TEES VALLEY GUIDE TO DEVELOPING PRIMARY SCIENCE CAPITAL

A CPD and classroom activity pack for EYFS and primary teachers

Cleveland Scientific Institution

CENTRE for INDUSTRY EDUCATION COLLABORATION

CONTENTS

INTRODUCTION

The Tees Valley has an undeniably rich industrial heritage. Ship building began in earnest in Stockton in the 1700s, and the 1850s discovery of iron ore in the Cleveland Hills put the area firmly on the global industrial map with the large-scale production of iron and steel earning Middlesbrough its impressive nickname: the 'Infant Hercules'.

But Teesside's industrial might and the career opportunities that came with it, did not die out when the infamous steelworks' blast furnaces closed for good in 2015, nor when the demolition of its iconic structures began in 2022. Today, Teesside is host to a vast array of businesses connected to a network of STEM industries ranging from low-carbon energy and the manufacture of offshore wind turbines, to cutting edge biosciences and companies at the forefront of the digital and creative sectors. The Infant Hercules is alive and well!

Research reported in the Primary Science Capital Teaching Approach[1] shows that a child's perception of whether or not 'science is for me' is often fixed by the time they leave primary school. If children are to see science as something which is part of their lives, now and in the future, we need to find creative ways to expand children's engagement with science through their learning experiences, to support them to form positive attitudes towards science, and to see connections between the science they learn in the classroom, and the STEM careers of people in their locality.

The more children feel that 'science is for me', the more open they will be to future potential careers in science related industries. This guide has therefore been written to support primary classroom teachers in the Tees Valley and beyond to nurture and develop the science capital of their children along with raising awareness of the host of STEM career opportunities on our doorstep.

Look at the Tees Valley Combined Authority webpage to find out some background information on Tees Valley's key industrial sectors[2].

Offshore

Logistics

Energy and renewables

Life sciences

Chemicals and process

Manufacturing and engineering

1 https://tinyurl.com/2ezhzmxu
2 Images reproduced with kind permission from Tees Valley Combined Authority https://teesvalley-ca.gov.uk/business/key-sectors/

USING THIS RESOURCE

This resource consists of a sequence of CPD sessions with associated classroom activities and other recommended follow up tasks. Science subject leaders and senior leaders should use the guide to aid them in delivery of CPD aimed at supporting teachers to better understand how to develop children's science capital specifically in Teesside, and to try out aspects of the CPD with their own classes.

The CPD and the classroom activities are supported with presentations and handouts where appropriate.

CPD ACTIVITIES

Each activity has been designed to be delivered as approximately a 30-minute segment within a standard staff meeting. Six activities are included, one per half term. Some sessions include 'gap tasks' intended to impact on classroom practice and provide a focal point for discussions at a later date.

CLASSROOM ACTIVITIES

There are three sets of classroom activities spanning the primary age range. Each activity specifies the target year group(s). Activities are recommended in a specific order to accompany the CPD sessions and can be delivered as stand-alone sessions.

Each classroom activity pairs with one or more CPD session as outlined on page 3.

SUMMARY OF CPD ACTIVITIES

THEME	PAIRED WITH CLASSROOM ACTIVITY (CA)	SUMMARY OF ACTIVITIES	HANDOUTS	APPROXIMATE TIME TAKEN
CPD 1 Understanding science capital	CA1: Science and me	Explore issues relating to 'science capital' to gain a clearer understanding of what is meant by the term.	1 P13	30 mins
CPD 2 Building science capital	CA2: Ten STEM things…	Discuss key aspects of science capital and consider ways it can be developed. Agree on specific areas of focus for school development.	2 and 3 p14 and p15	30 mins (+ ongoing actions based on areas selected for development)
CPD 3 Science capital topic planning	CA1: Exploring topic links	Plan a topic with children's knowledge and experiences at its heart, refocusing learning through a science capital lens.	Activity Sheet 2: Science and me (topic focus) p28	30 mins
CPD 4 Who uses science?	CA1: Exploring topic links	Plan a topic with children's knowledge and experiences at its heart, refocusing learning through a science capital lens.	4 and 5 p16 and p17	30 mins (+ time to collate)
CPD 5 STEM careers learning in the primary classroom	CA2: Ten STEM things…	Create a list of people and organisations who can help develop children's science capital and explore how to work with them effectively.	6 P18	30 mins (+ time to collate, and annual review)
CPD 6 Identifying STEM advocates in the school community	CA2: Ten STEM things…	Create a list of people and organisations who can help develop children's science capital and explore how to work with them effectively.		30 mins

SUMMARY OF CLASSROOM ACTIVITIES

THEME	SUMMARY OF ACTIVITIES	ACTIVITY SHEETS	APPROXIMATE TIME TAKEN
CA1 Science capital discovery	Discover different ways of eliciting and celebrating children's science capital with two discussion-based tasks and a STEM selfie challenge.	ACTIVITY SHEETS 1 2	APPROXIMATE TIME TAKEN 30 mins – 1.5 hrs (plus time to revisit as appropriate)
CA2 Ten STEM things to do before you leave primary school	Curate a list of ten exciting STEM related experiences children can engage with across their primary school career.	3	60 mins (plus time throughout the year – dependent on activities selected)
CA3 Connecting with science	A collection of ideas to be developed across the course of a school year supporting children to recognise, connect with, and share the science in all aspects of their daily lives.		30 mins – 2.5 hrs (plus time to revisit as appropriate)

CPD SESSIONS

CPD SESSION 1: UNDERSTANDING SCIENCE CAPITAL

AIMS

- To support teachers to understand science capital.
- To create a science capital action plan to carry out over the course of one school year.

RESOURCES

- YouTube Video: Science Capital – an introduction 3.
- Presentation slide 3.
- CPD handout 1.

ACTIVITY

Share the video 'Science Capital – an introduction' with staff to provide a concise summary of the key ideas underpinning the term.

Use presentation slide 3 to explore sticking points for an example school which reflect those which can arise as a school begins its science capital journey. Ask teachers to discuss potential solutions to overcome these barriers. The sequence of 6 CPD sessions and 3 classroom activities comprising of various tasks will support teachers to arrive at their own examples of good practice.

Can you suggest possible actions for this school?
Teachers say they 'do science capital' by engaging in Science Week and visiting a museum every year
Most staff indicate on an anonymous questionnaire that they don't fully grasp the meaning of science capital
A pupil voice survey indicates that children are not able to name many jobs which use science skills
Teachers feel more could be done to promote science learning at home and through events/organisations in the local community
Teachers report that though many children enjoy science learning some are disengaged; particularly those from less advantaged backgrounds
One teacher feels that children in her class perceive that a specific group of boys are the ones who are good at science
Each science topic has a 'key scientist' assigned to it but staff have commented there is a lack of diversity

Incorporating ideas from your discussion, the science subject leader creates a Science Capital Action Plan using the template on page 6. Identify practices already in place which align with a science capital approach and select 2-3 actions which staff feel are achievable in an agreed timescale.

NEXT STEPS

From **Classroom Activity 1**

- Ask teachers to carry out the Science and me task with their classes to find out more about the children's science capital starting points.

From **Classroom activity 2**

- Provide teachers with the list of Ten STEM things to do before you leave primary school to consider before follow up discussion time in CPD2.

3 https://www.youtube.com/watch?v=A0t70bwPD6Y

CPD SESSION 2: BUILDING SCIENCE CAPITAL

AIM

- To explore the different ways teachers can build the science capital of children.

RESOURCES

- CPD handouts 2 and 3.

ACTIVITY

Share Handout 2 with teachers. In groups, spend 10 minutes discussing the extent to which each of the scenarios could impact the science capital of children. Note that some scenarios represent good practice, and some are areas for development. Invite groups to share their ideas with a focus on recommendations for improving provision.

Next share Handout 3 and allow 10 minutes for groups to reflect on the example responses, considering next steps which could be implemented.

For the remaining 10 minutes, share any relevant feedback from carrying out the Stem and me activity in classes, and discuss thoughts on the Ten STEM things to do before you leave primary school and agree next steps for sharing this with children.

NEXT STEPS

- Visit the CIEC resources webpage for free-to-download classroom resources that support teachers to build the science capital of children. These resources feature hands-on practical enquiry, problem-solving, teamwork and discussions, and are set in real industrial contexts.
- Use CIEC publication links to industry visits and visitors from the information bank for a guide to which of CIEC's classroom resources pair well with visits to different industrial sites.
- Classroom activity 2: Ten STEM things to do before you leave primary school.

CPD SESSION 3: SCIENCE CAPITAL TOPIC PLANNING

AIM

- To support teachers to refocus their science topics and plan through a science capital lens.

RESOURCES

- A3 copies of Activity sheet 2: Science and me (topic focus).
- Presentation slide 5.

