you can. We can't wait to see you!

As always, I would like to pass on my thanks to the staff team, our committees and volunteers who make all this possible. Please do continue to get in touch if you would like our help or to offer your support.

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Education in Science (*EiS*) is the ASE house magazine and is published four times a year. It is sent to all members as one of the many benefits of membership. The contents of this magazine do not necessarily represent the views or policies of ASE except where explicitly identified as such.

Editorial Contact: Jane Hanrott
Janehanrott@ase.org.uk

Advertisement Manager:
Rebecca Dixon-Watmough
Rebecca@ase.org.uk or call 01254 402368

Typesetting: Karen Dyer

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Call 01707 283000
info@ase.org.uk
www.ase.org.uk

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Staff changes at ASE!

We are excited to announce some changes in the staff team, with the welcome addition of two new staff members and some changes amongst existing staff.

Following the departure of Jo Williams from ASE/Millgate, **Laura Townsend**, currently Membership Lead and IT Support Co-ordinator, will be moving across to become Head of Booksales and IT. Laura has a creative writing background and keen interest in publishing. She is looking forward to bringing her experience within membership to help inform future ASE and Millgate publications. She will join the existing team of Karen Dyer and Natasha Kirkwood in supporting ASE's resource publications and the ASE/Millgate bookshop.

Jane Hanrott will be stepping back from her journals administrative role after many years, focusing on her ASE journal and book copy editing and proofreading responsibilities.

To supplement the publishing team, we are pleased to welcome **Pauline O'Conner** as our new Publishing Assistant, from 1st May. Pauline's role, based at ASE HQ, will be to take on the journals administration, together with the ASE/Millgate book order fulfilment responsibilities.

We also welcome **Melanie Bennett** to the HQ team in a new position, Membership Officer. Melanie will be taking over the membership-related tasks from Laura.

We very much look forward to this new staffing team and wish Pauline and Melanie the best of luck in their new roles at ASE!

1851 Trust: Protect our Future

Climate and sustainability education are soon to become part of the school curriculum, yet many young people and teachers are feeling ill-equipped and powerless to play their part in the vital action needed to tackle the climate emergency. In response to this, the education charity, 1851 Trust, has declared its ambition to help 1 million young people take action to protect nature, people and the planet through its new *Protect Our Future* platform.

New research amongst 11-16 year-olds commissioned by 1851 Trust and environmental charity Hubbub reveals that more than half of children (51%) are worried about what the planet will be like in the future. However, the research also found that almost a third (31%) of 11-16 year-olds say they are unclear on what measures they can take to be more environmentally friendly, which is acting as a barrier to them taking action. Only a quarter feel that climate change is something they can fix, while 14% said that they don't feel as if their actions will make a difference.

Teachers are feeling similarly at a loss as to what they can do to support learning in this area, with 70% saying that they do not feel equipped to teach about climate change effectively (see https://www.teachthefuture.uk/teacher-research).

The *Protect Our Future* platform aims to inspire and help young people to understand their role in tackling climate change, empowering them to become independent thinkers and problem-solvers. The resources for young people and teachers will be free to use, rigorously researched and packed full of science-based knowledge, inspiration and practical actions, so they can take the lead in climate conversations and take action to help shape a more positive future for the planet.

Protect Our Future is a collaboration between 1851 Trust and forward-thinking young people, schools, universities, brands and charities. It will provide a more holistic education experience, with an emphasis on out-of-the-classroom learning. A pilot programme is bringing together 13 secondary schools, in partnership with Reckitt and Hull City Council, to work together over the next 18 months to help accelerate low-carbon projects to meet Hull's net zero ambitions.

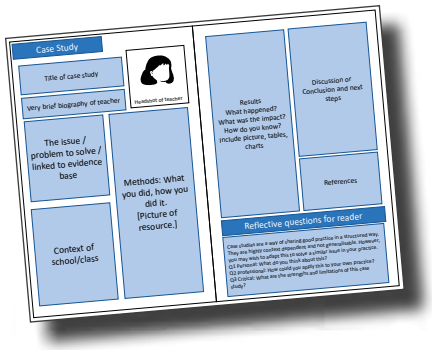
Now the charity is calling for more partners to support the expansion of the *Protect Our Future* programme to other areas of the UK and to accelerate the development of much needed resources for teachers. The platform is set to launch in June 2022.

To find out more about partnering with 1851 Trust on *Protect Our Future*, contact lyndsey-lee.dunwoody@1851trust.org.uk and, to sign up for updates on the *Protect Our Future* platform, visit: https://protectourfuture.org

An exciting new member benefit: SSR is changing!

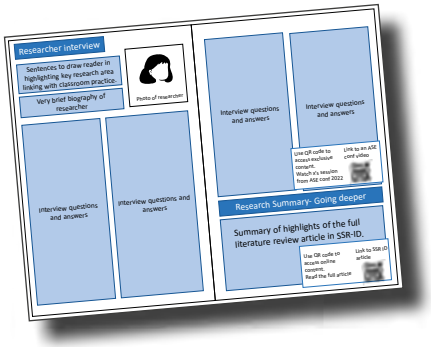
We are delighted to announce an exciting new member benefit – a new format for *SSR* being launched in June! Following on from feedback from readers, we are splitting each issue of *SSR* into two components: *SSR in Practice* and *SSR in Depth*. Also as a result of feedback, we are bringing these pairs of issues out three times a year, so that members will receive 6 publications, two each per term.

SSR in Practice will be a termly, magazine-style, professionally-reviewed journal focusing on science education in the classroom. Article styles in *SSR in Practice* will be clearly structured with writing briefs (frameworks) provided to support inexperienced writers. *SSR In Practice* is a journal that we hope members will be able to both read and contribute to. It aims to provide CPD for both readers and contributors and will draw on the expertise of the whole ASE community and wider science education network. It will be largely commissioned and curated by the Co-Editor, supported by several ASE national committees (11-19, Technician, Research and Health & Safety).



The first issue of *SSR In Practice* will include:

- science leadership article
- case studies of classroom practice
- practical ideas
- advice for early career teachers
- a Moss Safari centrefold
- application of primary CPD to secondary practice
- examples of STEM careers
- real-life science for context/ hinterland
- education researcher interview
- journal club
- updates on the implementation of the Welsh curriculum and major educational reform in Scotland
- talking point about how schools and FE can work in partnership to develop the technical STEM pipeline.



ASE's longstanding, academically peer-reviewed *SSR* journal is not disappearing. Longer articles, often research-based, sometimes themed and including more detailed science notes, will now appear, online, in *SSR in Depth*, which will also be issued termly alongside *SSR In Practice*. Our aim is to encourage more members to engage with this in-depth content by linking to selected in-depth articles from *SSR In Practice*. ASE has been publishing articles relating to research-informed practice for many years and we will be dipping back into the archive via *SSR In Practice*, where a regular *Journal Club* article will support readers in how to approach the reading of longer in-depth articles. The *SSR* archive is accessible to *SSR* readers via the ASE website (www.ase.org.uk).

Authors may continue to submit articles or proposals for *SSR In Depth* by sending articles or proposals to ssreditor@ase.org.uk

The interlinking of the two components of *SSR* will be developed over time and the new format will allow the inclusion of more topical articles in *SSR In Depth* that may explore, in more depth, issues raised in *SSR in Practice*.

The inaugural edition of *SSR in Practice* would not exist without the support of the Interim Co-editor and ASE Chair-elect, Helen Harden, the current Editor, Geoff Auty, members of the national committees, authors, reviewers, current *SSR* Editorial Board members, and the online fast feedback group. We would like thank these already very busy professionals for their time and expertise.

If you would like to get more involved, we are looking for more reviewers. Please e-mail Jane Hanrott at janehanrott@ase.org.uk if you are interested.

We are also seeking to develop a way for teachers to quickly and easily submit proposals for articles in *SSR in Practice*. Watch this space!

New awards for RSci and RSciTech

We are proud to announce the following awards, granted since February 2022.

RSci

Kam Yu Chow

RSciTech

Heather Rogers
Caroline Morgan
Sarah Wright
Eirini Savvidou
Andrew Jones
Rhiannon Fowler
Samantha-Jayne Randall

A manifesto for young people's learning and the environment

The National Association for Environmental Education (NAEE) is celebrating its 50th year of supporting schools and teachers in their work, helping young people to learn about environmental and sustainability issues and what we might do about them.

We have recently been involved in helping the DfE think through policy responses to the demands made during COP26. These included calls for more and better education about climate change and the other environmental threats that we face, such as the already serious and rapidly growing threats to biodiversity and habitats, as well as the need for more education about the impacts that these are having on people across the planet.

The calls stressed that these must not be an add-on to what is currently being taught, but instead an integral part

of what every subject sets out to do. The DfE's strategy was launched on April 21st.

In response to COP26, NAEE wrote a manifesto for young people's learning and the environment. Its purpose is to build on existing work in schools and further stimulate change in thinking and practice. Doing this means that young people can be even better prepared to meet the social and environmental challenges that they will face through their lives, and be ready to contribute to solving them. The manifesto is aimed at school leaders and governors, teachers, pupils and students, and is relevant to policymakers, administrators, inspectors, teacher educators and NGO education teams. It was launched on April 28th and a copy can be found here: https://naee.org.uk/wp-content/uploads/2022/04/NAEE_MANIFESTO_2022.pdf

The manifesto sets out 16 commitments to guide institutions to become more sustainable, and improve the education that pupils and students receive. It is built on four principles that are at the heart of what is important for schools to do in relation to young people's learning and the environment.

William Scott, NAEE Chair of Trustees, **Nina Hatch**, NAEE Executive Director, and **Justin Dillon**, NAEE President.

Professor Chris King

We are sad to announce the death of Professor Chris King in February 2022. Chris was a great friend to ASE, serving on the SSR Associates panel and contributing to ASE publications over many years. His long-time friend and colleague, Susan Burr, wrote the following tribute:

Chris was a kind person, with a dry sense of humour, a teacher at heart who wanted to share his knowledge. In addition to producing many workshops offering courses to would-be geology teachers, he worked with colleagues to put together a website of activities entitled *Earth Learning Idea* – a fantastic resource open to all.

I was privileged to work with Chris at the Earth Science Education Unit at Keele University as part of a group of educators who delivered workshops to Scottish schools. Chris was an Earth Science education enthusiast and passionate about the message being delivered in schools. The workshops were always practically-based and were specifically designed using Scotland's geology.

Chris also gave sessions at the ASE Annual Conference; again, he wanted to share his expertise with delegates. He also organised a major speaker with an Earth Science background to present a lecture.

Hopefully his legacy will remain, as pupils and teachers are enthused by Earth Science. Youngsters will gain a lifelong interest and may even become geologists.

I remember two things: firstly, his tales about his life as a young geologist – when in Tasmania we went through the mining area in which he had worked and he took a picture to remind him; secondly, the pile of blue trays that I have with all my workshop materials. My last workshop with him was the online Scotland beneath your feet, in November 2021.

Rest in peace, friend.

Interested in ASE publications?

New Chair of Publications Group needed!

We are looking for a new Chair of Publications Group, to commence on 1st September 2022, for a five-year term. If you are interested in science education publishing, passionate about books and resources, and want to work with a team of dedicated committee members and the ASE publishing team, then this is a role for you!

Alongside the responsibilities that come with being Chair, duties include liaising with the staff team and other ASE groups regarding publications in hand, possible new titles, the identification of gaps in the market, and keeping a watching brief over ASE resources, either for sale or as membership benefits on the ASE website, and the ASE journals, in consultation with the journal editors and their Boards, as well as direct involvement in the decision about the winner of the ASE Book of the Year Award.

It is one of the most rewarding of the committee chair positions, with a tangible outcome of your work in the form of published books and journals!

If you are interested in finding out more, please contact elections@ase.org.uk

Our huge thanks go to James Williams, Chair of Publications until the end of last year, and to Leigh Hoath, who has stepped in as Interim Chair until the end of August.

June

8th June: Webinar – An Inspector Calls: Preparing for an 11-19 Ofsted science 'deep dive' – Online event
This session will address what is it like to be inspected, what will Ofsted be looking for and what evidence will they be looking for?

11th June: ASE Scotland Conference
Kinross High School, KY13 8FQ.

