SCIENCE MUSEUM GROUP

SCIENCE CAPITAL IN PRACTICE

FOUNDATIONS FOR THE FUTURE

Summary of findings from the Science Museum Group's *Science Capital in Practice* programme in collaboration with the UK Association for Science and Discovery Centres

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THE VISION: GROWING SCIENCE CAPITAL

In Britain today, scientific discoveries and new inventions influence our lives every day. Despite this, a lot of people feel alienated from STEM – science, technology, engineering and maths.

Figures show that although many people like and enjoy science at school, relatively few aspire to continue with science-related study or careers, or feel comfortable in places where science is presented or discussed.

To address these challenges, King's College London, University College London and the Science Museum Group undertook a five-year research and development partnership called Enterprising Science. From this emerged the science capital approach which aims to tackle inequalities in STEM participation.

Today, the Science Museum Group is committed to playing its part in enabling more people to engage with and participate in science. It is exploring and applying ways of growing science capital in individuals and society – bringing a greater diversity to the type of people who participate in, benefit from, and contribute to science and innovation.

If more people are inspired to engage with STEM, it will not only bring a broader range of perspectives and solutions to world challenges, but also help to build a fairer and more inclusive society.

This report shares the latest practical applications of the ongoing research into science capital. It summarises outcomes of the *Science Capital in Practice* programme, which aimed to help increase diversity and inclusion in science through applying the science capital approach in a variety of museums and science centres.

WHAT IS SCIENCE CAPITAL?

Science capital gives us research-based insights into what shapes people's attitudes, engagement and relationship with science, technology, engineering and maths (STEM).

It recognises the significance of what you know about STEM, how you think about it, what you do and who you know in shaping your identity and relationship with science and maths.

Equity and social justice are integral to the concept of science capital, enabling and empowering everyone to access the opportunities and wonders of STEM.

Each of us has a different amount of science capital; it is not fixed and can change across a lifetime. Every experience that you have can influence your relationship with STEM both positively and negatively.

Recent figures show that among 11–15 year olds, five per cent have high science capital, meaning they are actively engaged in STEM; 68 per cent have medium science capital, meaning that they are interested but not engaged; while 27 per cent have low science capital and feel science is not for them. This data, collected with young people, likely reflects their family's science capital levels – which in turn influence many of the choices encountered throughout life.

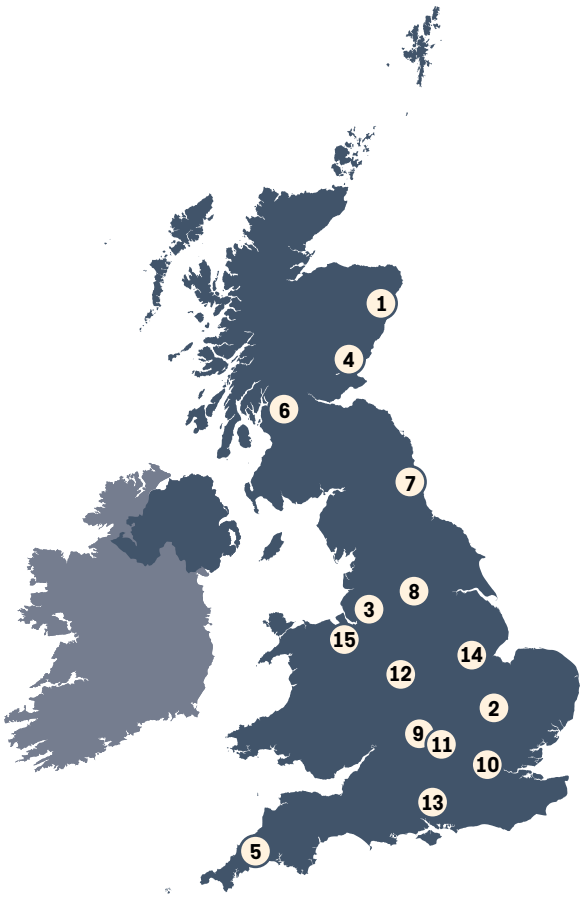
By taking a science capital-informed approach we can understand and challenge inequalities – and find important new audiences for our work.