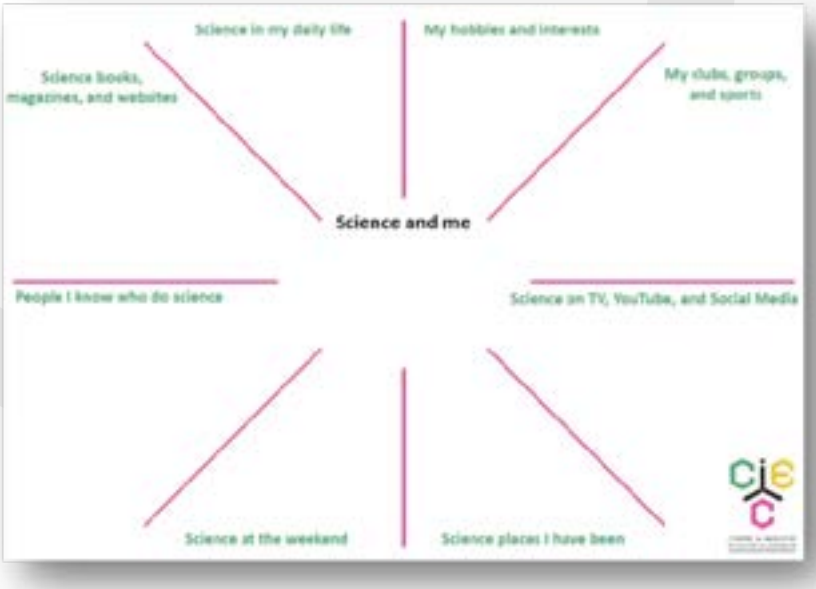
ACTIVITY

Ask teachers to bring their medium-term plan for their next science topic to this session. Using A3 copies of Activity Sheet 2 from the classroom activities, alongside **presentation slide 5**, staff populate the document with their own responses, then add further detail with the experiences of their class(es) in mind. Teachers can draw on their developed understanding of science capital accumulated throughout the preceding CPD sessions, and any knowledge they may have gleaned from the classroom activities.

NEXT STEPS

- Teachers use the *Exploring topic links* task from Classroom activity 1 with their class as a starting point for a new topic.

To further embed good science capital practice into a whole school approach, use this document to form the basis of end of year transition discussions to give teachers taking on new classes a head-start in understanding the science capital of their students.



CPD SESSION 4: WHO USES SCIENCE?

AIMS

- To broaden teachers' perceptions about who uses and applies science knowledge and skills in their jobs, hobbies, and interests.
- To recognise how frequently we encounter the applications of science in our everyday lives.

RESOURCES

- CPD handouts 4 and 5.
- Presentation slides 7 and 8.
- CIEC's Career Cards.

ACTIVITY

Using Handout 4, present teachers with a range of job titles, interests, and hobbies, including a selection which are representative of the school's wider community. These should not be limited to STEM professions or those with obvious links to science and engineering.

This list is not exhaustive but here are some examples to consider:

Sports/fitness/training	Fashion/textiles/sewing	Hair and beauty
Gardening/floristry	Uniformed service	DIY
Nursing assistant and personal care	Animal care	Cookery and baking
Electrician	Construction worker	Joiner/carpenter
Doctor/nurse/physio	Chef/catering/hospitality	Mechanic
Personal trainer	Photographer/graphics	Painter/decorator
Musician/DJ	Pharmacist/first aid	Driver/transport

It is important that teachers and children recognise the difference between STEM careers (the people who are doing science, such as physiotherapists and dermatologists) and jobs which use the applications of STEM (such as athletes and beauticians). With this distinction in mind, ask teachers to spend 10 minutes in groups, discussing the different jobs, interests, and hobbies presented to them, identifying where possible links that could be made to the science curriculum and discerning between those who 'do' science and those who 'use' science. The key difference being those who 'use' science only need to follow procedures that rely on the outcomes of science without needing to think about the science or make decisions based on scientific knowledge and understanding.

As a stimulus for the discussion, share **presentation slide 8** and ask teachers to note down the links they have identified using Handout 5.

To ensure a variety of science skills are explored, distribute the cards so that no two groups have the same cards.

Once discussions are complete, ask groups to share one or two examples and agree how and where staff will be able to access the ideas generated to support them in their future planning. For example, these links could be collated into a database kept in a central location (physical or digital) and added to as resources are created, and examples of good practice emerge.

NEXT STEPS

- CIEC's Career Cards activities have been designed to be used with 9-11 year olds to raise their awareness of the range of STEM careers open to them, some of the career opportunities available in industry and the advantages of studying STEM subjects when they are older. The cards are designed to be used alongside a PowerPoint presentation.

  The resources are free to download from the Career Cards page on the CIEC website. The cards can be printed and cut out, or a class set purchased from the online store.

- Try any of the tasks from Classroom activity 3 to give children opportunities to demonstrate their own science knowledge and skills and to give everyone the chance to showcase their areas of expertise.

CPD SESSION 5: STEM CAREERS LEARNING IN THE PRIMARY CLASSROOM

AIM

- To review science provision to identify where links to STEM careers could be made.

RESOURCES

- Copies of each year group's long-term and medium-term planning documents.
- Presentation slide 10.
- CPD handout 6.
- Online STEM careers resources.
- Internet access for research activity (tablets, phones, or laptops).

ACTIVITY

Working in year group or phase teams, ask teachers to review the long-term and medium-term planning documents for science, considering where links to STEM careers could be made within each curriculum topic.

There will be clear links such as introducing electrical engineers when teaching electricity, or botanists when learning about plants, but teachers will likely appreciate guidance in making links which may be less obvious. There are some great online resources listed below to make available to support discussion.

Use **presentation slide 10** to introduce staff to a selection of high-quality STEM careers resources. Teachers are given electronic copy of Online STEM careers resources from the information back, to enable them to access the weblinks to carry out internet-based research into chosen providers collecting their ideas in Handout 6.

As with CPD session 4, agree a format and central location where teachers will be able to access the ideas generated in this session to support them with future planning. Review the collated database on an annual basis to ensure links are relevant and up to date. An indication of which links have been used successfully and signposts to any short-term planning documents will also be useful to others.

NEXT STEPS

- Using the ideas generated, teachers select the careers they will include in their short-term lesson plans. Include a diverse range of famous scientists and engineers and make contact with identified people in the extended school. Include class visits to places of work, visitors joining you in the classroom in-person or virtually via video call, and presentation slides from ambassadors showcasing their job.
- Create a whole school display to promote STEM careers with each class contributing work detailing the careers they have discovered. Individual classes have a 'working wall' style display where information about different STEM careers is added as they learn about them.
- Use STEM careers resources with the children then have a go at the STEM selfie task from Classroom activity 1 and enthuse children across the school by guiding them to recognise their inner scientist and celebrating their unique skills, talents, and interests.

CPD SESSION 6: IDENTIFYING STEM ADVOCATES IN THE SCHOOL COMMUNITY

AIM

- To identify a range of people within the school community willing to promote awareness of STEM skills and careers.

RESOURCES

- Presentation slides 12-15.
- Tees Valley and North East STEM outreach providers.

ACTIVITY

Share presentation slide 12 of the CPD presentation, reflect on the outcomes of CPD activities 4 and 5 which explored who uses science and identified opportunities in the curriculum where effective links might be made to a range of STEM careers. Ask staff to identify who within the school community might be suitable STEM advocates and make a list. Consider:

Children's parents/carers and extended family members	Staff members with previous career experiences
School governors	Staff members' friends and family
Past children now in FE/HE/employment	Local companies
Colleges/Universities/Organisations	Local services e.g. dentist, GP surgery

Children will likely be aware of certain STEM careers such as doctors and dentists and know less about the different types of engineers and scientists. Addressing these blind spots is important to providing well rounded coverage.

Use the information bank resource Tees Valley and North East STEM outreach providers to evaluate a selection of the Tees Valley STEM outreach opportunities and ask staff to consider which options might complement their year group's curriculum. Encourage discussion around experiences staff may have had with local STEM outreach providers to add any other providers they are aware of to the list.

The experience potential STEM advocates have of engaging with primary age children will vary and some may feel more confident speaking to a group of children than others, so it is worth considering a variety of different ways of engaging with them. Use **presentation slide 13** to support staff in forming their ideas about how these interactions might look in their classrooms.

Here are a few examples:

Class visit to their place of work	In-person visit to the classroom
Video call Q&A with the class	Pre-recorded videos
Virtual site-visit	Live demonstration
Presentation slides including photographs of the person doing their job	Storyboard depicting a 'typical' day in their job

Consider what type of interaction with a STEM advocate would be preferred. To help prepare for classroom visits, share **presentation slides 14 and 15** with staff. This will help teachers to form a clear idea or how a session might work and to better understand the responsibilities of all parties involved. Armed with this information, staff will feel more confident when approaching STEM advocates with a specific request.

NEXT STEPS

- Approaching identified STEM advocates to gauge willingness to work with a class.
- Develop a bank of presentation slides with STEM advocate profiles can be built up over time and kept centrally on the school's network to use in future years. Agree how and where staff will be able to access the list of identified STEM advocates to support them in their future planning and revisit the list annually to ensure it is up to date.
- Read this selection of articles written by members of the CIEC team for top tips on engaging with industry ambassadors – you will find these in the appendices:

Article	Author
Take your science teaching to the next level: STEM volunteers in the classroom	Jane Winter
Site-seeing to inspire primary children	Mackayla Millar
How to make effective links with industry	Joy Parvin

CPD HANDOUTS

CPD HANDOUT 1: SCIENCE CAPITAL ACTION PLAN

Science capital focus	Where are we now?	Where do we want to be?	How and when will we get there?
Taking children's own experiences into account from their own locality • Find out about children's interests, experiences, aspirations, family background, local community/area • Use examples and settings that are familiar and local in science lessons • Encourage children to think about their own experiences and relate these to what they are learning science lessons			
Encouraging children to share their experiences • Use open questioning regularly • Use talk strategies that encourage all children to engage in lessons, including quiet or shy children • Create opportunities to recognise and link children's personal experiences, interests, and hobbies to their science learning			

CPD HANDOUT 2: DO THESE ACTIVITIES DEVELOP SCIENCE CAPITAL?