A face-to-face event which includes two parallel strands for primary along with physics, chemistry and biology sessions for secondary, as well as an 'All' strand that has something for everyone! There will also be a fantastic exhibition, with suppliers demonstrating their latest exclusive offers and resources. Please visit our live digital timetable at: https://asescotlandconference2022.sched.com/

17th June: ASE Northern Ireland Biennial Conference Online – Post-pandemic recovery

Our biennial NI event will include five concurrent workshops encompassing areas of interest for primary, post-primary and technicians. There will also be the option to access recorded workshops after the event. Please visit the live digital timetable at: https://aseni22onlineconf.sched.com/

20th June: Tackling issues around transition – Online event

Join a panel of primary and secondary science educators to discuss the challenges and expectations teachers face around transition...

21st June: Using Maths in Science to promote progress
Blakesley Hall Museum, B25 8RN.

Promoting progress in maths and science using vocabulary and ideas to enable pupils to make links and apply the knowledge they have gained.

29th June: ASE Technicians' Conference South
University of Surrey, GU2 7XH.

The Conference will feature practical lab-based sessions, the majority of which are being presented by technicians, for technicians. Please visit the live digital timetable at: https://asetechnicianssouthconf22.sched.com/

29th June: ASE South East Conference
University of Surrey, GU2 7XH.

Our regional conference has a great selection of sessions to whet the appetite of primary and secondary educators, and a fantastic exhibition, full of suppliers demonstrating their latest exclusive offers and resources. Please do browse the live digital timetable at: https://asesoutheastconference2022.sched.com/

30th June: ASE Primary Science Hub
Harris Garrard Academy, DA18 4DW.

Every half-term, we aim to facilitate tailored primary science CPD for the SE London and Kent region to support new and experienced primary science subject leaders

July

7th – 8th July: ASE Futures Conference
Northampton University, NN1 5PH.

Our two-day 2022 conference takes place in a stunning location and offers an evening meal onsite on the Thursday evening, with the option of onsite accommodation too. The timetable is currently being co-ordinated and will shortly be available to view at: https://asefuturesconf2022.sched.com/

For the full event listing visit: https://www.ase.org.uk/Events

For any conference queries, please e-mail conferences@ase.org.uk

Science teacher retention update: data and support from ASE RISE

Andy Chandler-Grevatt

How useful would it be for a Head of Science to know the level of wellbeing, job satisfaction and career intentions of their science department? Wellbeing and job satisfaction are important but complex aspects of science teacher retention. ASE RISE provides data and resources to support science departments in improving these aspects. This report presents the overall findings and offers some strategies to improve a specific issue of acknowledging staff achievements.

This is the first year of the ASE Retention Initiative for Science Educators (RISE). Based on the success of the Gatsby Charitable Foundation-funded ASE SOS project (https://www.ase.org.uk/sites/default/files/ASE%20SOS%20Report.pdf) and their additional funding to resource the ASE RISE Hub, science departments with Department ASE membership were able to participate in this year's survey.

Participating departments get their own data set to compare to the whole cohort. From the whole cohort, we can see that the areas needing attention are: acknowledgement of teachers' status; having control of their lives; and being able to give others attention (Table 1). Linked with these emotional needs, Table 2 shows that teacher morale, flexibility at work and managing a work-life balance also need attention.

Needs being met well	Needs not being well met
• Having an emotional connection to others • Feeling competent/sense of achievement • Having a sense of purpose	• Feeling that their status is acknowledged • Feeling in control of their lives • Giving others enough attention

Table 1. Wellbeing (emotional needs)

Highest scores	Lowest scores
• Knowing where to get help if needed • Getting on with colleagues/ department • Able to talk to my manager	• The morale of my department is high • I have flexibility in my work • I am able to manage my work-life balance

Table 2. Job satisfaction

The ASE RISE Hub provides resources for all elements of the ASE RISE survey. From this report, one aspect that science leaders have some power to affect is improving staff morale.

Support and resources to improve acknowledgement

ASE RISE Hub resources that support improving staff morale include: *the Focus on Acknowledgement* (https://www.ase.org.uk/resources/rise-focus-acknowledgement) which explains why it is important and what departments and school leaders can do (see extract in Figure 1); and a resource, *Acknowledging Staff Achievements*, which lists approaches that science leaders might use in their department.

Focus: Acknowledgement

The emotion needs audit asks this question: Do you feel you have status that is acknowledged? In the ASE SOS Pilot Study (May 2021) feeling acknowledged ranked one of the lowest in the emotional needs audit (ranked 8 out of 10).

What does this mean?
This is concerned with our status, reputation and feeling valued in a community. It is our sense that we are contributing something to the common good.

Life (External issues)
Teachers may get a sense of acknowledgement from other parts of our lives (see Community), but it is likely that most full time teachers identify as a teacher and feel a sense of status through that. Being a teacher (professional identity) overlaps considerably with their personal identity, they are both closely entwined.

Figure 1.

Want to be involved in ASE RISE?

The more science departments that are involved in the survey, the more useful the data will be to support science teachers, science departments, senior leaders and policymakers.

If your science department would like to take part in ASE RISE from September, the easiest way is to sign up for the 11-19 Science Department membership (https://www.ase.org.uk/institutional-membership) and register your interest.

More information about ASE RISE can be found at https://www.ase.org.uk/rise-retention-initiative-science-education-programme

Andy Chandler-Grevatt is the Chair of the ASE 11-19 Committee.

Early career teaching – Engaging activities to get students thinking

Sarah Longshaw

As I write this piece, my kitchen is full of small-scale practical experiments that I have been trying out. It's important that we try out the experiments that we want our students to do, for a number of reasons.

Not only do we need to check that they can be carried out safely, and we want to know that they work, but trying them out enables us to make any adaptations for specific classes and individuals. It also allows us to consider what questions we want to ask. And it reveals if there are times when students could become distracted, so we can think about what they could usefully be doing then (perhaps plotting a graph as they go along, for example).

I am trying out some biology experiments. I have placed Aqua Gel Balls in Lucozade (original) and salt solutions. The beads in each of the solutions have shrunk in size and the beads in the Lucozade have changed colour (the Lucozade being orange). However – this doesn't happen within the duration of a lesson – so this is an experiment that would either need to be run across a couple of lessons or delivered in *'Blue Peter: here's one I set up earlier'* style. Why do I like it? Because it gets students talking – perhaps asking why the beads have reduced in size? Is there a pattern to this? Why have the ones in the Lucozade turned orange? and so on.

By using things that students are familiar with, they can focus on what's happening. I haven't measured the mass of the beads; you can just compare them to ones left in water and observe the difference (a qualitative judgement).

Having said that, when the beads are in water, because they have (almost) the same refractive index they appear to be invisible, so careful handling is necessary (I used a sieve to separate them from the liquid that they were in). It is also important not to lose them down drains, as they can clog pipes.

I have also been trying some experiments with pineapple and jelly – pineapple contains an enzyme that prevents jelly from setting – so, if

a piece of pineapple is placed on the jelly, what happens? So far, I have tried a piece of fresh pineapple from a snack pack, a piece tinned in juice and a piece tinned in syrup. After a while, the ring that was tinned in juice has left an impression in the jelly, but it takes ages and is not the engaging activity that I had hoped for. (I have not yet tried a piece freshly cut from a pineapple – though I did try kiwi fruit, which is also reported to prevent jelly from setting.)

As I try out these activities, using items with which students are likely to be familiar, I wonder how the practicals could be adapted into simple investigations – what happens if we soak the pineapple in an acid or alkaline solution, for example? I might try that next.

Sarah Longshaw is co-project lead for the ASE Keeping Science Practical Programme.

Practical Science

Keeping Science Practical – Wolfson Project

Sarah Longshaw

As we enter the last term of the academic year, and we near completion of the support offered to our first cohort taking part in the above project, let's pause and reflect. This year has, once again, been anything but normal, and educators have once again risen to the challenges, in spite of higher levels of absence (both staff and students) in schools. So, keeping science practical has again often been challenging. There are gaps in every year group – in both knowledge and skills; this is inevitable but this is also where having a practical policy and a well-sequenced curriculum, showing how skills are developed (alongside knowledge), is beneficial.

Subject leaders taking part in the project have considered this and decided on next steps, according to the needs of their particular setting.

We can probably list a myriad of different ways in which technicians support the delivery of good practical work – many of these are centred around the equipment, although we shouldn't overlook their role in staff training and support. Because the role is so wide-ranging and varied, the opportunity to share good practice and ideas with others is invaluable. In some schools, technicians can also act as demonstrators – and the role of demonstration in practical work is also key to students developing their understanding and skills.

The benefits of a network include having others in similar situations of whom you can ask questions and seek advice from, and the use of asynchronous tools enables this to happen remotely, so that expertise is distributed across those taking part in the project.

Early Career Teachers (ECTs – those in the first years of their practice) have perhaps suffered the most disruption, with periods in the last two+ years having required teaching to be delivered remotely, or in 'bubbles', with limited or no practical work and restricted interaction. Firstly, I think we should acknowledge the resilience of our ECTs in adapting to these changes.

Understanding why, when and how to get the best from practical work is essential, but having practical strategies to support this is equally important. We have already touched on demonstrations and, whilst many ECTs will have delivered practical work this way during the restrictions of the pandemic, they may not have had much opportunity to unpick and examine the components of success.

We are very much looking forward to discussing the impact of the project with our participating schools and finding out on which aspects they have focused – the successes, the challenges and their next steps. We're also keen to discuss how they have benefited from the ASE Science Department membership, both as a collective and as individual members.

We will shortly be recruiting schools for our next cohort; if you are interested, you can find out more and register your interest at https://ase.org.uk/your-secondary-school-eligible-our-keeping-science-practical-programme

Sarah Longshaw is co-project lead for the ASE Keeping Science Practical Programme.

Teaching primary science outdoors

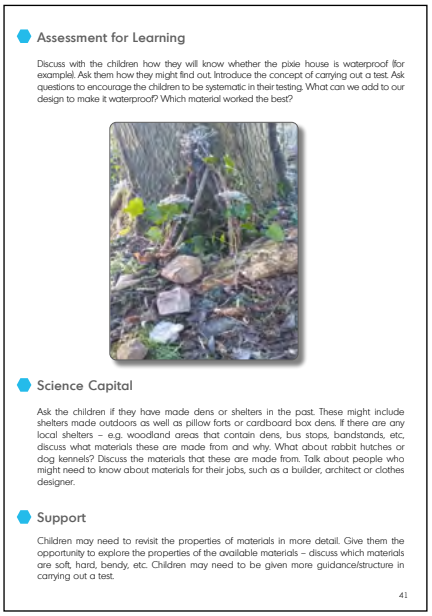
Helen Spring

FEATURE

As a primary science and outdoor learning consultant and author, I am clearly an advocate of teaching science outdoors. There are many benefits of outdoor learning; these include health benefits (Twohig, Bennett & Jones, 2018; Engemann *et al*, 2019), wellbeing, enjoyment and engagement (Waite *et al*, 2016), as well as improvements in attainment (Education Endowment Foundation, 2021; Harvey *et al*, 2017; Hamilton, 2018). Personally, I think it is important to consider why we are teaching in a particular location – be it indoors or outdoors.

The outdoor space available should be seen as an extension of the available learning space. Sometimes, teaching outdoors is the right thing to do simply because the lesson is messy or noisy; sometimes the indoor classroom might be too hot, or the lesson is about something that is outdoors. Sometimes a lesson is better taught indoors – perhaps the weather is poor, and the children don't have appropriate clothing, or maybe equipment is breakable and needs to be handled with more care than might be possible outdoors.

When I lead CPD about teaching science outdoors, I encourage teachers to share the barriers that prevent them from teaching outdoors. Common barriers include the perception that it is harder to plan to cover curriculum objectives, to assess children and to record findings outdoors. A good lesson plan will include planning for assessment and, where appropriate, recording opportunities. It can be helpful to consider which objectives in a topic **should** be taught outdoors (often those that relate to plants and habitats, for example), and which objectives **could** be taught outdoors. I am a firm believer that almost every primary science objective **could** be taught outdoors (Spring, 2021).



Assessment for Learning

Discuss with the children how they will know whether the pixie house is waterproof (for example). Ask them how they might find out. Introduce the concept of carrying out a test. Ask questions to encourage the children to be systematic in their testing. What can we add to our design to make it waterproof? Which material worked the best?