> The more science capital you have, the more likely you are to feel that STEM is useful and important in your life, something you have a stake in, and which is 'for you'.

BUILDING A COMMUNITY OF GOOD PRACTICE

The *Science Capital in Practice* (SCIP) programme began in June 2019 and shared findings at the *Science Capital in Practice: Foundations for the Future* seminar in July 2021. A collaboration between the Science Museum Group and the UK Association for Science and Discovery Centres (ASDC), the programme aimed to establish a growing community of good practice around the application of science capital principles in informal science settings.

From Dundee to Winchester, Wrexham to Cambridge, 15 science centres and museums across the UK were partners in the project. There was huge variety among the institutions involved, which included Isaac Newton's house at Woolsthorpe Manor in Lincolnshire, Glasgow Science Centre, the National Coal Mining Museum in Wakefield, the Eden Project in Cornwall and Kew Gardens in West London.



Map of *Science Capital in Practice* programme partners

Each partner received a grant, training, mentoring and access to a range of resources to support them in embedding a science capital approach within their organisations. Although the pandemic impacted the implementation of some of the work participants intended to do, each institution shared valuable outcomes and learning in terms of increasing diversity and inclusion in science.

> We knew the discussion around science capital represented good practice, backed up by research. We want to understand the barriers to engagement better."

> "I think there are very few times that we get involved with programmes that actually really help us improve our practice and give us space to do that.

Partners carried out a variety of projects as part of the SCIP programme, with visitor workshops, outreach activities, activity packs, guided and self-guided visits, in which – despite the pandemic – over 100,000 participants engaged for over 120,000 hours, following 58 internal training sessions involving 700 staff, volunteers and partners.

1. **ABERDEEN SCIENCE CENTRE, ABERDEEN**
2. **CAMBRIDGE SCIENCE CENTRE, CAMBRIDGE**
3. **CATALYST SCIENCE DISCOVERY CENTRE, WIDNES**
4. **DUNDEE SCIENCE CENTRE, DUNDEE**
5. **THE EDEN PROJECT, CORNWALL**
6. **GLASGOW SCIENCE CENTRE, GLASGOW**
7. **INTERNATIONAL CENTRE FOR LIFE, NEWCASTLE**
8. **NATIONAL COAL MINING MUSEUM, WAKEFIELD**
9. **OXFORD UNIVERSITY MUSEUM OF NATURAL HISTORY, OXFORD**
10. **ROYAL BOTANIC GARDENS KEW, LONDON**
11. **SCIENCE OXFORD, OXFORD**
12. **THINKTANK, BIRMINGHAM MUSEUMS TRUST, BIRMINGHAM**
13. **WINCHESTER SCIENCE CENTRE, WINCHESTER**
14. **WOOLSTHORPE MANOR, LINCOLNSHIRE**
15. **XPLORE! SCIENCE DISCOVERY CENTRE, WREXHAM**

BENEFITS OF A SCIENCE CAPITAL APPROACH

Today's museums and science centres are committed to broadening audiences and providing equal access. But as the science capital research indicates, many people feel excluded by STEM. In addition, the approaches we tend to use in museums can favour those who are already culturally engaged and will exclude people who face inequalities in wider society.

The science capital approach offers new ways to tackle these issues, and thus has resonated across the formal and informal learning sectors, both nationally and internationally.

Science capital research gives us insight into what influences and shapes people's attitudes towards STEM, as well as helping us to nurture our existing audiences. In doing so it further enables us to identify ground-breaking ways that we can reach out and connect with new and infrequent visitors.

Science capital is frequently referred to by policymakers, strategic leaders and funders. As such it gives us a strong common language to use to communicate the value of informal learning experiences in society.