1 Always ask children to raise their hand to answers to questions	**2** Refer to a wide range of careers which show a variety of STEM skills	**3** Choose examples of hobbies or interests that appeal more to boys or to girls	**4** Use examples that show how science links to children's own experiences	**5** Occasionally involve families or the wider community in science learning
6 Subscribe to a science magazine for children	**7** Engage in a programme to develop links with scientists in local industry	**8** The Y5 cohort take part in Children Challenging Industry every year	**9** Send a group of higher ability children to Middlesbrough College for a science workshop	**10** The Y4 teacher mentions a child's parent who works at Hartlepool Power Station in a lesson about electricity
11 Arrange for a doctor to visit EYFS each year	**12** Involving parents in science learning and homework activities is not a priority	**13** Arrange a 'stay and play' session for EYFS parents to enjoy some science related activities with their children after school	**14** FSM children are invited to an engineering workshop to make a balloon powered car	**15** Make links with other local schools to celebrate science learning

CPD HANDOUT 3: BUILDING SCIENCE CAPITAL – EXAMPLE RESPONSES

1 Provide children with individual whiteboards to write down ideas or ask pairs to discuss, then answer together, to ensure all children answer questions	**2** Refer to a wide range of occupations and link to learning in science lessons and across the curriculum	**3** Refer to all hobbies and interests using inclusive language regardless of 'traditional' gender perceptions	**4** Link children's experiences to science learning to ensure all learners are included	**5** Create frequent opportunities to use the skills, knowledge, and experiences of families and the local community
6 Increase the choice of available science reading with a range online and 'real' reading materials	**7** The Children Challenging Industry Programme has shown that engagement with local industry and real-life scientists can raise science capital	**8** Reach out to a variety of organisations to ensure each year group is receiving exciting STEM opportunities	**9** Challenge high achievers but make this one element of a wider focus on providing extra-curricular opportunities to all children	**10** Invite the child to share their knowledge and invite the parent in to talk about their job Involve a variety of occupations, where they can be meaningfully linked to learning
11 Introduce the children to a range of other science workers. Consider diversity of age, ethnicity, gender, skill type, career pathway	**12** Involve families in homework tasks and keep them informed of local science events	**13** Routinely engage families in their children's science learning starting from an early age, and continue into KS1 and KS2	**14** Target less advantaged children to help redress limited opportunities at home	**15** Make links with other schools (local, national, and international) to share good practice and for children to take pride in science achievements

CPD HANDOUT 4: SCIENCE SKILLS CARDS ACTIVITY

Sports/fitness/training	Fashion/textiles/sewing	Hair and beauty
Gardening/floristry	Uniformed service	DIY
Nursing assistant and personal care	Animal care	Cookery and baking
Electrician	Construction worker	Joiner/carpenter
Doctor/nurse/physio	Chef/catering/hospitality	Mechanic
Personal trainer	Photographer/graphics	Painter/decorator
Musician/DJ	Pharmacist/first aid	Driver/transport

CPD HANDOUT 5: SCIENCE CURRICULUM LINKS TO JOBS, HOBBIES, AND INTERESTS

Job/hobby/interest	Science curriculum links
Example: sports fan	Forces including friction in shoe/glove/wheel design, properties of materials for sports clothing, nutrition, exercise, heart rate monitoring, conditions for growth of grass on pitch.

CPD HANDOUT 6: STEM CAREERS LINKS TO THE CURRICULUM

Year group(s): _____

Science Topic	STEM careers links

CLASSROOM ACTIVITIES

CLASSROOM ACTIVITY 1: SCIENCE CAPITAL DISCOVERY

AIMS

- To uncover science capital by exploring science related links to hobbies, interests, and our daily lives.
- To gain insight into the science capital of children to support lesson planning which takes children's own experiences into account from their own locality.
- To explore existing science knowledge, skills, and experiences.
- To raise awareness of and celebrate the variety and diversity of STEM careers.

30 mins (+ time at home depending on chosen delivery method)

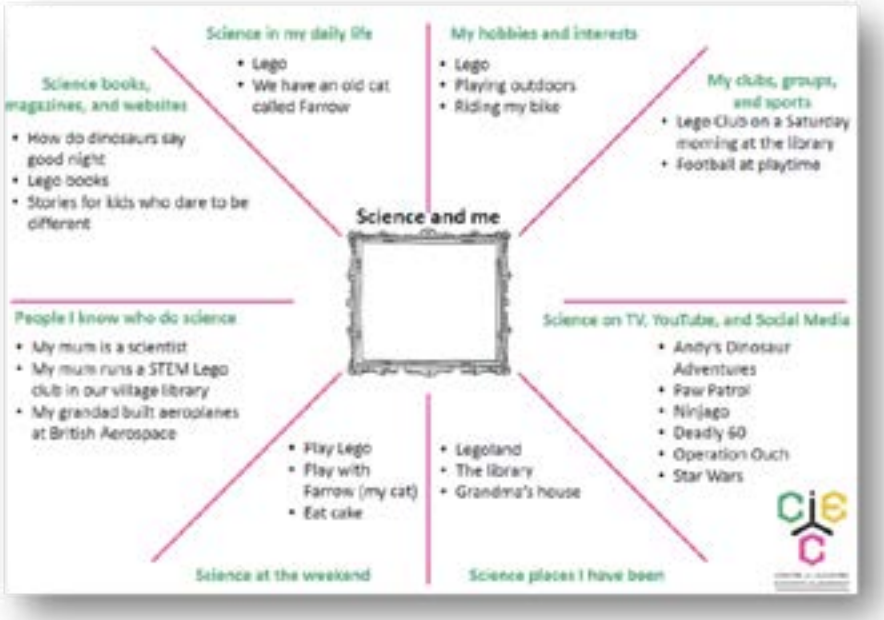
SCIENCE AND ME

RESOURCES

- Activity sheet 1.

ACTIVITY

- Present each child with a copy of **Activity sheet 1**. Discuss each of the eight sections and provide examples which children might include. The completed version here provides an example of how a child might respond to this activity.



The information gathered can be used to support science planning. Consider these different approaches when deciding how to carry out this activity:

'Getting to know you' transition activity	The beginning of a new school year, or transition sessions in the summer term, would be ideal opportunities to get to know the science capital of a new class.
Annual science or STEM event	If transition timetables are too busy then British Science Week (March), the Great Science Share (June), Children Challenging Industry programme, or other annual science themed event offer alternative opportunities for children to revisit their Science and me sheet to capture growing science capital and changing interests.
Revisit annually	Revisit this activity each year as part of the school's long-term provision for the development of science capital.
Family project	This activity works well as a family project to complete at home, especially for younger children or use it to form the basis of a parent/carer 'stay and play' session. For older children, consider beginning the activity in the classroom, then sending it home to be completed in discussion with family members. This will lead to a fuller picture of the science capital of each child.

For each section, ask children to think about the topics presented in a science capacity. For the sections 'My hobbies and interests', and 'My clubs, groups, and sports', children may record anything which fits the heading regardless of an apparent connection to science. This information will support identification of science links within their interests which children may not consider to be science-y.

EXPLORING TOPIC LINKS

30 mins

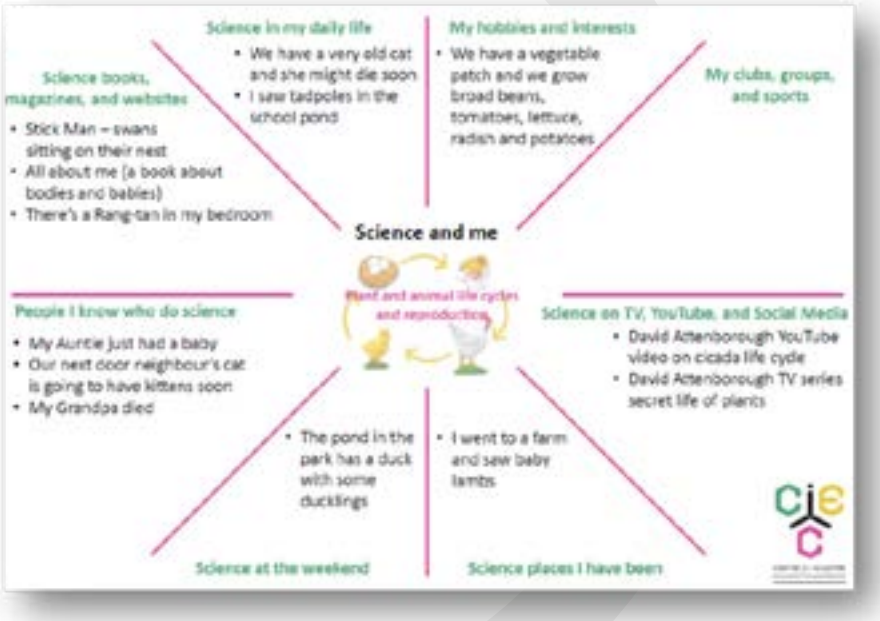
RESOURCES

- Activity sheet 2.

Before embarking on a new science topic, use **Activity sheet 2** to encourage children to explore their own knowledge, skills, and experiences which have links to classroom learning. Specific learning objectives do not need to be shared at this early stage; broad topic areas such as *plants*, or *space* will suffice.

Launching a new topic with this pre-learning task will draw out valuable information about the children's identities, lives, interests, and experiences, which can then be used to create lessons which are more connected to children's ow experiences and the area where they live.

The completed **Science and me (topic focus)** example here provides an insight into the sorts of responses children might contribute.



The information gathered can be used to support science planning. Consider these different approaches when deciding how to carry out this activity:

Individuals *UKS2*	Children complete the activity as an individual – this initial document could then be added to as the topic is explored or revisited at the end of a topic to demonstrate growth of science capital.
Groups *LKS2 and above*	Groups work together to discuss their ideas and jot their collective ideas down.
Whole class *EYFS and above*	Have a whole class discussion and annotate a class copy of the activity sheet.