Science Capital

Ask the children if they have made dens or shelters in the past. These might include shelters made outdoors as well as pillow forts or cardboard box dens. If there are any local shelters – e.g. woodland areas that contain dens, bus stops, bandstands, etc. discuss what materials these are made from and why. What about rabbit hutches or dog kennels? Discuss the materials that these are made from. Talk about people who might need to know about materials for their jobs, such as a builder, architect or clothes designer.

Support

Children may need to revisit the properties of materials in more detail. Give them the opportunity to explore the properties of the available materials – discuss which materials are soft, hard, bendy, etc. Children may need to be given more guidance/structure in carrying out a test.

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Assessment outdoors is exactly the same as assessment indoors. Teachers should plan in opportunities to speak to children about their ideas and understanding, make time for observing them carrying out practical activities and consider how children might share their understanding with others. Consider using ideas adapted from Explorify, such as discussing which of three leaves is the odd one out and why, or which pixie house is the best and why.

Children can use natural materials or chalk on the playground to represent their ideas – this works particularly well when the topic requires modelling, such as the circulatory system or parts of a plant. Children could photograph or draw what has been created outdoors if a permanent record is needed – this could even be annotated back in the classroom (https://www.springlearning.co.uk/assessment/).

Uses of everyday materials

Conceptual knowledge: In this activity, children identify and compare the suitability of a variety of everyday materials.

Working scientifically: In this activity, children perform simple tests.

Assessment: Children meeting the conceptual knowledge objective will be able to say why they have chosen the materials that they have, for example, "I have chosen leaves and plastic for the roof because it is waterproof; I have not used sticks for the roof, because the gaps let the water in". Children meeting the working scientifically objective will be able to say how they know which material is 'best' for a purpose. For example, "I know that leaves and plastic are waterproof because I poured water over my pixie house and it stayed dry inside. When I poured water over the pixie house with the roof made of sticks, it got wet inside".

https://www.springlearning.co.uk/publications/

Don't forget that writing is also allowed outdoors! Alternatively, you may want to follow up an outdoor science lesson with a literacy lesson that uses the practical science as the context.

References

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Helen Spring, Spring Learning, Primary Science and Outdoor Learning Consultant.
Twitter: @SpringLearns
E-mail: helen@springlearning.co.uk
www.springlearning.co.uk

Science Ninjas – helping primary teachers engage with practical science

Jason Harding and Maria Pack write:

The science national curriculum (NC) has always strongly emphasised practical work in all its guises. For some time, we've pondered: why is it that, despite the various versions of the science NC prominently featuring scientific investigation, enquiry and practical work, they are notably less well addressed in primary science lessons than scientific concepts?

So, we asked primary teachers why they thought this is the case. What the teachers said is best summarised as:

- They feel overwhelmed by Working Scientifically (WS).
- They feel more able to plan lessons based on scientific concepts and far less confident about incorporating or using WS.

We wondered, what was problematic in understanding which activities helped primary children learn through practical work? So we asked primary teachers what they thought the Key Stage 1 (ages 5-7) WS statement *'observing closely, using simple equipment'* meant. The two most popular responses are best summarised as:

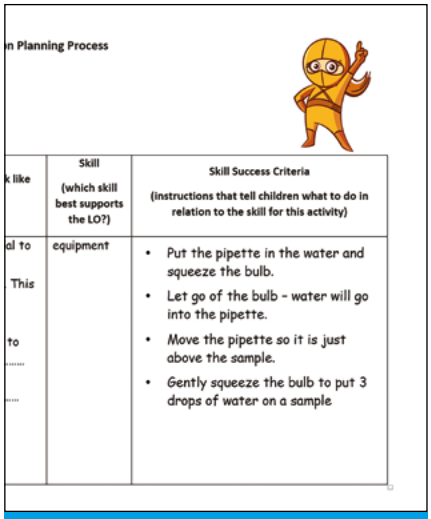
- *Look at something for longer.*
- *I don't know.*

On reflection, it is not surprising that primary teachers may find this aspect challenging. Looking for learning opportunities within specific activities that can be shaped into appropriate learning objectives for practical work is tricky.

While watching lessons, we've seen this played out many times. Commonly, we hear instructions such as *'Make sure you observe closely'*, but there's

To explore the effects of water resistance. To investigate the effects of friction.	Make boats with streamlines to promote speed. Once boats are created, chn to put them in water see how long the boats take to cross the water tray.	Recording Observation	• I can describe streamline objects • I can make observations • I can record my observations	Differentiated recording sheets SEN to be given wordbank to create pupil voice and describe their boats	Go through PPT and discuss air resistance and how it is affected by design of objects. Explain the task to chn: create a boat with stream lines, show example and model how to label their creations.

Excerpt from Y5 Forces SOL: both observing and recording are mentioned but nothing in the planning about how either will be supported.



n Planning Process

k like	Skill (which skill best supports the LO?)	Skill Success Criteria (instructions that tell children what to do in relation to the skill for this activity)
al to This to	equipment	• Put the pipette in the water and squeeze the bulb. • Let go of the bulb - water will go into the pipette. • Move the pipette so it is just above the sample. • Gently squeeze the bulb to put 3 drops of water on a sample

Excerpt from Y1 Everyday materials SOL, where the practical lesson planning explicitly supports the children to correctly use a pipette.

rarely any support for how to do this. Speaking to teachers about such lessons leads us to believe that it's because they haven't considered what close observation looks like in the particular instance, or that planning to observe successfully in one activity can look very different to successful observation in another.

So, what could we do to help? Our approach was to try to find a simple way to fix this problem as we knew that we may also need to introduce teachers to new ways of working, as well as possibly introduce new activities or rethink old and trusted ones.

This was how our Science Ninjas action research project came in to existence.

When planning a practical lesson, we ask our Ninja teachers to make simpler WS choices by focusing on just one of four skills:

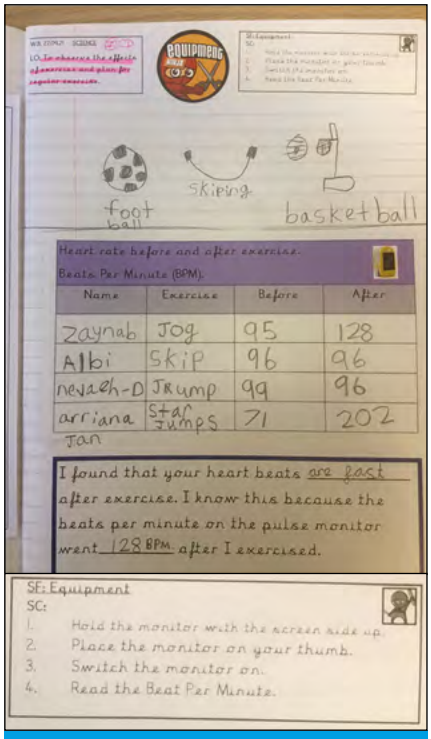
- Using equipment;
- making measurements;
- making observations; or
- recording observations/ measurements.

They select the best skill to focus on based on what the activity is and what they want their children to learn – the lesson's 'Ninja moment'. The teachers make sure that the Ninja moment includes specific support about the skill.

Time to appreciate how using the skill has helped the children is built into the lesson and, when the children demonstrate the skill successfully, this is celebrated.

We've been supporting our Ninja schools to use this approach for the past four years and notable improvements have been seen:

- More practical work happens in the schools.
- The children and teachers feel more ownership of their science lessons.
- The science leaders are becoming increasingly skilled and confident in critiquing, improving and providing their staff with feedback about practical lessons.
- The teachers have stopped considering WS a barrier, have gained confidence in teaching science practical activities and now see the benefits of engaging with science learning through working scientifically.



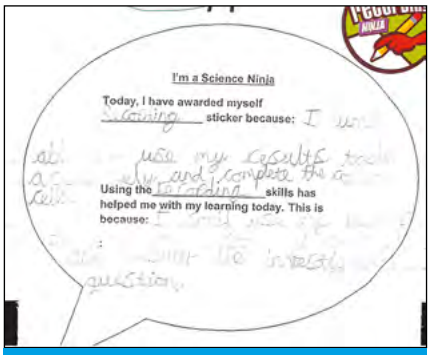
Heart rate before and after exercise.
Beats Per Minute (BPM).

Name	Exercise	Before	After
Zaynab	Jog	95	128
Albi	Skip	96	96
nevaeh-D	Jump	99	96
arriana	Star Jumps	71	202

I found that your heart beats are fast after exercise. I know this because the beats per minute on the pulse monitor went 128 BPM after I exercised.

SE: Equipment
SC:
1. Hold the monitor with the screen side up.
2. Place the monitor on your thumb.
3. Switch the monitor on.
4. Read the Beat Per Minute.

Y2 child's write up of a practical lesson about exercise while learning about the topic 'Animals including humans', including a 'Ninja moment' where the children are supported to correctly use a pulse rate monitor.



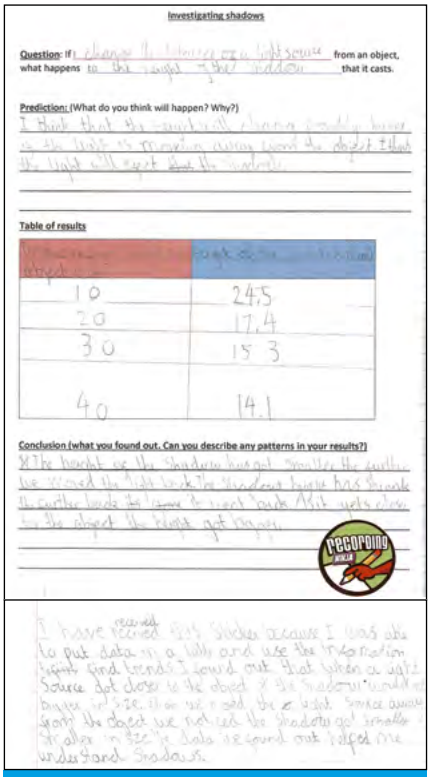
I'm a Science Ninja

Today, I have awarded myself _____ sticker because: I

Using the _____ skills has helped me with my learning today. This is because:

Reflection from a Y3 child on how recording has helped them organise and use their observations while learning about plants.
"Today I have awarded myself a *recording* sticker because: *I was able to use my results table accurately and complete the correct cells.* Using the recording skill has helped me with my learning today. This is because: *I could use my results and answer the investigation*."

Our goal is for primary teachers and their children to have ownership of WS.



Investigating shadows

Question: If I _____ from an object, what happens _____ that it casts.

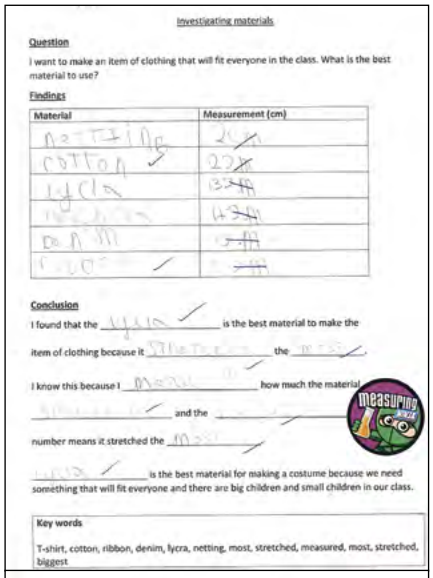
Prediction: (What do you think will happen? Why?)

Table of results

10	24.5
20	17.4
30	15.3
40	14.1

Conclusion (what you found out. Can you describe any patterns in your results?)

Y6 child's write-up about shadows while learning about light, including their reflection about how recording has helped them learn.



Investigating materials

Question

I want to make an item of clothing that will fit everyone in the class. What is the best material to use?

Findings

Material	Measurement (cm)
cotton	22

Conclusion

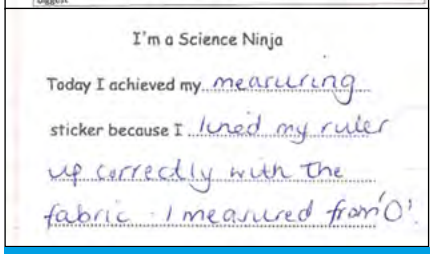
I found that the _____ is the best material to make the item of clothing because it _____ the _____.