STEM SELFIE

30 mins + (depending on chosen delivery method)

This makes a great home/family challenge or try it in school as part of a STEM day/week. Take the opportunity to turn the activity into a whole school competition with entries submitted via a learning platform or social media account and displayed on the school website or a centrally located display board. Some examples are included below or search online for more inspiration.

In EYFS, do this activity as a class or even through role play areas where children are encouraged to use STEM themed dress-up resources and props. If children have access to a camera, encouraged them to take their own STEM selfies or have an adult take the photographs for them.

Try this activity following a sustained period of raising awareness of STEM careers, perhaps towards the end of a school year where teachers have been working to embed STEM careers awareness into the curriculum.

Children can submit images showing themselves:

Participating in a STEM activity in school	Enjoying a STEM activity outside of school	**Sharing their STEM career aspirations**	**Dressed like a scientist/engineer**

CLASSROOM ACTIVITY 2: TEN STEM THINGS TO DO BEFORE YOU LEAVE PRIMARY SCHOOL

AIMS

- To know more about the STEM opportunities in my local area
- To connect more with the science in my day-to-day life and know more about the science experiences available to me

RESOURCES

- Activity sheet 3.

Visit a STEM/science museum or science exhibition, or event
Invite a scientist or engineer to visit your school and ask them questions about their job
Visit a company site or university science department to see scientists and engineers at work
Read about science and discuss it with your classmates and family and keep up to date with science in the news
Watch/listen to science related programmes and online content. Share what you have learned with others.
Take part in a STEM/science competition
Take part in national STEM events and citizen science projects with lots of other schools
Introduce a sustainability or environmentally friendly idea to your school
Take science learning outside of your classroom
Learn about Teesside's industrial heritage and the range of career opportunities available in our local area

This activity is best adopted as a whole school approach so that each year group can participate and have similar science related experiences. Be ambitious but realistic with what is achievable if deciding to take this on as a one-year challenge e.g. Ten STEM things to do before you leave Year 5.

A pre-written list of **Ten STEM things to do before you leave primary school** has been included here with some suggestion. An editable version is available to download separately to create your own list. Use this list as a starting point to discuss the activities which would best suit the school and the interests of the children.

1	Visit a STEM/ science museum, exhibition, or event.	• The Dorman Museum - Middlesbrough • Head of Steam – Darlington Railway Museum • Tees Cottage Pumping Station – Darlington • Bring it On – Engineering fair – Sunderland • Great North Museum – Newcastle • Discovery Museum – Newcastle • The Centre for Life – Newcastle • Kielder Observatory – Northumberland • Killhope Lead Mining Museum – Durham • Museum of Archaeology – Durham • Durham Mining Museum – Durham • Locomotion – Durham • Land of Iron - Skinningrove
2	Invite a scientist or engineer to visit your school and ask them questions about their job.	• Contact RTC North – STEM ambassador hub • Contact local companies, universities, or colleges • Explore the jobs and skills of those in your school community (teachers, governors, parents, carers) • STEM Directory – a database of providers offering a range of STEM enrichment to schools • EDF – Hartlepool power station and visitor centre • Teesside University – Primary schools' outreach • NEPIC directory – list of North East chemical industry companies
3	Visit a company site or university science department to see scientists and engineers at work.	
4	Read about science and discuss it with your classmates and family and keep up to date with science in the news.	Science Reading (books and magazines) • Create a science section in your class reading area • Links for science books • Join the Royal Society YPBP judging panel here • Whizz Pop Bang magazine • Aquila magazine • Books for topics (Science) • @MrsF_Primary – Literacy in Science • That Science Lady – Science Story List and Diverse Representation in Science • Teaching science through stories Science in the news – local, national, and international • Newsround • First News • National Geographic Kids – website and magazine • Topical Science Updates • PSTT – I bet you didn't know… • Twig science reporter

5	Watch/listen to science related programmes and online content. Share what you have learned with others.	• Explorify • Podcasts E.g. Brains on!, But why?, Smologies • YouTube e.g. Bill Nye Science Guy • Brainiac • Operation ouch • Lead an activity with younger children • Have a go at a science activity at home with family or friends: IndusTRY AT HOME, Marvin & Milo, Science Bob, The Royal Institution, Science Museum, NUSTEM – STEM at home, Starters for Science, Science fun at Home, Science for One • Safely repeat a classroom activity at home
6	Take part in a STEM/science competition.	• Bridge building • Design an invention • Make a poster • CLEAPSS competitions • British Science Week poster competition • STEM selfie • Dress as a scientist/engineer • Greenpower Education Trust – design build and race a Goblin Kit Car • NEPIC – Primary School Environmental Award • F1 in Schools
7	Take part in national STEM events and citizen science projects with lots of other schools.	• British Science Week • The Great Science Share • National Careers Week • The Bulb Project • Big Garden Bird Watch – RSBP • Apply for a Blue Peter 'Green Badge' • Royal Society Partnership grant • British Ecological Society • Mammal web

8	Introduce a sustainability or environmentally friendly idea to your school.	• CIEC's Sustainability Resource • Start recycling in your class/school (e.g. paper, plastics, batteries, ink cartridges) • Research renewable sources of energy (e.g. solar panels, wind turbines, heat pumps etc.) • Set up a book swap shop • Apply for the Woodland Trust Green Tree Schools Award • Work towards the Eco-Schools Green Flag award • Set up an eco-committee • Royal Society – climate and the environment classroom resources • WWF – Learn tab • Practical Action
9	Take science learning outside of your classroom.	• Plant seeds and watch them grow • Explore the habitats of local wildlife • Experiment with forces with a trip to a local park • Create a scale model of the universe in an outdoor space • Go pond dipping • Learn bushcraft/survival skills • Visit a local secondary school or college for a science lesson • iNaturalist UK – animal and plant identification app • iSpot – website – help anyone identify UK wildlife • Nature Detectives
10	Learn about Teesside's industrial heritage and the range of career opportunities available in our local area.	• Create a school mural which depicts your local area and includes any connections to local industry. • Invite representatives from local industry to speak with children about their jobs

If you would like an editable template for 'Ten STEM things to do before you leave primary school', please get in touch with us ciec@york.ac.uk.

Here are some ways you might use this resource:

Staff	The example pre-written list of activities is shared with staff and discussed. A reduced list of ten STEM things is agreed.
Class discussion	Teachers share the pre-written list with their classes for discussion. Children select the ten STEM things they would like to do from the list or make their own suggestions. Hold a vote to agree the final ten STEM things.
Personalise	Create a personalised list based on discussions with staff and/or children and create a passport to be stamped as children progress through school.
Display	Create a whole school display, mapping each year group's science capital experiences. This could be updated annually with photos, work samples, and children's comments.
Big book	Have each class or year group start a 'big book' to chart their science capital experiences across their time at primary school. This could also work as a subject specific collection of evidence which the Science Subject Leader curates.

CLASSROOM ACTIVITY 3: CONNECTING WITH SCIENCE

AIMS

- To recognise the science which is relevant to our daily lives.
- To recognise the science in our interests, skills, and experiences.
- To share the 'expert' knowledge we have about our hobbies, skills, and special interests.

30 mins initially (+ time when required throughout KS1-KS2)

MY SCIENCE JOURNEY

Children complete a science journal ideally over several years, or over the whole period they are in school, but certainly for at least a year. This is a personal record and exploration of their own science experiences interests, and a place to chart their changing ideas and attitudes as they grow and learn. Separate from any class 'big book' or individual exercise book, a journal belongs to the child and is a personal record and exploration of their own science experiences interests. This personalised record follows each child throughout their time in primary school, reflecting their changing ideas and attitudes.

Journals might include photographs, sketches, and annotations which reflect each child's personal engagement with the topics they are learning in the classroom as well as their own developing personal interests in relation to science. These journals would be especially useful to revisit at the beginning of each new topic so that children could draw on prior learning and aid recall.

Making provision for the journals to be taken home once per half term will support science discussion with families and the building of science capital through increased home-school engagement. Encouraging children and their families to add to the journal would show real valuing and linking of the children's interests and experiences.

SCIENCE, SCIENCE EVERYWHERE

45 mins initially
(+ time to revisit as appropriate)

Create a space in the classroom (wall display or table-top) for children to share their ideas and experiences which capture all the various ways science is relevant to our everyday lives. Anything is acceptable providing there is a link to the science topics the class study. This is a great outlet for show-and-tell requests and an opportunity for classes to build their collective science capital.

Contributions from the children might include the following:

personal stories	photographs	drawings
models	diagrams	questions
jokes	crafts	news stories
poems	museum visits	hobbies
Recommendations for:		
books	TV shows	podcasts
YouTube channels	magazines	Films

This working-wall style display would create a meaningful space for students to share science themed show-and-tell items. It could also be used to identify guest speakers for future science lessons (children or family members).

Children will benefit from an introduction to the display to provide some guidance on what can be included but creativity should be encouraged. Also consider how often to allocate class time to enable children to engage with each other's contributions.

A benefit of investing classroom time in this display would be

Depending on the children's contributions, particular ideas may be identified to explore as a class in lesson time, or questions may arise to incorporate into lesson plans.

ASK ME ABOUT...

1 hr initially
(+ time to revisit as appropriate)

We all know of that one child who has an encyclopaedic knowledge of dinosaurs or can list fifty facts about space without coming up for air, but some children, particularly the shy ones, can sometimes keep their hobbies and interests a little more hidden. This activity will give prominence to and value each individual's special interests for all to celebrate, encouraging everyone to find their voice within science lessons.