I know this because I _____ how much the material _____ and the _____ number means it stretched the _____.

_____ is the best material for making a costume because we need something that will fit everyone and there are big children and small children in our class.

Key words

T-shirt, cotton, ribbon, denim, lycra, netting, most, stretched, measured, most, stretched, biggest



I'm a Science Ninja

Today I achieved my measuring sticker because I used my ruler up correctly with the fabric. I measured from '0'

Y2 child's work while investigating the stretchiness of different materials as a part of learning about 'Uses of everyday materials', and their understanding of what good measuring means for the activity.

Working with our Ninja schools has shown us that:

- Teachers need to feel confident that the WS portion of a practical lesson makes sense to them and is useful, not burdensome or hidden.

For this to happen they need: support that helps them to work out how one element of WS specifically and explicitly applies to the activity in that lesson.

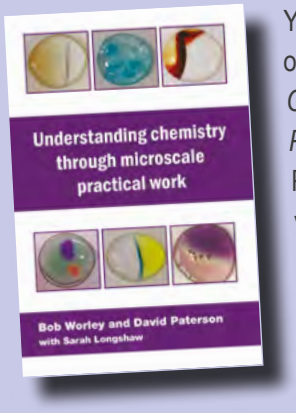
- The science leaders need CPD on how to look for evidence that their and their colleagues' lessons and the children's work show that the practical activities have supported learning.

For this to happen they need peer-to-peer, non-judgemental forums supported by science education professionals, where they can discuss how their/their colleagues' practical lessons went, so that the science leaders and their teachers can decide if an activity and/or the planning is appropriate, good or bad, and how they'll adapt, amend or choose to replace it.

We couldn't be prouder of our Ninja schools, leaders, teachers and children. They're living proof that the primary community can successfully engage with primary science. They also realise that this is a learning journey for them and that they need ongoing support that recognises where they are, which helps them to move forward from that point, at a pace that they're able to sustain.

Jason Harding is the Section Leader for Biology and Primary at CLEAPSS and chairs the ASE Primary Futures Network in London, and **Maria Pack** is the Lead Primary Consultant at CLEAPSS. Jason and Maria run the Science Ninjas action research project in collaboration with Professor Christine Harrison and Lucy Wood from King's College London.
E-mail: primary@cleapss.org.uk

Microscale chemistry – are you teaching it?

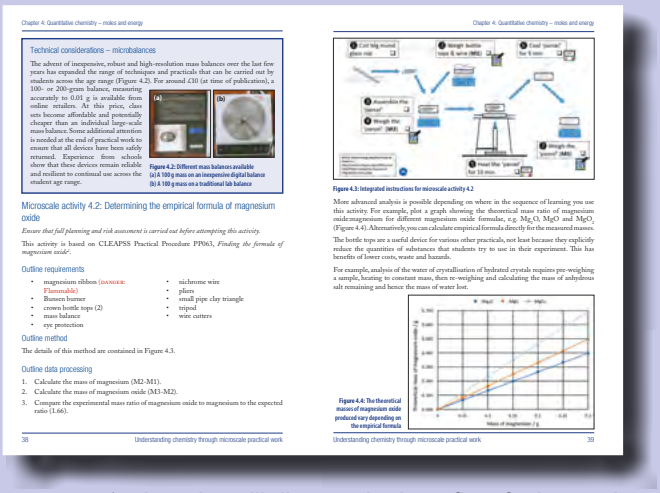


You may have already seen details of ASE's new *Understanding Chemistry Through Microscale Practical Work* (Worley & Paterson), which is proving to be very popular.

We would love to know if you are adopting microscale procedures in your teaching and, if so, whether you are using the book and how useful you are finding it?

Please let us know at info@millgatehouse.co.uk and we will use your feedback to inform future editions of the book!

Author David Paterson CSciTeach is presenting a session at the ASE South East Conference at the University of Surrey on June 29th where he will discuss the benefits of microscale chemistry and demonstrate some common practicals. To find out more visit: https://www.ase.org.uk/Events



Chapter 4: Quantitative chemistry – moles and energy

Technical considerations – microbalances

The advent of inexpensive, robust and high-resolution mass balances over the last few years has expanded the range of techniques and practicals that can be carried out by students across the age range (Figure 4.2). For around £30 (at time of publication), a 100- or 200-gram balance, measuring accurately to 0.01 g is available from online retailers. At this price, class sets become affordable and potentially cheaper than an individual large-scale mass balance. Some additional attention is needed at the end of practical work to ensure that all devices have been safely returned. Experience from schools show that these devices remain reliable and resilient to continual use across the student age range.

Figure 4.2: Different mass balances available (a) A 100-g mass on an inexpensive digital balance (b) A 100-g mass on a traditional lab balance

Microscale activity 4.2: Determining the empirical formula of magnesium oxide

Ensure that full planning and risk assessment is carried out before attempting this activity.

This activity is based on CLEAPSS Practical Procedure PP063, *Finding the formula of magnesium oxide*[1].

Outline requirements

- magnesium ribbon (DANGER: Flammable)
- Bunsen burner
- crown bottle tops (2)
- mass balance
- eye protection
- nichrome wire
- pliers
- small pipe clay triangle
- tripod
- wire cutters

Outline method

The details of this method are contained in Figure 4.3.

Outline data processing

1. Calculate the mass of magnesium (M2-M1).
2. Calculate the mass of magnesium oxide (M3-M2).
3. Compare the experimental mass ratio of magnesium oxide to magnesium to the expected ratio (1.66).

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Chapter 4: Quantitative chemistry – moles and energy

Figure 4.3: Integrated instructions for microscale activity 4.2

More advanced analysis is possible depending on where in the sequence of learning you use this activity. For example, plot a graph showing the theoretical mass ratio of magnesium oxide:magnesium for different magnesium oxide formulae, e.g. Mg_2O, MgO and MgO_2 (Figure 4.4). Alternatively, you can calculate empirical formula directly for the measured masses.

The bottle tops are a useful device for various other practicals, not least because they explicitly reduce the quantities of substances that students try to use in their experiment. This has benefits of lower costs, waste and hazards.

For example, analysis of the water of crystallisation of hydrated crystals requires pre-weighing a sample, heating to constant mass, then re-weighing and calculating the mass of anhydrous salt remaining and hence the mass of water lost.

Figure 4.4: The theoretical masses of magnesium oxide produced vary depending on the empirical formula

Understanding chemistry through microscale practical work 39

The book is available to purchase at www.millgatehouse.co.uk

Science on Stage 2022

Frances Evans, ASE Field Officer, writes:

Science on Stage Europe brings together science teachers from across Europe to exchange best practice, teaching ideas and concepts with passionate colleagues from over 30 countries. The festival happens every two years and is a great opportunity to work with colleagues in different countries. The UK sent 11 teachers to Prague in March to be part of the event.

There was a great buzz around the conference floor, with each delegate having a stand from which to showcase their project/ideas. This meant that each teacher had an opportunity to visit other stands, share ideas and set up links to develop ideas further, with the possibility to present a joint project at a future festival. There were also workshops and some larger presentations to the whole audience.

There are opportunities to apply for a travel scholarship to meet with a colleague to continue the work and develop a joint project. Science on Stage also publishes teaching materials, developed by teachers for teachers, which can be downloaded free from www.science-on-stage.eu/teachingmaterials

The UK delegation won two awards this year: Emma Crisell for her project on 'Food for the 21st century – making a difference', and Ian Robinson won the Czech Physical Society award for his project 'Geophysics on a budget – Open source research level Earth Science projects for school and home'.

Anyone can apply to be part of this amazing experience and submit a project idea for the next festival in Finland in August (5th – 8th) 2024. We can offer support. Full details about the themes and the application process will be available later in the summer.

Quotes:

'Science on Stage 2022 has been one of the most valuable and immersive science CPD experiences of my teaching career. I have shared my project on making snowflakes and climate change, but learned so much more from the amazing teachers from across Europe. Their enthusiasm and passion for science is infectious, so I return to the UK with a suitcase of ideas to share with others and have a go with my students. I would say do it!!! Get involved and start your Science on Stage journey today' (Sam Ireland)

'I have had the most amazing immersive CPD experience, made friends from across Europe and am now looking forward to meeting a colleague from Italy on Monday to start working together with our schools on something really exciting. Please can I come back again?' (Sophie Brace)

'I feel so incredibly lucky to be here. Met some amazingly inspirational people. Thanks you all so much. When can I come back?' (John Cochrane)

'Wow, what an experience! I have met so many amazing people. I am looking forward to collaborating with them. Thank you!' (Jenny Petrie)

'Science on Stage has been a joy. Everyone here is passionate about teaching and so willing to share ideas. I have loved telling my stories and making friends. The whole event has been inspiring' (Jules Pottle)

The UK delegation.

Teaching learners with special educational needs and additional support needs

Susie Nyman with Rob Butler

Susie's Science Literacy toolbox for SEND students

Susie Nyman teaches at the Sixth Form College, Farnborough. She has put together a toolbox of strategies and resources to help teachers of learners with special educational needs, and is well known for her multi-sensory strategies. Susie shared some of her ideas with the Inclusive Science Education Group.

Susie opened with pen portraits of her learners. She told us of one learner who needed a giant A1 graph of the menstrual cycle, using strawberry laces, to help visualise it in his head. Another learner needed to break down words into components and then relate the learning of them to their prior experiences. A favourite whole-class activity is playing the 'weakest link', using mini-whiteboards, as a show-and-share activity to test if students have learned concepts. Susie made the point that there are many ways to teach science; it isn't just about textbooks and classic experiments.

Vocabulary

Glossaries of terms are useful to learners, Susie puts them at the start of each student's book, but we should remember that they need to be actively used to be effective. You can use Post-it notes with these glossaries to group ideas and self-test words, for example.

Science terminology can be quite challenging for learners. To help with this, we can break down challenging words into prefixes, roots and suffixes, which help learners to make sense of complicated words. For example, 'chloro' means green, 'photo' means light, 'poly' means many, and so on. This can help students to understand words, and understanding can also help them to select the correct terminology to use, particularly for tricky terms such as hypo/hyperglycaemic. There are many words that can be made easier to understand through the etymology, for example 'arthro', meaning related to joints (arthropods, arthritis) or 'osis' meaning process (as in osmosis, mitosis).

When teaching new terminology, Susie suggests the following strategies:

- Speak and use the words out loud;
- Write words on interactive and mini-whiteboards;
- Break down words into parts, e.g. 'o-eso-pha-gus' and write them down on coloured Post-It notes using different coloured pens;
- Repeat the words a few times;
- Discuss the etymology of the word, for example, the Greek 'stoma', which means mouth;
- Give an example in a sentence; and
- Regularly revisit the terminology using games, e.g. Bingo, or the 'weakest link'.

Strategies

A typical sequence of activities might look like this (Figure 1):

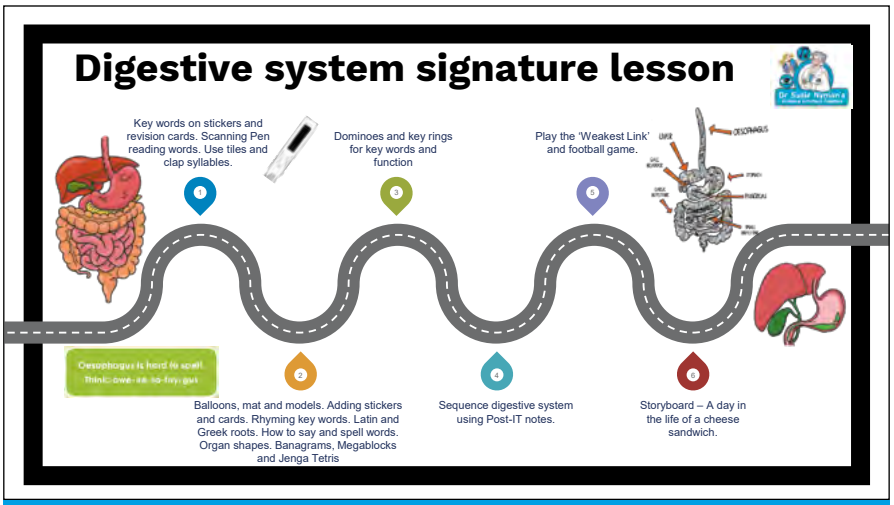
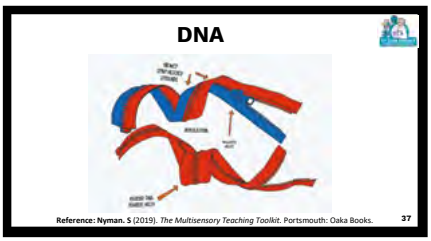


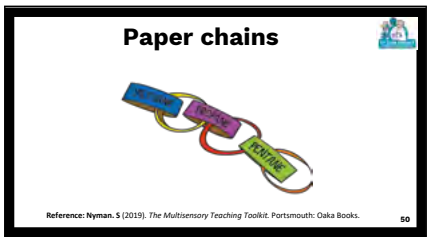
Figure 1.

Susie has a giant mat of the heart, which can be used in different ways: labelling parts, modelling flow of blood and explaining the vocabulary. Using little aids to memory can help students remember sequences; for example, reminding learners *'to try before you buy'* can help them to remember 'tricuspid before bicuspid'.

There are tactile/multi-sensory strategies, included modelling DNA by using double-ended zips (available from John Lewis) to help students understand what is happening during replication. Susie also uses card sorts to match circuit symbols to their names so that students remember them, and strawberry laces to plot distance-time graphs on pre-created axes. Playdoh is a really good material with which to model the digestive system, because it stimulates all of the senses.

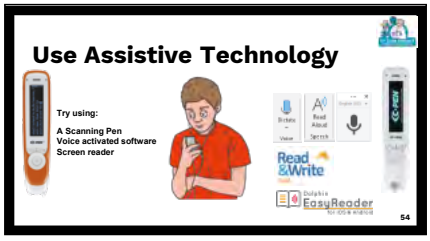


The Periodic Table of elements can be made tactile by using a large shower curtain or physical pottery models with which the students can interact. You can extend this by physically modelling electron configuration using marbles, and model organic compounds using lollipop sticks (these are useful to show the double bonds). Paperchains can be used to link a sequence of alkanes together to help learners to remember their names.



All these activities include a multi-sensory component.

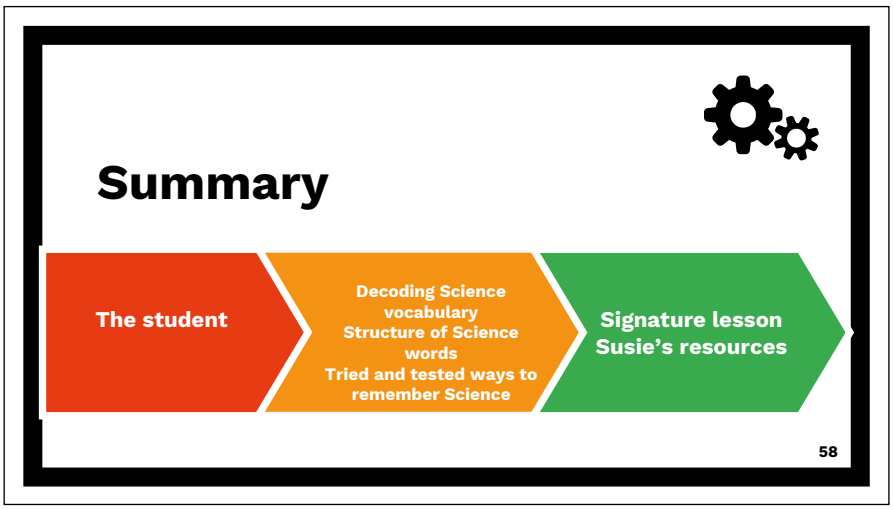
Susie reminded us that assistive technology is incredibly powerful, whether using reading/scanning pens or software such as *Read & Write Gold* or *Dolphin Easyreader.*



Susie emphasised that learners need to believe in themselves; she always tells her learners *'If you can believe, you can achieve'*.

Take-away messages

- Some students learn best with a multi-sensory experience. How can we build those into our teaching?
- How can we relate learning to real life?
- What strategies can we use to help learners understand and remember?



Useful links from the workshop

https://www.oakabooks.co.uk

https://edu.rsc.org/feature/how-to-help-students-decode-science-vocabulary/3010205.article

https://www.bbc.co.uk/bitesize/articles/z8fdr2p

From the British Dyslexia Association: https://www.youtube.com/watch?v=bIzZzbrlK9c

Multi-sensory teaching: https://www.youtube.com/watch?v=0r5i4c7OLDk&t=29s

Susie Nyman teaches at the Sixth Form College, Farnborough. She came to the Inclusive Science Group to share some of the ideas that she presented at ASE's International Day.
@DrSusieNyman on Twitter
E-mail: snyman@farnborough.ac.uk

The Inclusive Science Group is made up of interested educators from all phases and sectors who have an interest in teaching students who have additional support needs or special educational needs. It is organised by Rob Butler from ASE and Jane Essex (ASE and RSC member), who both have an interest in this area of science education. Membership of this group is open to anyone, and attendance at the meetings is optional. Notes taken during the discussion will be shared with the whole group.

You can join by filling in the form at:
https://www.ase.org.uk/ise

ASEConf2022 – a celebration: Part 2

In the February 2022 issue of EiS, we featured short accounts of some of the sessions at the 2022 online ASE Annual Conference. Please find some more write-ups from the event below:

Exploring the key elements that make an aspirational curriculum

Andy Chandler-Grevatt

The ASE Annual Conference always attracts teachers and educators who are thinkers and the session that I did at ASEConf2022 was geared to such an audience. Curriculum thinking has developed significantly over the past decade. As the Curriculum Editor for Oxford University Press's *Activate*, I explained to delegates how we had developed the Oxford Smart Curriculum and reviewed our science curriculum.

I introduced the features of curriculum thinking, including coherence and sequencing, understanding knowledge, learning and progression, and the idea of a curriculum narrative. I then explored with delegates what would make a curriculum aspirational. This led to me sharing the Oxford Smart Curriculum, which has six pillars underpinned by research evidence and informed by data. These are:

- Awe and wonder
- Coherence
- High expectations
- Responsive teaching and learning
- Learner identity
- Metacognitive learning

I then explained how I had reviewed the existing *Activate* science curriculum. From the six pillars, I did a detailed analysis of the key concepts, how they developed over Key Stage 3 (ages 11-14), looked for gaps, unnecessary repetition and opportunities for exemplifying coherence within and between the sciences and other subjects. I showed extracts of complex spreadsheets illustrating how this process was carried out.

We discussed the idea of 'curriculum narratives' and how they are intended to support teachers to teach, built upon fundamental concepts, identifying and challenging common misconceptions, recognising the complete journey through the key stages. We talked about how we could support all learners to see how science is relevant to them, in society and as part of careers, and how to ensure that all learners can identify themselves in science through inclusive and diverse representation.

This session helped teachers to discuss curriculum thinking beyond just sequencing and coherence and to consider what makes a curriculum inspirational for their students, who will either use science in their lives and work or become scientists themselves. For more information, please visit: https://fdslive.oup.com/www.oup.com/oxed/secondary/Smart/Smart_AQA_Curriculum_Paper.pdf?region=uk

Moss Safari

Andy Chandler-Grevatt

Conference delegates joined Andy on a fascinating live Moss Safari. Armed with just a microscope, a spotters' sheet of the 'Big Five' and the water squeezed from some moss, we spent 30 minutes exploring the microscopic world. Not only did we see nematodes and rotifers feeding, we saw diatoms

gliding about as well as several single-celled organisms. We then discussed our findings and the applications to science education.

Moss Safari is suitable for all ages and the narration can be pitched to the needs and capabilities of the audience. For example, primary school children can consider microhabitats, adaptations for feeding and moving and simple food chains. Secondary school students can observe the internal body systems of the multicellular organisms, the diverse structures of single cellular organisms and adaptations to extreme environments. A-level students can compare the body systems of the multicellular organisms and apply

biochemistry to their adaptations for freezing and dehydration.

The excitement and enthusiasm of the delegates matched that of the science trainee teachers and Year 8 (age 13) students with whom Andy has worked. One of the main aspects of this is 'not knowing (yet)'. The 'Big Five' spotters' sheet helps give (ahem) focus on what to look for. Seeing the organisms for the first time raises curiosity and questions. This leads to wanting to know what they are, what they eat, how they move, and how they survive in the extreme habitat of moss. In addition, there is much that science doesn't yet know about the organisms that we see in moss, with tardigrades and nematodes being model organisms for research.

We also came across a single blue microplastic fibre during our expedition. This illustrated how humans impact all environments, from a drop of water from moss to the vast oceans. Studying the very small has lessons that can be applied to the whole planet.

To do your own Moss Safari, see Andy's blog for details and downloadable resources: https://mosssafari.wordpress.com/

Look out for a Moss Safari centrefold feature in the June issue of the new SSR in Practice journal!

Dr. Andy Chandler-Grevatt is Curriculum Editor for Oxford University, Senior Lecturer at the University of Brighton and Chair of the ASE 11-19 Committee.

Practical primary science ideas with limited resources

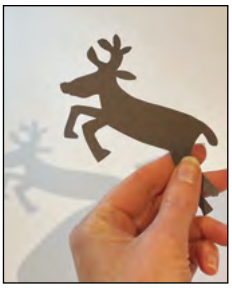
Jo Montgomery

The pandemic has taught us that science is not only important and everywhere around us, but that you can also teach quality practical science at home, in school, in bubbles, in between, online, in-person, close-up and from a distance – and that you can do it with very few resources! In my session for the 2022 ASE Annual Conference, I presented a whole host of fun and engaging, hands-on ideas using easy-to-find household items.

You can encourage children's curiosity, questioning, awe and wonder, working scientifically and enquiry skills, using basic resources. The session took participants through 25 easy investigations using paper – there are many more – and there's an accompanying blog post here: https://drjosciencesolutions.co.uk/2021/05/25/science-investigations-with-only-a-piece-of-paper/

As this hands-on workshop pivoted to online, I made the session even more accessible to all by reducing the resources required further – to little more than a sheet of paper! I illustrated and explained ways in which we can use a piece of paper to investigate and explore different areas of the curriculum, including:

Light



How to use shadow puppets when teaching about light, and plotting the movement, direction, shape and size of shadows to help explain night and day and the rotation of the Earth. You can also make a pinhole camera or project models of constellations. Explore optical illusions with thaumatropes, and refraction of light through water, glass and other materials causing a perceived change of direction.

Properties of materials, absorbency, capillary action and water transport in plants: through paper opening flowers, capillary caterpillars, walking rainbows and even separation of materials using chromatography, children can explore absorption and capillary action. There are many applications for these investigations, including water transport in plants, separation and discovering clues in a crime scene investigation.

Movement, forces and electricity

With a balloon and paper shapes, children can explore static electricity and the effect of charge. By folding shapes and bringing in some cross-curricular DT and engineering, children can create and investigate relative strength, comparing different types of paper and their ability to hold mass: which shapes are best for supporting structures and building bridges? Can they create a horse that 'walks' down a slope, or a caterpillar that moves with forced movement of air? What effect does changing the wing shape or size have on paper planes, hoop gliders or adding aerodynamic nose cones to rockets? This can then be applied to parachutes, or paper spinners and seed dispersal.

By slowing down and keeping things simple, it allows children to focus on developing skills and to wonder.

Jo Montgomery CSciTeach is a primary science specialist. E-mail: drjo@drjosciencesolutions.co.uk

The PREP ROOM

Compiled by Jodi Clements

Easy food tests

Tracy Black writes:

Here is an easy version of the food test practical that is not messy and gets the desired results, good for low ability students but has also been used for higher ability students so that they have to follow the method without intervention from the teacher. It is a bit time-consuming to set up, but pays off when the washing up comes back!

We set up one tray for a pair of students to share, but 3 or 4 students could all use one tray and still have some hands on experience. Each tray contains: crushed biscuit, milk, 'Lucozade', 0.05 M iodine solution, Benedict's solution and Biuret solution, a pestle and mortar, test tube rack, test tubes, spatulas, filter paper, pipettes and a spotting tile.