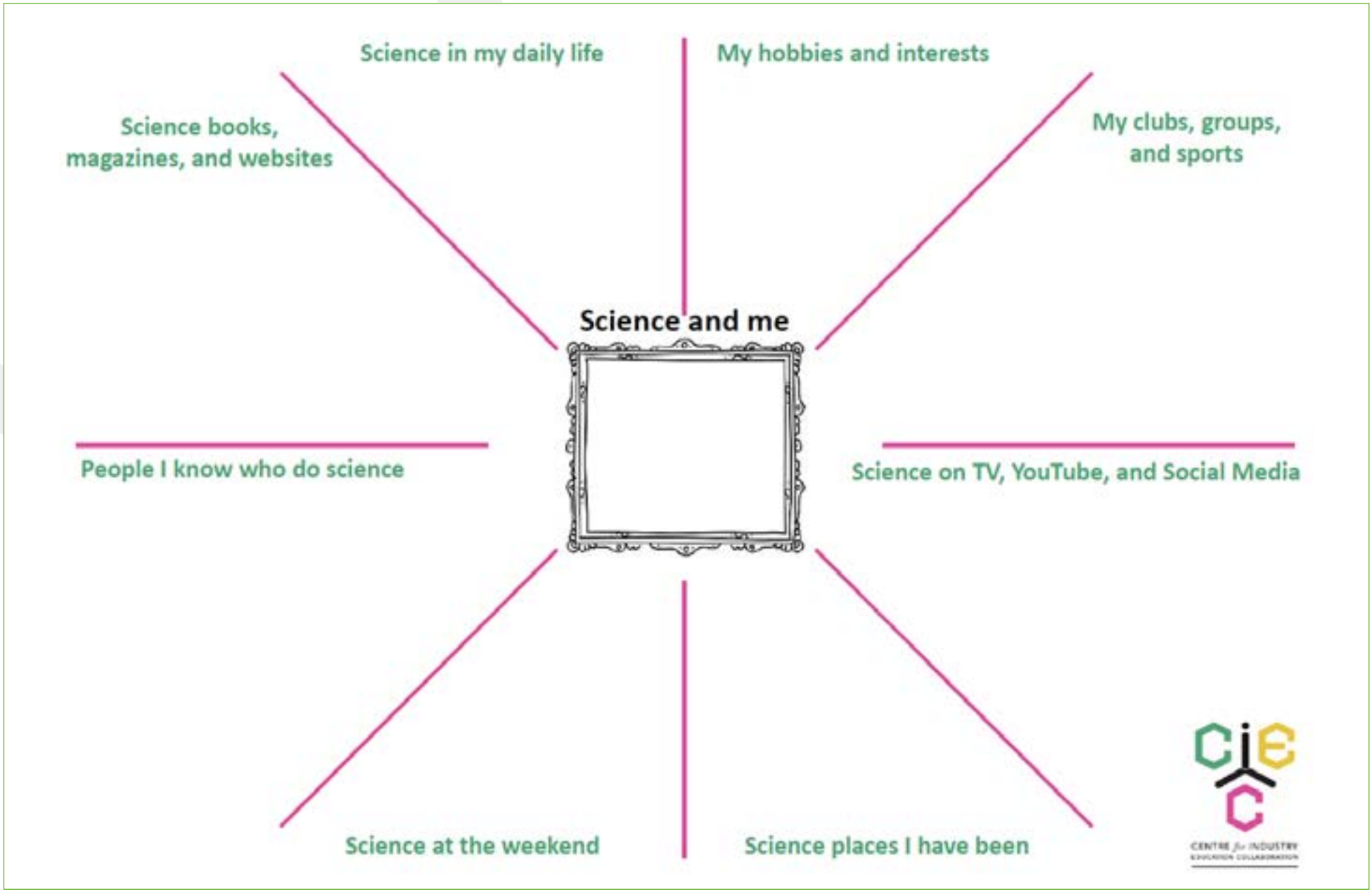
Create a classroom display titled 'Ask me about…' which features every child in the class. A simple drawing or photograph will work well, or children could dress as an expert in their chosen field or pose to showcase their special hobby or interest. Creative use of photoshop as part of a computing project would allow children to digitally inhabiting an environment inspired by their interest.

Surround each child's image with pictures and words denoting the things they love and explain all about. Here are some popular examples:

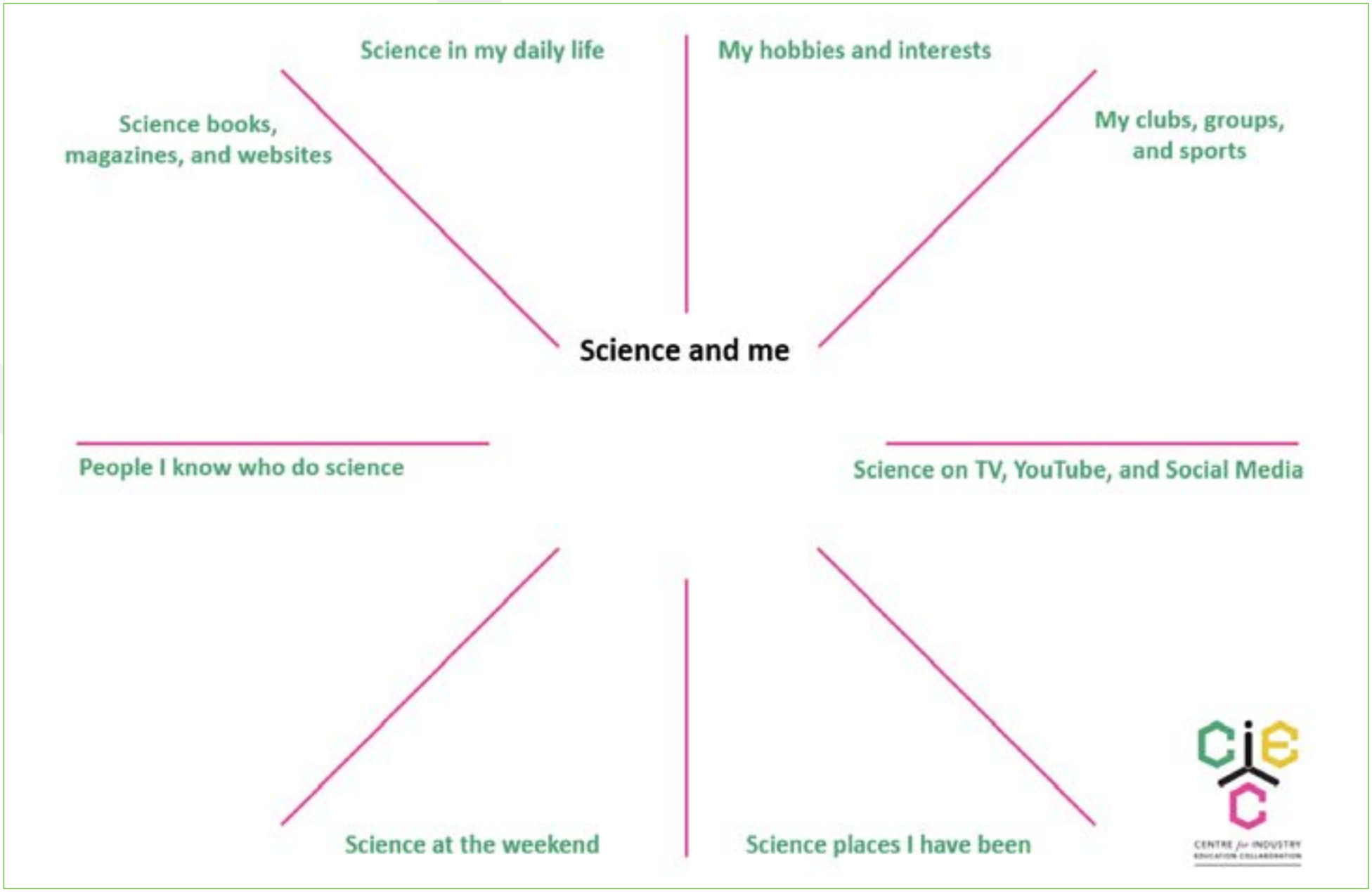
football	dancing	baking
gardening	rugby	gymnastics
skateboarding	growing vegetables	fishing
pet care	Lego	judo
drawing/painting	hiking	camping
dinosaurs	bike riding	Minecraft
space	horses	swimming
rocks	playing an instrument	bugs

Use the display throughout the year to call on experts to add their unique insight into lessons spanning the curriculum and beyond.

Activity Sheet 1: Science and me



Activity Sheet 2: Science and me (topic focus)



Activity Sheet 3: Ten STEM things to do before you leave primary school

	Activity	Suggestions and resources to help
1	Visit a STEM/science museum, exhibition, or event.	
2	Invite a scientist or engineer to visit your school and ask them questions about their job.	
3	Visit a company site or university science department to see scientists and engineers at work.	
4	Read about science and discuss it with your classmates and family and keep up to date with science in the news.	
5	Watch/listen to science related programmes and online content. Share what you have learned with others.	
6	Take part in a STEM/ science competition.	
7	Take part in national STEM events and citizen science projects with lots of other schools.	
8	Introduce a sustainability or environmentally friendly idea to your school.	
9	Take science learning outside of your classroom.	
10	Learn about Teesside's industrial heritage and the range of career opportunities available in our local area.	