We use full fat (blue top) milk. The 'Lucozade' is a glucose solution, coloured orange with any standard food colouring. The biscuit is a cheap one that contains glucose syrup. The Biuret solution is the bought pre-mixed version, which usually contains 0.1 M sodium hydroxide and 0.01 M copper sulfate and is low hazard; however, you must check the concentrations of your particular stock and label and risk assess accordingly. We do test it out on the milk before each use to make sure that it works. Feedback from teachers is always favourable when they follow this method, and it could easily be adapted to suit other settings and/or abilities. The most common mistake is using Benedict's instead of Biuret, but that is a learning opportunity, a chance to talk about reading instructions and labels correctly and selecting the correct equipment.

You will be testing milk, biscuit and Lucozade for starch, protein, sugar and fat. Never be tempted to taste food in a laboratory.

1. Collect your tray of equipment. Everything that you need to test the 3 different foods is in the tray. Wear safety spectacles.

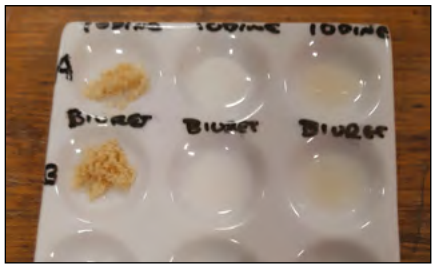
2. Crush the biscuit in the mortar using the pestle.

3. Take the spotting tile and label one row 'A' and one row 'B'. Row A is for iodine solution, so label as so, and row B is for Biurets. Label the tile using a sharpie or similar type of marker, or a chinagraph pencil. Place a small spatula full of the crushed biscuit in one dimple in row A and one dimple in row B.

4. Using the pipette, put 3 drops of milk in the next dimple along in row A and do the same in row B.

5. Using another pipette, put 3 drops of Lucozade in the third dimple in row A and repeat in row B.

6. Your tile should look like this now.



7. Put 3 drops of iodine solution (0.05 M) in each of the foods in row A. What colour does it go? Black indicates that starch is present. Orange indicates that starch is not present.

8. Put two drops of Biuret solution in each of the foods in row B. What colour

does it go? Mauve/light purple indicates that protein is present. Pale blue indicates that protein is not present.

9. Take the beaker with three test tubes in. Add a spatula full of crushed biscuit to the tube marked 'biscuit'. Add a pipette of milk to the tube marked 'milk'. Add a pipette of Lucozade to the tube marked 'Lucozade'.

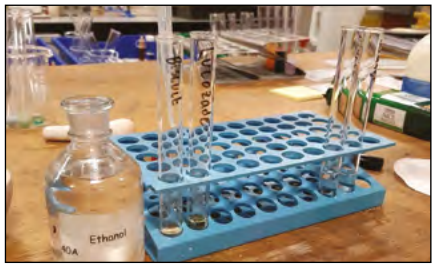
10. Add 10 drops of Benedict's solution (irritating to eyes and skin) to each test tube.

11. Put approximately 100 ml of hot water from the kettle into the beaker. Your teacher will help you with this.

12. Leave the test tubes in the hot water for 3 minutes or more and observe the colour changes. An orange colour indicates that sugar is present. A blue colour indicates that no sugar is present.

13. Take the test tube rack with 4 test tubes in. Place 1 spatula of biscuit in test tube labelled 'biscuit'. Place 1 pipette of Lucozade in test tube labelled 'Lucozade'.

14. Add 1 pipette of ethanol (highly flammable – no naked flames) to test tube labelled 'biscuit' and 1 pipette of ethanol to test tube labelled 'Lucozade'.



15. Wait 2 minutes, then add biscuit and ethanol mix to one of the test tubes

labelled 'water'. Add Lucozade and ethanol mix to second test tube labelled 'water'. Observe the colour changes. If it goes cloudy white, then fat is present.

16. Take a piece of filter paper and pipette 1 drop of milk onto it. Allow the milk to dry. Does it leave a greasy mark on the paper? If yes, fat is present. If no, fat is not present.

Sample results

Tracy Black RSciTech works at St. Aldhelm's Academy, Poole.

Technicians' cleaning hacks

Ana Gurkan

Being a school science technician is a hands-on job, the kind where you learn as you go. It is a rather lonely job, as most of us work in small teams, and many juggle all the work by themselves. Networking with other techs is the best way to learn valuable hacks that make our job easier.

When I started, I struggled to find cleaning tips. I decided to gather advice from seasoned techs and create a document to share with others. As simple as it might seem, I am confident that it will come in handy, especially for people who are new to the role and have no previous lab experience. I have listed some hacks below. Depending on the nature of the stain, you might

have to increase the concentration of the cleaning agent. Start from the lowest concentration and work your way up, bearing in mind that, with an increased concentration, risks increase. If the cleaning agent is hazardous, wear eye protection, but wear goggles if the cleaning agent is corrosive.

1. Limewater residue comes off after rinsing with 0.1 M HCl.
2. Keep a set of crucibles/test tubes for the same dirty practicals.
3. Sodium thiosulphate removes iodine stains.
4. Oxalic acid removes iron stains. Solid and most solutions are harmful to skin, eyes and if swallowed.
5. Wear gloves when washing anything with traces of $KMnO_4$ or $AgNO_3$.
6. Eosin stains come out with 0.5 M sodium hydroxide. It may need a few repeat applications. NaOH solutions above 0.5 M are corrosive.
7. 0.5 M HCl removes yellow/red fehlings/Benedict's stains.
8. To clean rust stains from glassware, soak it in 0.5 M oxalic acid (irritant to skin and eyes) or 0.5 M citric acid (solutions greater than 0.5 M are irritant to skin and eyes). If the sink is stained, scrape all the solid off and leave the acid overnight.
9. 20 vol H_2O_2 (irritant to eyes) and 0.5 M HCl remove permanganate and methylene blue stains on glassware.
10. Silver mirror residue is easily removed with 1 mol/dm³ HNO_3 (corrosive to skin and eyes, avoid inhaling fumes). HNO_3 may be reused until it stops working. It is worth keeping some of it labelled for this purpose.
11. Burnt-on sugar lifts with 1 M NaOH (corrosive) or with a soak in 20 vol H_2O_2 (irritant to eyes).
12. Swish around a few copper turnings or a sink plug chain in round-bottom flasks to scour stains off. Keep hold of the end of the chain to remove it after the flask is clean.
13. Check the benches for stains after using $AgNO_3$. 0.5 M nitric acid (irritant to eyes and skin, avoid inhaling, may produce toxic fumes) or 0.5 M sodium thiosulphate remove fresh stains. They will appear as a pinkish-brown stain initially, but eventually darken to black. Magic sponge removes older stains, but it is hard work.
14. Squirt a bit of washing up liquid in a test tube to remove re-solidified molten sulfur fused to its bottom. It will lift off after about 24 hours. You might need a minimal amount of test tube brushwork after the soaking.
15. To remove green algae from distilled water containers, swirl around a piece of cotton wool and some water in them. This also works on some other inaccessible deposits in glassware.
16. To remove potassium permanganate stains from glassware and work surfaces, use 0.5 M sulphuric acid (irritant to skin and eyes) and 10 vol H_2O_2.
17. Keep a bottle of 1 M HCL for cleaning cloudy glassware. This can be used several times before disposal.
18. For cleaning soot marks from the outside of glassware, soapy water and a scourer work fine.
19. Wear gloves to handle ninhydrin bottles to avoid getting purple fingers.
20. To avoid staining sinks with Gram's staining, use staining racks (two stirring rods joined at their ends with rubber tubing) over ice cream tubs. Pour the content of the tub carefully down the plughole.
21. Use a ziplock bag or wrap magnets in clingfilm before using them with loose iron filings.
22. Clean sublimed iodine crystals off the inside of flasks by swilling with a bit of KI solution. Save the resultant iodine solution for food tests.
23. To find out which metal strip is zinc, drop the piece of metal on the floor and listen to it. Only zinc makes a flat sound.
24. Label glassware with permanent markers. This will not rub off with fingers but comes off easily with a wet scrubber sponge or with a bit of ethanol (highly flammable, no naked flames).
25. Avoid masking tape or duct tape on glass or plastic, as it is hard to remove.
26. Blue painter's tape is best for removable labels on plastic.
27. If you carry out microscale experiments, create permanent sets of glass vials for solids or squeezy dropper bottles for liquids. Label them with printer labels covered with clear tape.
28. Use a damaged spring (used for Hooke's Law) as a drying rack for microscope slides.
29. Keep the ethanol used for the Testing Leaves for Starch experiment in a bottle for cleaning purposes. Even though it is green, it will be very useful around the lab.

Ana Gurkan is a senior technician at The Petchey Academy in Hackney, London.

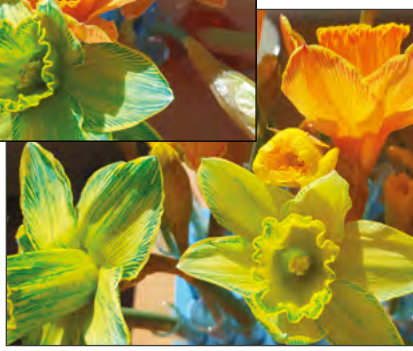
Primary-secondary transition

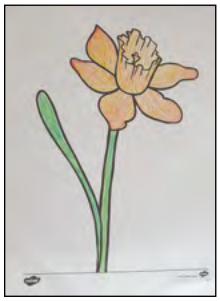
Tracy Black

Primary school liaison is currently a big focus within our Multi Academy Trust and as the main feeder primary school for our secondary is in the same Trust, it seemed right to start forging some stronger links. Since the pandemic began, there has been no formal transition day and open evenings have been virtual, so many of the potential Year 7 (age 12) students of the future have not had a chance to visit. Hopefully this will all be back to normal in 2022 but, in the meantime, our science department has started to think of ways to encourage our feeder schools to get involved. One planned event was a visit from Year 3 (age 8) in March to come to do some science in the labs for British Science Week. We had planned to use the theme of growth to plant cress in different media and begin some investigative skills with them. Sadly, due to staff shortages at both schools (will Covid ever let us be normal again?) and a lack of volunteers to help walk Year 3 pupils to our school, we had to do a last-minute rethink.

It was decided that I would go to the primary school to introduce myself, talk about British Science Week and do some activities with them. I wanted to keep the theme of growth and March lent itself to doing one of my favourites, dyeing daffodils to show water uptake. We sourced some suitable worksheets from the Internet and set about assembling equipment that could be easily transported and would be safe to use in a primary school classroom. There was a slight moment of panic when the daffodils I had bought were still in tight bud on the morning of the visit, but my lovely colleague saved the day and did a dash to the local supermarket, where she found some beautiful open ones. Putting neat food colour (YPO Messy Play in blue and red) into test tubes with bungs in the top and then transporting them in racks to distribute around the classroom was a great idea – no chance of spillage, no hands or uniforms stained with dye, but an opportunity to talk about the names of some scientific equipment and for them to use it. We packed some beakers and pipettes and got the children to draw up water to dilute the food colour in the test tubes, so another skill was learnt, and they really enjoyed it. For such a simple activity, it was so lovely to see the excitement on their faces and to hear their thoughts on predicting what would happen. We put one daffodil just in water, which gave an opportunity to talk about controls. I also took along the daffodils that were still in bud, so we discussed if they thought that they would take up the dye or not and if there would be any differences in the results. All good science!

As luck would have it, the day of the visit was a warm spring morning and both classrooms that I worked in had large sunny windowsills as well as very hot radiators. I am not sure who was the most excited as we saw the daffodils changing colour in front of our eyes. They certainly made a lovely display by the time I left, as the photographs show. I left the children blank daffodil pictures to colour in once they had seen the results. The teacher sent some through to me, saying that she was amazed at the detail they had included and that the children had absolutely loved the whole experience. We both agreed that me going out to them was a great introduction and that the children will feel even more excited about coming to the labs because of it.





Primary liaison is certainly enjoyable, definitely worthwhile and is also a great opportunity to raise the profile of the technician.

Tracy Black RSciTech works at St. Aldhelm's Academy, Poole.

Is evidence enough?