INFORMATION BANK

CIEC PUBLICATION LINKS TO INDUSTRY VISITS AND VISITORS

If you are considering a visit to an industrial site and feel unsure where to begin, read Mackayla Millar's open-access article Site-seeing to inspire primary children published in the ASE's Primary Science journal for some pointers to help get you started.

CIEC Publication	Age-group	Suitable if learning about	Can be used to accompanies a visit to/from
A Pinch of Salt	7-9, 9-11	States of matter Solutions, evaporation, and filtration	Brine fields Rock salt industry Local council
Career Cards	9-11	STEM careers Industry	Links can be made to all forms of visit or visitor linked to STEM careers and industry in general
Cough Syrup	9-11	Materials Microorganisms linked to the development/manufacture of medicine	Pharmaceutical development lab or manufacturing site Bio-technology company Hospital, doctor's surgery, or pharmacy
Feel the Force	9-11	Forces Sustainable transport	Haulage or logistics company Shipping port
Forces and Recycling	7-9, 9-11	Forces Recycling	Recycling plant Council recycling centre (tip/rubbish dump)
Generating Electricity	9-11	Electricity Renewable energy	Power plant (electricity) Local technology company (sensors)
Healthy Drinks and Tasty Toothpaste	7-9	Teeth Oral hygiene Toothpaste recipes and manufacturing	Dentist/dental hygienist Dental hygiene product developer/manufacturer
IndusTRY AT HOME	5-7, 7-9, 9-11	STEM careers Industry Various curriculum links	Various – please visit website for more information

Is There Anyone Out There	9-11	Space	Space exhibition at a museum Aerospace/aeronautical engineering company Astronaut video call
Kitchen Concoctions	7-9, 9-11	Recipes, ingredients and products Devising, making and following recipes	Development labs or manufacturing sites for products relating to personal care, food and drink, cosmetics, medicines, cleaning etc.
Medicines from Microbes	9-11	Microorganisms linked to the development/manufacture of medicine	Pharmaceutical development lab or manufacturing site Bio-technology company Hospital, doctor's surgery, or pharmacy
Medicine for Pets	7-9, 9-11	Materials Animals	Development lab or manufacturing site for pharmaceuticals Bio-technology company Veterinary practice or animal hospital
Oil for Beginners	5-7	Sustainability Renewable and non-renewable energy	Oil processing plant
Plastics Playtime	9-11	Plastics recycling Sustainability	Plastics manufacturing site Car manufacturing site Recycling plant Council recycling centre (tip/rubbish dump)
Potatoes to Plastics	9-11	Reversible and irreversible changes, sustainability, the environment	Bioplastics manufacturing site
Renewables Don't Run Out	7-9, 9-11	Sustainability Renewable and non-renewable energy	Renewable energy plant Biomass power station or generator
Rough Guide to Gas	9-11	Properties of materials States of matter	Gas processing plant Oil rig Healthcare/hospital setting (using medical gases)
Runny Liquids	7-9	States of matter Properties of materials	Bio-technology site Industry where viscosity of liquids is measured

Science of Healthy Skin	9-11	Properties of materials Personal care Recipes, ingredients and products Devising, making and following recipes	Development lab or manufacturing site for personal care products
Smart Bricks for Smart Plants	7-9	Plants Nutrition	Fertilizer production plant Tomato growing plant Garden centre/nursery Farm
Turf Troubles	7-9	Plants Requirements for plant growth	Local sports centre, stadium, park etc Garden centre/nursery
Water for Industry	9-11	Water Heating and cooling Filtration Properties of materials	Industrial site using cooling water systems Water treatment/filtration plant Civil engineer visit/talk Gas processing plant

ONLINE STEM CAREERS RESOURCES

Provider/Organisation	Resource(s)	More information
The Association of the British Pharmaceutical Industry (ABPI)	Job case studies	Written for an adult audience, these case studies could be used to show children the range of career options open to them in the pharmaceutical industry.
Meet the future you	Engineer career profiles Career skills quiz	Fun website showcasing different roles in engineering matched to children's interests and skills. Answer a few short questions and find out how your skills and passions could lead to an exciting job in engineering.
National Careers Service	Explore careers	Government careers search tool designed for public use. Could be used by teachers to demonstrate the range of career opportunities available or focus on careers linked to areas of study. Provides information such as average salary, typical working patterns, career pathways, and what the job will involve.
Neon Futures	Engineering careers resources	Various downloadable leaflets, posters, postcards, booklets, and activities to inspire children to explore engineering. Resources can also be ordered in print, free of charge from the website. Highlights below.
	Postcards: Find your route into engineering	8 postcards showing exciting areas where engineers are making a difference: electronics, medicine, power, products, space, sport, transport, and water.
	Booklet: From idea to career	A guide to 12 different engineering disciplines to help children work out which area(s) might be right for them.
	Poster: 100 jobs in STEM	A popular poster highlighting 100 exciting job roles that link to STEM.
	Booklet: What is engineering?	A booklet that helps children and their teachers understand engineering.
	Presentation: Engineer your future	A PowerPoint presentation for teachers, advisers, and ambassadors to use to inform and inspire young people about a career in engineering.

NUSTEM	Primary Careers Tool	A carefully curated database of over 100 STEM careers sorted by National Curriculum topic in Science and Maths.
	STEM Person on the week	A STEM engagement activity that reduces provided counter-stereotypical character attributes through a set of diverse STEM role models. This resource equips teachers with everything they need to effectively run this 5-week intervention in their school setting. The resource is simple to use and suitable for children in years 1-6.
The Ogden Trust	Phizzi Professionals	The Phizzi Professionals series of downloads gives an insight into career pathways from physics. There's even a blank template.
Primary Science Teaching Trust (PSTT)	A Scientist Just Like Me	Designed to raise awareness of diversity in science-related jobs and to provide illustrated examples of a wide range of science-based careers. It consists of a series of short slideshows, each one telling the story of a particular scientist or person working in a science-related job. The resources focus on the skills, attitudes and habits that are needed to carry out the work.
	Science at Work	Activity sheets and accompanying videos about past scientists or people who worked in science related jobs which include information and links to find out more.
Royal Meteorological Society	Exploring climate change careers	A collection of YouTube videos. Hear directly from a diverse group of people working in climate science and engineering to find out about their roles, why they think it's important, and the paths they took to their jobs.
That Science Lady	STEM Careers List	Organised by National Curriculum topic to develop children's awareness of the range of STEM careers available to them. Intended for use by teachers to select careers linked to their current science topic and discuss these with children.

TEES VALLEY AND NORTH EAST STEM OUTREACH PROVIDERS

Provider/ Organisation	Area(s) covered	Outreach offered	Description	Age group	Cost	Find out more and book your place
Bring It On	North East	Event Resources	Annual 2-day exhibition for future engineers in the North-East. Venue: Stadium of Light Videos showcasing the diversity of engineering careers	UKS2	Free (12 tickets per school)	Email: info@bringitonne.co.uk Use the 'Contact Us' button on the Bring It On website
CIEC	Tees Valley North East UK + beyond	Classroom sessions STEM ambassadors Teacher CPD Teaching resources Home resources	Children Challenging Industry programme (UKS2) fully resourced problem-solving classroom activities and interactive site visits to industry. Range of free primary science curriculum-linked teaching resources.	EYFS/KS1/ KS2	CCI - £300	Visit the CIEC website Email: ciec@york.ac.uk
Engineering Together	Tees Valley	Teaching resources Virtual and in-person talks	Various STEM resources and climate activities on the website. On request, local STEM ambassadors can speak to schools about careers now and in the future, including green careers.	EYFS/KS1/ KS2	Free	Email: we.are.engineering.together@gmail.com
Gemma Warner	Tees Valley	Workshops (in-person)	Bridge and tower building workshops, and career talks delivered in-person by a local civil/structural engineer. Workshops can be tailored to suit audience, including SEND classes.	EYFS/KS1/ KS2	Free	Email: gemmawarner@hotmail.com

Neon Futures	Tees Valley National	Workshops (in-person) Teaching resources	Range of exciting engineering experiences inspiring careers resources and stories that showcase modern engineering – primary suitable workshops include: • Logistics factory – ages 5-19 • The pipe bridge challenge – ages 8-19 • The energy car challenge – ages 8-19 Range of career resources available to download from the Careers Resources page	KS1/KS2	£200-£300	Apply online by selecting the required activity on the Neon Futures 'Experiences' webpage
Newcastle University	North East	Workshops (virtual)	Selected workshops previously in-person, adapted to be delivered virtually via Teams or Zoom: • Think Like a Scientist (Y5-6) • Young Scientists(Y3-4) • Ask Our Students (Y3-6)	KS2	Free	Use the 'Book Now' button on the Newcastle University website
North East Raising Aspiration Partnership	North East	Lego Engineering	Children explore STEM careers and take a closer look at engineering through the use of Lego, and try their hand at designing, building and racing their own vehicles in a fun competition.	UKS2	Free	Email: info@nerap.ac.uk Or create a teacher account and complete an online booking form on the NERAP website
North East STEM Hub		STEM ambassadors Teaching resources Equipment loans	Request a STEM Ambassador to come into your classroom, either face-to-face or virtually, free of charge. A wide range of STEM resources available for schools to hire as part of our Kit Club. From robotics kits to full size skeletons and microscopes. Our kits are designed to complement the curriculum and inspire students about STEM subjects.	EYFS/KS1/KS2	Free	Visit the North East STEM Hub 'Teachers' webpage to find out more.