Richard Dawson

Introduction and ambition

The *Change the Story* project is exploring new narratives that influence behaviours and attitudes towards the climate crisis. It asks pupils to explore how the past has influenced the present, and then how people today are trying to make a better future for their own communities and the wider world. It conveys a sense that creating a better future is an intentional action, one that starts with what we do today and the sort of future we imagine. Over the past twelve months, the project has worked in three primary schools (with Years 4, 5 and 6 pupils, ages 8-11) to pilot this approach. The results have been positive but highlight key barriers.

Teaching the basic science of climate change was well done in the schools with which we worked. However, despite pupils having a clear understanding of the impact of the climate crisis, considering small individual changes still formed the dominant part of their schools' educational responses. If we broaden that school-level response to society as a whole, it becomes clear that scientific understanding of the climate crisis alone is not bringing about a response sufficient to the challenge we face.

This raises questions about what science education is for. Science is clearly a system of knowledge concerned with the physical world and its phenomena. And pupils should also *'understand the uses and implications of science, today and for the future'* (National Curriculum). However, it is scientific 'progress' that has led to many of the industrial practices that are creating the climate crisis – science is not always for good. How do we balance the huge benefits of science with the existential threat of the climate crisis? What is the appropriate response of science education to the climate crisis?

We clearly need to include, but go beyond, scientific knowledge if we are seeking to address the climate crisis, for example through exploring the adoption of new technologies and/or changed ways of living. Key to our project's approach is narrative storytelling. *Change the Story* recognises that fear as a response to climate change is disempowering. We need to construct positive and realistic stories, which provide real hope that tackling climate change is not only possible but can also lead to a better world.

Adaptation for the classroom, not just the climate

Our work with primary schools on *Change the Story* has encouraged pupils to observe patterns of climate data over time and research secondary sources, and to systematically explore the relationship between actions and consequences. It has underpinned this understanding with real-life interviews with elders so that pupils were able to gain a genuinely-felt sense of how changes have taken place. It has encouraged pupils to make conclusions based on their research that are evidence-based and to present these within the classroom and to other participating schools. Pupils have used their research results as a springboard to make predictions for the future and consider how best to intentionally create better futures for all. In this way, learning has placed science in a context that is meaningful and engaging to young people's lives, now and in their future.

Most of this will not be new, but is such evidence enough? William Scott and Paul Vare suggest an approach for learning that integrates learning *for* change and learning *as* change: an attempt to steer education towards addressing known challenges (doing good things) and critically reflecting on the knowledge. After all, what is good today might not be good tomorrow (See Table 1).

The three orders of learning are not hierarchical; there is movement between them. When we are clear on what needs to be done, first order learning is sufficient. But when faced with wicked problems such as climate change, we need to ask if first and second order learning are sufficient? On the other hand, when we begin to address issues such as climate change through third order learning, the results can become normalised as first/second order learning.

What does this mean in the classroom?

As described above, moving into considering the future has proven the most challenging element of our work thus far. A key barrier has been 'accepted wisdom', whereby pupils repeat what they have been told by others. In many ways, this is to be expected. As one teacher in the project pilot explained, *'There was a lot of regurgitating things they'd heard already'*. In exploring the past and the present, knowledge was often already established, whereas the future still

First order learning	Second order learning	Third order learning
We know what the issues are, we know how to address them; the role of education is to inform society what it needs to do. An example is recycling as a solution to the issue of waste. The goals and paradigm of society remain unchanged (i.e. consumption and a market economy are 'good').	We know what the issues are; addressing the issues requires radical change in how we approach solutions and the role of education becomes developing competences to explore and implement new solutions. An example is the circular economy, which views 'waste' as 'food' for new processes. The goals and paradigm of society remain unchanged.	In this level, the goals and paradigms of society itself are questioned; new forms of organising and being emerge; solutions become contextualised in a whole new way. The role of learning is seen as constant experimentation, feedback, revision and iteration as learners tackle complex and inter-related issues.

Table 1. The Three Orders of Learning.

only exists in our imagination. We found a strong tendency for pupils to repeat 'accepted' present-day solutions to the climate crisis, with a strong emphasis on individual and local action: drive less, walk more, pick litter.

Teachers mainly selected two activities to explore the future from the range offered through the project. These started by asking pupils to consider the values they felt would be most beneficial in building a better future, based on the work of Common Cause (2011). We felt this to be an important underpinning for taking action. A teacher's comment supports this: *'They talked about their values, which was really interesting. It was good, I wasn't sure whether they would understand what the values were, but we have school values that they could relate to and introduce the concept. They got really into it'*.

Teachers then asked pupils to root these values in a specific place, through creating a model of their 'village of the future'. They started by making models of their community today and then changed them into their preferred future. Pupils clearly enjoyed and valued this work. Here the challenge was to help pupils be both imaginative and pragmatic. Electric cars were a big focus, but few thought about where the electricity came from. As class teachers reported, more help was needed in developing practical ideas, whilst providing a balance between 'feeding' answers and pupil creativity.

The project asked pupils to communicate their ideas for the future through creating a digital story. Offered this creative approach, solutions such as waste-eating machines emerged. This sounds fantastical, but is actually close to some realistic technical solutions to the climate crisis (see *Web Resources* overleaf). Interestingly, in creating digital stories, pupils appeared to have a broader imaginal response than during the 'village of the future' activity. To some extent, they overcame the barrier of 'accepted wisdom', but their ideas were often more rooted in fantasy than practicality. Hicks and Holden (1995) describe how *'reality and fantasy sit side by side'* in the typical future visions of 7 year-old children, and this may in part be what we were seeing here, especially with the younger pupils. Hicks and Holden also add that this *'is not a reason for ignoring their interest'*.

Bridging the gap between fantasy and pragmatism

Learning from the pilot, we have now created Futures Cards, consisting of 24 cards that each describe a new potential solution to the climate crisis (Figure 1). They are intended to stretch pupil knowledge from something they already know to something new, but based on their initial ideas. For example, many pupils will suggest using cars less and cycling more. Using the cards as prompts, we ask if these ideas are enough, and present ideas that relate to transport, asking, *'Have you thought about…? Is personal change enough?'* Pupils can relate each idea, including their own, to different levels

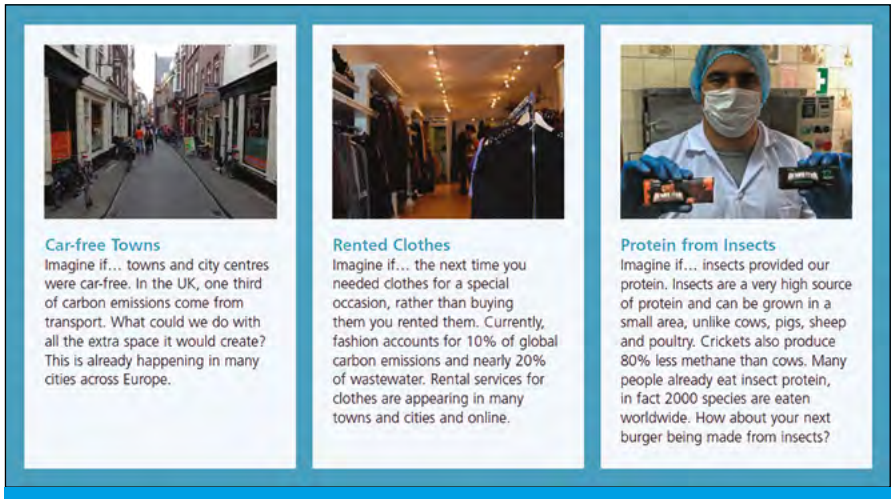


Figure 1. Example of a Futures Card.

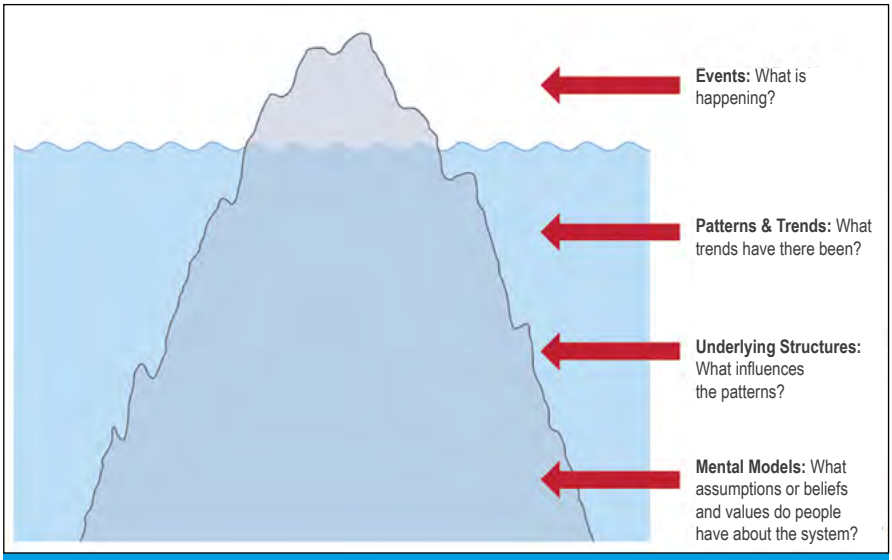


Figure 2. Iceberg model.

of impact, for example by using a sphere of change/influence map. This encourages them to look at scales beyond the immediately personal and local. Indeed, some of the examples are from inspiring innovations in a variety of places around the world.

This approach also links with the iceberg model (Figure 2), which is designed to help see the different patterns an event is part of, the structures that are causing it to occur and the models that are giving rise to those structures. For example, *walking more* is a surface level event, but how do we create a trend where everyone feels that they wish to walk more, with community changes that support this trend (e.g. dedicated car-free walking routes)? What changes in beliefs will emerge (e.g. valuing health over convenience)? The iceberg provides a structure to question and deepen initial pupil ideas, to take pupils beyond stock responses to the climate crisis and to think more conceptually, to use their geographical and scientific imagination to move towards realistic but dynamic solutions to the challenges we face.

Concluding thoughts

There is a good range of resources addressing the science behind the climate crisis. However, as one teacher put it, *'We had done climate change before, but this [project] definitely angled it more positively…more empowering, rather than just factual. Much more about being changemakers, changing things, where do we want to be, how we will change things. It changed how I would approach it'*.

This bodes well. However, clear challenges persist in helping pupils to envision their future, accessing new ideas and solutions that go beyond the 'accepted wisdom'…a wisdom that presently falls short of carbon reduction targets. Pupils are seeing positive possible futures, but they still need the cognitive tools and affective resources to get there.

Evidence is a key part of responding to the climate crisis. To create a different future also requires imagination – a strong vision of where we want to be and how science can be in service to that aim. This is not the domain of science alone, and integrating the Arts and design subjects will be a critical part of how education responds effectively to the climate crisis.

Change the Story resources are now available from the project website (see below).

Web resources

Change the Story:
https://www.changethestory.eu/uk/

Waste-eating technology:
www.biotechniques.com/microbiology/a-tiny-solution-for-plastic-pollution-scientists-discover-polyurethane-feeding-bacteria/

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Richard Dawson is the Director of Wild Awake and manages the *Change the Story* project.
E-mail: richard@wild-awake.org

The latest Green Tick evaluation summaries

OurFuture.Energy website

https://ourfuture.energy

OurFuture.Energy is an interactive website supporting the teaching of energy-themed topics within science, geography and career lessons. It has been developed by the Glasgow Science Centre in partnership with four energy industry stakeholders: OPITO, RenewableUK, UKOOG and NIA, which contributes to a representative and balanced website. Throughout, high quality and attractive photographs and videos are used to complement descriptive and explanatory text: a series of pages designed to engage teachers, and students aged 11-16, with scientific, technological and careers issues relating to the energy industry. However, it goes beyond providing information about our current energy industry by including insights into innovative technologies being developed or imagined. It also has a collection of resources relating to COP26 held in Glasgow in November 2021. The website is attractive and accessible for users and includes search facilities and filters to support teachers in identifying and selecting curriculum-related resources. As energy-related issues become more prominent in people's minds, this website provides a welcome source of information and inspiration for teachers and students.

There is a vast amount of curriculum-linked information to support teachers in planning lessons. The searchable nature of the resources and curriculum linkage makes planning classroom activities efficient and effective. It supports independent learning activities such as Flipped Learning, *Marketplace* and *Information Stations*, without the need for duplication of resource sheets. It also supports student research for project work, revision and debate and is now enhanced by additional classroom support materials. The website goes beyond the 14-16 curriculum, but this is a great advantage for planning enrichment and extension activities. It is well laid-out for students and teachers and information is straightforward to locate. It is highly supportive of science teaching and learning across the four home nations, through curriculum links on each resource page.