Northumbrian Water	North East	Teaching resources Site tours Talks	A range of resources to support teachers in delivering curriculum linked activities and experiences. • Site tours are suitable for classes of up to 30 Y5-6 children (currently suspended due to covid but plan to return)	EYFS/KS1/ KS2	Free	Visit the Northumbrian Water 'Teachers' webpage to find out more
NUSTEM	North East	Workshops Teaching resources Teacher CPD Loan boxes Classroom resources Home resources	Northumbria University STEM outreach programme. Check out their Primary page to see all the different ways they are: • Supporting Children • Supporting Teachers • Supporting Families	EYFS/KS1/ KS2	See website for costs for individual elements	Visit the NUSTEM 'Primary' webpage
Primary Voices	Tees Valley	Virtual and in-person talks	Careers and climate change talks to inspire children to undertake climate action. Primary Voices uses plain language to provide key facts and demonstrates how everyone is part of the solution. Each short YouTube clip is accompanied by a Worksheet.	EYFS/KS1/ KS2	Free	Email: primary.voices@gmail.com
Spark Tees Valley	Tees Valley North East UK + beyond	Resources Workshops	Workplace related resources linked to curriculum specific objectives or topics with an emphasis on careers and role models in local workplaces.	EYFS/KS1/ KS2	£325/year School support packages available	Email: andrew@sparkteesvalley.com

Warburtons	Tees Valley National	School visits Teaching resources	Practical, informative learning experiences which teach the importance of a balanced diet, hygiene and safety, food waste and basic food preparation in an enjoyable and creative way. • Site tours are currently suspended due to covid	EYFS/KS1/ KS2	Free	Visit the Warburtons School Visits and Teaching Resources websites for up to date information.
WES Lottie Books	Tees Valley	Downloadable books Virtual and in-person talks	Three free to download books with prompts to everyday climate actions written by a local author. Book reading by the author to inspire young people into STEM careers through the WES Lottie Tour.	EYFS/KS1/ KS2	Free	Email: teesandtyne sidecluster@wes.org.uk

APPENDICES

APPENDIX 1: TAKE YOUR SCIENCE TEACHING TO THE NEXT LEVEL: STEM VOLUNTEERS IN THE CLASSROOM

Take your science teaching to the next level: STEM volunteers in the classroom

Jane Winter describes the impact that STEM professionals could have in the primary classroom, and shares some tips for how to get started

Figure 1 Scientist at work: Meeting people from the world of work helps children to understand the relevance of science beyond the classroom

As you have chosen to read this, you are probably enthusiastic about teaching science and you probably teach above average science lessons in terms of children's engagement and progress. You are more likely than the 'teacher in the street' to have heard of Science Capital and to know that, as well as ensuring enjoyment and learning in science lessons, it is important to raise children's aspirations and to help them to understand that science is relevant to their lives both now and in the future. However, I wonder if you have dipped your toe into the wonderful world of inviting STEM professionals (volunteers from science-based industries, universities, etc.) into your classroom? Are you ready to push yourself out of your comfort zone to work with a stranger and welcome them into your classroom to give your science teaching a whole new dimension? The logistics of finding someone and then arranging a mutually convenient time can appear daunting, combined with fact-handing over control of some of the lesson. So, do the benefits make the effort worthwhile?

A little effort reaps huge rewards

Teachers who have taken the plunge report that working with STEM professionals leads to deeper engagement and more 'sticky' learning. Remember the proverb 'Tell me something and I will forget, show me something and I may remember, involve me and I will understand'? If you want children to *really* understand that science is done by 'normal' people and is something that they could aspire to, letting them meet and interact with real live scientists is unsurpassed. Moreover, if children see links between the science that they do in school and a real-life context, the experience becomes more meaningful and relevant to their lives. Children often learn more, and retain this learning for the long term.

Key words: STEM volunteer ■ STEM professional ■ Ambassador ■ Science capital

	Potatoes to Plastics (without a STEM volunteer)	*Potatoes to Plastics* (with a STEM volunteer)
Links to Year 5 (age 9-10) curriculum	Yes	Yes
Cross-curricular introduction	Children read and write about STEM professionals in an English lesson.	As well as reading about STEM professionals, children meet and interview one before writing a report about them in an English lesson.
Introduction to main activities	Teacher tells children about how science can be used to find solutions to environmental problems. She gives the example of extracting starch from potato peel and gives children instructions to do this.	Children meet a scientist who shares some of the solutions to environmental problems that she and her colleagues have been working on. She tells them how to extract starch from potato peel and tells them that she will be coming back to show them what to do with it.
First activity	Class teacher supports children to extract starch from potato peel following instructions from CIEC publication.	Class teacher supports children to extract starch from potato peel following instructions left by the scientist.
Second activity	Class teacher supports children to turn potato starch into bio-plastic following instructions from CIEC publication. She heats the mixture for them in a saucepan on a cooker.	Class teacher and scientist work together to support children to turn potato starch into bio-plastic. The scientist brings in a magnetic hotplate, which she demonstrates to children before using it to heat their mixtures. During the activity she also answers children's questions about her job and shares anecdotes from her experience.
Final investigation	Children test their bio-plastic and send their findings to a fictitious company. (If the findings are sent to CIEC, the children will hear back from the 'company' who will thank them for their contribution to research and development.)	Children test their bio-plastic and send their findings to the scientist. She promises the children to pass on their findings to the Research and Development department of her company. In due course, the children hear back and are thanked for their useful contribution.

Figure 2 An example of a science activity with and without a STEM volunteer

A tale of two science lessons

Figure 2 uses CIEC's latest primary science publication, *Potatoes to Plastics*, to exemplify the differences between carrying out a set of science activities in the classroom both with and without the support of a local STEM volunteer. As we already know, lessons without

Figure 3 A STEM professional can bring specialist equipment into the classroom. Here, a magnetic hot plate is being used, which simultaneously heats and stirs the liquid

the input of STEM professionals can be engaging, effectively cover the science programme of study and support children to understand that science has an important role to play in their lives. This example links closely to the Year 5 'materials' strand of the curriculum and is also topical, as it shows how a waste product, potato peel, can be turned into a biodegradable alternative to a fossil fuel-based product. One might have thought that it would be hard to improve on this science experience in terms of engagement, learning and relevance.

However, Figure 2 demonstrates how the input of a STEM professional can take the learning experience to the next level, in many ways. Getting to meet a real-life scientist does more to dispel stereotypes than any other experience that you can give children in school. Furthermore, if that scientist tells children about how they use aspects of science familiar to the children in their work, the school curriculum becomes more meaningful to the children, raising Science Capital whilst increasing long term retention of learning. Teachers often tell us that when they are reviewing the year with children in July, it is the work with STEM volunteers that children recollect most enthusiastically, which leads to secure learning that can be built upon in subsequent years.

First: catch your scientist

The easiest place to try to locate a STEM professional can be within

It is second nature for teachers to use a variety of tools to help children learn. Teachers choose their vocabulary carefully, repeat instructions in a variety of ways and use non-verbal reinforcement to clarify meaning. This reduces the cognitive load for children as they grapple with fresh ideas and concepts. However, it is not possible to pass this experience on to visitors when we welcome them into our classrooms. I once attended an assembly run by an enthusiastic and well-meaning engineer from a local power plant. Sadly, even the teachers in the audience didn't understand most of what he said, let alone the Key Stage 1 (age 5-7) children sitting in the front row!

CIEC's 30+ years of experience providing training for scientists and engineers to work with primary school children can help. CIEC's team supports potential volunteers to develop the skills to enable them to communicate effectively and confidently in the classroom. CIEC's CPD team identifies activities that will make strong links between the primary science curriculum and the science that takes place in a particular workplace (see Figure 5). This service is often commissioned by companies who would like to develop the effectiveness of their schools' outreach team. CIEC can also support groups of schools that want to get the best possible results from inviting STEM professionals into their classrooms.

When volunteers have developed their role in partnership with CIEC, the impact on the children has been very high. STEM professionals also tell us how much more meaningful the interaction is for them, as a result of CIEC support. They feel more confident going into the classroom, as well as having the satisfaction that their more skilled approach is having a positive impact on children's lives. Moreover, collaboration with CIEC maximises the development of skills that they take back to the workplace – benefiting both themselves and their employers.

Figure 4 Lightening the load with CIEC

the school community. Send a letter to families and ask colleagues about relatives or friends who have STEM careers. This approach can lead to two different groups of people coming forward. Firstly, you may have offers from people who use the products of science at work. For example, hairdressers use a range of chemicals that would be harmful if the correct procedures were not followed. Motor mechanics need to manage the use of products in engines as well as understand the physical laws of motion. If you have volunteers in this group, try a cross-curricular English-focused activity. Groups of children interview these volunteers about their jobs and share written reports. The quality of children's work tends to be higher when children plan these interviews in advance, planning questions that they would like to ask and giving volunteers notice of the questions.

Real-life STEM application	CIEC publications	Link to the National Curriculum
Aeronautical Engineering	*Feel the Force*	Forces
Growing the microorganisms needed to make antibiotics	*Cough Syrup* *Medicines from Microbes*	Living things
Environmental Science	*Sustainability or Potatoes to Plastics*	Living things and their habitats
Agronomy	*Turf Trouble*	Plants
Power Plant Engineering	*Generating Electricity* http://www.ciec.org.uk/resources/generating-electricity.html	Electricity
Veterinary Science	*Medicines for Pets*	Materials

Figure 5 Bridging the gap between real-life applications and primary science

Children do benefit from meeting a range of people who use science in their jobs, as it helps them to understand the relevance of science to their lives and raises their Science Capital. However, the focus of this article is on a second group of volunteers. These are people who need STEM qualifications to do their jobs, including scientists and engineers. When asking for such volunteers, you may be surprised by the range of careers represented in your school's wider community. In my own experience, I have met a quality control specialist working in a food factory, a radiographer from a hospital, an environmental scientist working for the council and an agronomist who supports farmers to get the best yields from their crops. You cannot really have too many STEM volunteers as, ideally, every class in the school should get to work with at least one STEM professional every year – so don't turn anyone down!

Making use of contacts is a good first step towards developing the school's broad link with the STEM world of work. However, to find the exact scientist who you want to carry out a specific activity, contact a local organisation that employs STEM professionals, such as a science-based industry, a university or a military station. If you are lucky, you will find that the organisation that you have approached encourages their employees by allocating time each year to participate in schools' outreach. Companies wish to support their local community, whilst raising awareness of what the company does and the range

Figure 6 Two-way benefits: children learn from STEM professionals, and CIEC's volunteers value the experience and enrichment to their working lives

Figure 8 Thank you letters are often treasured by the STEM volunteers who receive them

of careers that they have available. There are also nationwide initiatives, such as STEM Ambassadors, which might lead to you locating the right person to visit your school.

With the advent of modern technologies, it is possible to arrange for children to have virtual contact with scientists who live further away. With geographical barriers removed, children can meet specialists who might not be present in your local area, and possibly for more than one meeting. The recent experience of the CIEC team has shown that working remotely with scientists is a positive experience for everyone concerned. However, we would always counsel that face-to-face meetings are preferable for that real 'wow factor' memorable learning, with remote meetings supplementing, rather than replacing, professionals' in-person visits to the classroom.

Figure 7 Many activities link primary science with real-life applications

Following the visit, by way of thanking the STEM professional, children write letters, providing a real audience and purpose for this literacy task. These are often treasured by the recipients, and may well increase your chances of persuading your STEM professional to come back to your classroom the following year (Figure 8).

Cross-curricular support

The *Potatoes to Plastics* resource described above includes magazine-style articles written about some of the scientists working in the Chemistry Department at the University of York. These are designed to be used in an English lesson, with literacy-learning objectives. Another article written about an 11 year-old boy is intended to inspire children to write about themselves as future scientists. Both activities can support teachers to address the thorny issue of being expected to produce science writing to the same standard as writing in English lessons, as well as incidentally raising Science Capital. These activities are a useful supplement to working with STEM professionals in the classroom, but cannot replace the magic of this experience.

Now you have read about the opportunities that working with STEM professionals could open up for you and your class, what are you waiting for? I have no doubt that once you have dipped your toe in the water, you will never look back.

Jane Winter has been a Professional Development Leader with CIEC since 2014. She believes that a good science education starts from Early Years and loves supporting teachers throughout the primary age range to deliver inspiring science experiences.
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Site-seeing to inspire primary children

Mackayla Millar explores the benefits of industry site visits to enrich the primary curriculum

Figure 1 Children enjoying a site visit

Educational visits are always a highlight of any school year, with museums, historical experiences and outdoor activity centres often winning in the popularity stakes, but have you ever considered a visit to a local manufacturing plant or science laboratory? You might feel that this would be a health and safety headache best avoided, or perhaps that a class full of excitable children may not be welcome in such an environment, but you might be pleasantly surprised on both counts. With guidance from the CIEC team, scientists, engineers, and technicians working at local industrial sites are often very keen to share their workplaces and passion for STEM careers with the next generation.

Safety first!

Risk assessments are a necessary part of any educational visit. They can be time-consuming and a real source of worry, especially when planning a visit to an industrial plant where there can be many perceived dangers. However, companies inviting children onto site will have undertaken rigorous risk assessments; your job is simply to assess the journey to and from the site as you would with any other visit. You may even be greeted in a classroom-style environment, which your class can use as a base, and find that protective equipment is provided for those all-important real-world experiences (see Figure 2).

A company with which CIEC work in the North East, Johnson Matthey, runs a great child-friendly activity that involves the children themselves in the risk management process. Children are supported to analyse potential hazards and the likelihood of them happening, drawing on examples that they can easily visualise, such as falling over in the playground compared to a piano falling from the sky! Wherever you visit, you can rest assured that companies will only take you to locations that are safe to visit, and you will be briefed on any rules to follow.

What will we see?

There are lots of different environments that you may encounter on a site visit. Production areas and factory floor tours are often included, where children can observe the busy working environment and see products at various stages of manufacture. You might see heavy machinery or robots in action, receive a demonstration of

Figure 2 Children wearing PPE during a visit to an industrial site

Key words: Industry, Site visit, STEM careers

Figure 3 Children getting hands-on with specialist equipment

specialist scientific equipment, or even be given a chance to operate tools, programme using Computer Aided Design (CAD), or carry out experiments under careful supervision. These types of hands-on experiences (see Figure 3) enable children to undertake a safe and simplified version of the work carried out by scientists, engineers and technical staff.

Control rooms are another possible element of a visit to industry (see Figure 4), presenting an opportunity to see the beating heart of a site with an impressive array of sensor technology under continuous monitoring, and communication devices relaying messages around the site or sometimes around the country. Companies may mock up a control scenario on computers for children to explore and find out what happens if, for example, a valve does not fully close, and an alarm sounds to signal that action must be taken. Science laboratories are also fascinating spaces to explore (see Figure 5) and present opportunities for children to use key investigative skills such as controlling variables, repeat testing and recording precise measurements.

Enriching the curriculum

Site visits can be an exciting addition to a broad and balanced curriculum and require some careful consideration to ensure that they build on your classroom learning experiences in a meaningful way. By doing a small amount of research to find out what a company does and what products they make, you can establish tangible links to the National Curriculum topics and 'working scientifically' objectives. The CIEC website has an extensive range of free resources, which pose real-world challenges set within an industrial context for children to solve, all of which sit within the scope of the National Curriculum (see Jane Winter's article on page 30 to find out more about CIEC's resources).

For schools in the North East, Humber and the East of England, these resources form the basis of our flagship Children Challenging Industry programme, which links classes of 9-11 year-olds to companies and STEM ambassadors in their local area. This exciting programme provides unique STEM learning experiences that make the world of local industry real and relevant to pupils' everyday lives.

Virtual site visits

So far, I have very much focused on the benefits of in-person visits to industrial sites and the excellent ways in which they support pupil engagement and provide insights into STEM careers. Children get to see first-hand the scale of industrial operations, which can range from the microscopic to the colossal and might otherwise prove to be incomprehensible (see Figure 6). However, in-person visits may not always be possible; coaches can be expensive, some sites are just not child-friendly, and some children may be unable to access an industrial site due to specialist physical or sensory needs. So what are your options?

Figure 4 Children visiting a control room

Figure 5 Children visiting a lab

Figure 6 Pupil taking in the incredible size and scale of an industrial site

In 2020, and for the first time in its 25-year history, the CCI programme went virtual, bringing the scientists and engineers direct to the classroom via online video conferencing platforms (see Figure 7). The coronavirus pandemic presented some very challenging hurdles to the usual format (classroom lessons followed by a visit to site), and so, with a great deal of creativity and co-operation from our wonderful industry partners, we have been able to provide virtual site visits to participating schools. Whilst there have been some drawbacks, there have also been many unexpected positives.

No physical visit meant that companies have been able to take an 'access all areas' approach and show children parts of their site that would not be suitable to visit in person. For companies who operate across multiple sites, it has been possible to introduce classes to lots of different people from across the business whom they otherwise would not have met. Less time spent walking around sites has meant more time for discussions around career pathways and the skills that someone might need to be successful in a STEM industry. And children have been finding out more about the different routes into employment and how hobbies such as baking and computer gaming could lead them into jobs as scientists and engineers (see Kate Sutton's article on page 6 for more about careers education). As well as live Q&A-style discussions, companies have been able to provide photographs and videos that show children the huge scale of their sites and the variety of jobs that their employees do day-to-day.

Although these examples are taken from my experiences delivering the virtual CCI programme this year, I hope that some of them inspire you to start conversations with the CIEC team or the industry ambassadors living and working in your local area. And, if the cost of coach travel was something that may have put you off an in-person visit of this nature in the past, this might be the solution for you!

Engaging with industry ambassadors on site

Whether visiting sites in person or remotely, you can interact with an array of personnel including scientists, engineers, technicians, and people who have risen through the ranks to managerial positions, all of whom can share details of their career pathways. However you choose to visit a site, give some thought in advance to areas that you would like your conversation with their ambassadors to go. Children's questions can lead down many avenues, so be prepared to step in with your own questions to steer the conversation in directions that are relevant to your class. Topics that I like to ensure are discussed include those relating to the diversity of employees, the role played by teamwork, and how important it is to be resilient and open to learning from your mistakes.

How can CIEC help?

If you have identified a local company with which you would like to collaborate, but they do not feel confident engaging with children, put them in touch with the team at CIEC, who have the knowledge and expertise to help them get started. To ensure that your interactions with industry ambassadors are meaningful and have the required impact, we can provide training to help companies to frame their practices, processes and products within the framework of the National Curriculum, and to support them to adapt their communication style to engage effectively with your class.

Have you had any great experiences of site visits? Why not share them in this journal to inspire others to embark on their own 'site-seeing' journey?

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Figure 7 Children speaking with a scientist during a CCI virtual site visit

Figure 8 CIEC advisory teacher training industry ambassadors

CIEC offers support for the teaching of science across the primary age range. This support includes CPD programmes, bespoke in-school CPD, interactive websites for teachers to use with their classes, and a wide range of downloadable resources which encourage collaborative, practical problem solving. For more information, please visit our website:

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