OurFuture.Energy website is an engaging and informative resource that offers a great opportunity for teaching about energy resources.

CENTURY Tech

https://www.century.tech/

CENTURY is an intelligent learning platform using artificial intelligence (AI) to tailor learning materials to the individual needs of each student. It comprises a series of micro-lessons, 'nuggets', aimed at 7-16 year-olds, for English, maths and science, although not all science authoring is complete at the time of this evaluation. This summary focuses on GCSE sciences.

A diagnostic nugget assesses understanding of topics through a series of multiple-choice, drag-and-drop or short typed-answer questions. The platform uses data from the assessment to determine which learning nuggets to assign and adds them to the student's learning path.

Learning nuggets comprise a short video and slideshow, each covering the same content that students choose from, followed by questions assessing understanding of that nugget. Learning nugget assessment provides students with immediate feedback after each question. The platform gives students a percentage score and feedback statement.

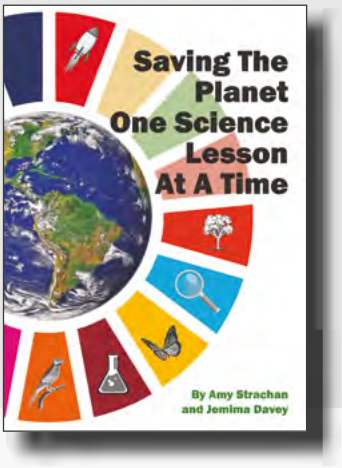
There are CENTURY courses matching GCSE specifications for AQA Combined Science Trilogy biology, chemistry and physics, Edexcel IGCSE separate sciences and Edexcel IGCSE Double Award. Schools can customise content to suit other specifications by selecting or deselecting nuggets. Once all nuggets have been written, CENTURY will create courses for all specifications.

CENTURY offers schools a teaching, assessment and revision platform that allows different approaches with great functionality.

- Students can use the platform to revise GCSE content at any time.
- Our subject evaluators liked the sense that the authors are teaching for understanding rather than just ticking boxes. They found the nuggets to be well written and the feedback within some questions to be very good.
- Teachers can assign work to students, with a due date.
- Teachers can use nuggets alongside class teaching to reinforce and assess learning.

Pricing for a science-only subscription is based on school size. For example, a school of 750 pupils would cost £2000 per year, making it a significant investment. The platform offers a versatile and powerful learning and revision tool. CENTURY is an impressive platform, with a lot of potential for consolidating and accelerating student learning. It would certainly be very beneficial for students aged 14-16 to use CENTURY for home learning and revision.

Available now...



Saving the Planet One Science Lesson at a Time

By Amy Strachan and Jemima Davey

ISBN: 9780863574795

ASE member price: £8.50

Saving The Planet One Science Lesson At A Time provides a framework for embedding global issues into primary science learning. Using the UNESCO Sustainable Development Goals, the book provides 17 chapters full of ideas and enquiry activities to add purpose and value to science education.

Each chapter includes: a summary of the global issue in relation to science learning; a relatable context to engage learners; a big question to discuss; ideas for responsible action related to the goal; links to science knowledge and skills; purposeful enquiry ideas; ideas and inspiration from around the world; an opportunity for responsible application of learning and a detailed purposeful enquiry.

With downloadable lesson slides for each chapter, the resource can be used for individual lessons or a whole school approach to science learning, so together we can save the planet, one science lesson at a time.

Enquiring Explorers: Fairground

By Leigh Hoath and Emma Vanstone. Illustrated by Claire Chamberlain

ISBN: 9780863574719

ASE member price: £8.50

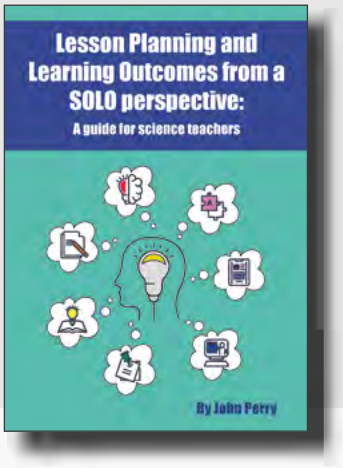
Charlotte and Zach are the best of friends and have been taken on an exciting day out. At Velocity Valley fairground they go on lots of rides, enjoy sweet treats and have a great deal of fun. Based on their day at the fair they need help to recreate some of the activities, using scientific thinking and planning to help to solve the problems.

Another beautifully illustrated story of Charlotte and Zach's adventures provides a context for children to think about different scientific enquiries and evaluating their work.

Notes for grown-ups provide guidance and extension activities. The book is accompanied by a downloadable resource pack.

Also available in the series: ***Enquiring Explorers: Space***.

Coming soon!



Lesson Planning and Learning Outcomes from a SOLO perspective: A guide for science teachers

By John Perry

ISBN: 9780863574900

ASE member price: £10.00

This book considers how to constructively align assessment tasks so that they mirror the intended learning outcomes. It also introduces, through the SOLO (Structure of Observed Learning Outcomes) Taxonomy, a vocabulary that teachers and learners can use to support the learners in developing a growing complexity in their responses to assessment tasks.

John's interest in the SOLO Taxonomy came about through helping schools to plan and prepare for the reform of the system of National Curriculum 'levels', used to report children's attainment and progress in 2014. However, through this work he saw that SOLO was much more than an assessment system, it was an approach that looked at the whole teaching and learning process. Crucially it takes into account the often contrasting views of teachers and learners on this process...

Authors celebrate their publications

April saw the publication of the next two books (*Concentrate, Russet!* and *Earth Grass*) in the endearing and beautifully illustrated *Stories for Science* series, by Elizabeth Flinn and Hannah Thompson. Family and friends came together to enjoy cake and celebrate the publications.

These books are perfect for sharing in front of the class or in smaller groups. The stories do not have satisfactory endings and the characters are left with a problem to solve. After doing some appropriate investigations in science lessons, children will be able to use their knowledge to write a happy ending to the story.

Extensive downloadable resource packs of teacher notes and lesson plans linked to the stories are also included.

Concentrate, Russet!

ISBN: 9780863574924

At the end of the summer, wise old Rudolph teaches the young squirrels how to prepare for the coming winter, but Russet doesn't pay attention. When winter arrives, will Russet be able to survive?

Curriculum link to Plants.

Earth Grass

ISBN: 9780863574948

Sirod dreams of having a soft green lawn to sit on, but the grass seeds she has must be faulty because, despite her best efforts, nothing grows.

Curriculum link to Plants.

The next two books in the series are currently in production and will be available in the summer.

A Friend for Howard

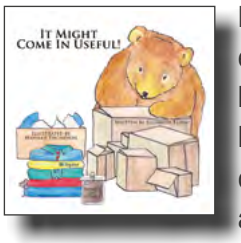
ISBN: 9780863574924

Howard is looking for a new friend, but none of his potential new companions is quite right.

Curriculum link to Living things and their habitats.

It Might Come in Useful

ISBN: 9780863574948



Bear saves everything because he knows it will all come in useful at some point. His collection grows so big that he has trouble finding what he needs. Is there a way he could organise things better?

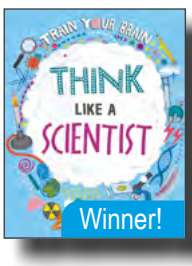
Curriculum link to Everyday materials.

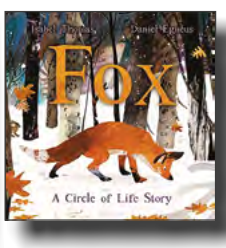
ASE Book of the Year Award 2022

ASE are excited to announce the launch of the ASE Book of the Year Award 2022, now in its seventh year.

This award seeks to find a book that goes the 'extra mile' and supports the ASE vision of 'science for all', a book that could supplement a teacher's understanding, that innovative hook, or something that goes beyond the traditional science curriculum.

The 2021 finalists:





To view the full list of winners and shortlisted titles from previous years, please visit www.ase.org.uk/BOTY

All books are available from www.millgatehouse.co.uk

In order to receive your ASE membership discount you need to first register for an account (if you havent already done so).

Once registered, go to the 'my account' section where you will find a menu item that asks 'are you an ASE member'. Click through and complete the form – don't forget to save it! Your details will then be updated, this usually takes about 48 hours.

When your account has been validated, the membership discounts are automatically applied at checkout.

Major reforms to Scottish Education

Susan Burr

The background

The Curriculum for Excellence (CfE) in Scotland engages students from 3-18 years. The framework was introduced in 2010 and, in 2021, the OECD was invited by the Scottish government to: *'assess the implementation of CfE, to understand how curricula are designed and implemented in schools and to identify what can be improved for CfE to continue to deliver quality learning for all students'* (Executive summary).

The report looked at both BGE Broad General Education (3-15) and the Senior Phase (15-18). Key findings were:

- CfE continues to be supported and offers flexibility to improve learning.
- Stakeholder engagement needs better structure and shared ownership to improve leadership.
- Coherence of policy is needed; work is needed to balance autonomy, equity for students, government initiatives and to align assessment with CfE ambitions.
- A structured approach is needed to plan longer-term developments.

The recommendations were:

- Coherent learning experience 3-18: *reassess vision against emerging trends; better balance between breadth and depth of learning; adapt the Senior phase to match the vision; and continue to build curricular capacity using research.*
- Consolidate institutional policy for effective changes: *provide time to support CfE at school level; simplify policies; align curriculum, qualifications and evaluation to deliver 'Building the Curriculum 5 (CfE)'; and develop a systematic approach to curriculum review.*
- Provide a long-term view and structured review.

What are the outcomes?

In Autumn 2021, the Scottish Government accepted the 12 recommendations of the OECD report: SQA would be replaced; remit of Education Scotland would be reviewed; and its inspection role removed. It appointed Prof. Kenneth Muir, formerly Chief Executive of GTC and HMI Chief Education Inspector, to undertake the consultation and report back. ***Putting Learners at the Centre: towards a future vision for Scottish Education*** was published in March 2022.

Summary of recommendations

A renewed vision

National discussion; learners at the centre; address article 29 of UNCRC; invitation to all partners and stakeholders.

To shape the vision

A new Qualifications and Assessment body: Qualifications Scotland:

- Responsible for design and delivery of qualifications, exams and awards.
- Governance structure should include more representation of stakeholders, learners, practitioners.

A new national agency for Scottish education:

- providing support and improvement functions for a number of existing bodies, including Education Scotland;
- providing accreditation and regulation of qualifications;
- providing advice on curriculum and assessment policy;
- making sure that all needs of learners and practitioners are met at local and national level;
- acknowledging that significant resources will be necessary;
- ensuring governance is participative;
- using digital means to engage with all stakeholders;
- Community Learning and Development Standards Council will remain part of new agency;
- Registrar of Independent Schools will return to the learning directorate of Scottish Government and will work closely with GTCS; all teachers will be registered and regulated by them;
- creating a forum for ongoing discussion about curriculum, assessment, learning and teaching, professional learning and leadership;
- SCQF to be brought into the Agency.

Inspection: An independent body enshrined in legislation, staffed by civil servants, funded by Scottish Parliament, with inspectors appointed by Her Majesty via the Privy Council, to: have a role to support improvement, evaluate major changes and report on the performance of Scottish education; liaise with Care Inspectorate and reduce burden on ELC; and look at local arrangements to support change at local and regional level.

Other implications: *Insight* tool to be further developed. There will be collaboration between agencies to ensure that policies are aligned. The Transitions Team will engage all stakeholders. *Still to come: Professor Louise Hayward's report on senior phase assessment.*

Useful links

Putting Learners at the Centre: towards a future vision for Scottish Education. Available at www.gov.scot

Scottish Curriculum for Excellence: into the future, published by OECD, June 2021. Available at: www.oecd.org

Curriculum for Excellence: Scottish Government. Response to OECD review, June 2021. Available at: www.gov.scot

Dr. Susan Burr, Chair, ASE Scotland, with help from colleagues **Stuart Farmer**, IOP Scotland, and **Dr. Colin McGill**, Edinburgh Napier University.

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