The sharing of good practice in applying a science capital approach, underpinned by academic rigour, is leading to transformation in the sector and new ideas for serving audiences. For staff, the science capital approach is empowering, enabling them to maximise the impact of their work.

The science capital approach reminds us that we need to focus on the whole environment into which we invite and welcome our audiences.

> [this has given us] the opportunity to ensure a more inclusive engagement with our audiences, that values and celebrates their experience of science in their lives and how we can build on it."

> "When we plan, discuss programming and create interpretation, we are using the science capital approach to consider how a wider audience might respond to new ideas.

SCIENCE CAPITAL IN PRACTICE: TIPS FOR SUCCESS

The SCIP programme's partner institutions began this project with differing levels of experience in the science capital approach. For some it was a new venture, while others were building on previous learning.

The bulk of the programme activity took place during the pandemic. Partners successfully pivoted their plans despite the challenges involved. As would be expected in any exploratory project, partners experienced some challenges and barriers that they worked to overcome, including:

- The difficulty of embedding new ways of thinking in staff teams that often change, and which may already be overstretched
- Struggles getting to grips with new terminology and meaning
- A sense of confusion, initially, among some staff who felt they didn't know enough science or work directly with science in their role
- New approaches sometimes being construed as criticism of all the old ways
- Worries about measuring impact.

All partners shared detailed feedback on their experiences of using and applying ideas from the training, the resources and their own activities, both in shaping their own ideas and in impacting audiences.

Common to much of the feedback was a key piece of learning – that the best way to start embedding the science capital approach is to adopt an experimental attitude, to take your time, and to have a go. Participants said:

- It works well to pilot activities first, experiment and then grow to bigger projects
- Small and meaningful can have a big impact
- A smaller number of quality projects where you can maintain relationships over a longer period is better than spreading yourself too thin
- This is a new way of thinking, and there is no magic formula – see what works in your setting and with your audiences.

Over the following pages are four practical areas of learning in each of four key areas of feedback from the participants, with quotes and examples to try in your organisation.

REACHING NEW AUDIENCES

How can the science capital approach help build and broaden audiences?

IT HELPS YOU CREATE ACTIVITIES, PROGRAMMES AND EXHIBITIONS THAT ARE RELATABLE AND RELEVANT FOR MANY AUDIENCES.

Many of the participants in the SCIP programme developed new activities using the **engagement reflection points** (see page 18) which were informed by a science capital approach. They help staff see STEM activities through visitors' eyes – realising that not everyone sees science in the same way.

Partners found the science capital approach helped them:

- Consider a diversity of role models
- Put the human story at the centre
- Change language and vocabulary in signage and materials
- Encourage more explicit references to skills
- Promote conversation.

It also made staff more aware of and reflect on what is appropriate for different audiences – for example, kitchen science activities will not work where food is in short supply.

> I think one of the strongest learning points we got was from the training at the Children's Centres. They pointed out – and it hadn't even occurred to us – that if we use foodstuff in the kits, they probably wouldn't be used for science."

> "...science capital has really helped us understand how small changes in our delivery have monumental changes in audience participation and enjoyment of each session."

> "It is an opportunity to start to diversify our conversation around who science is for, how it's created, the history of scientific developments in a more diverse manner, diversifying those stories.

IT CAN HELP DISMANTLE BARRIERS THAT MANY PEOPLE EXPERIENCE TOWARDS STEM TOPICS AND MAY ENCOURAGE PEOPLE TO VISIT FOR THE FIRST TIME.

Through the science capital approach, staff understood audiences' barriers to engagement, and were better able to put themselves in visitors' shoes. They created experiences to highlight science in everyday life. This was particularly relevant for people who had never visited their institution before.

Newcastle Centre for Life worked with members of local Deaf groups to offer hands-on science sessions and to explore barriers to accessing the STEM activities on offer in the centre.

Cambridge Science Centre used science capital principles to create a science magazine distributed in foodbox deliveries. The team hopes to build on the success of this to encourage people to visit in person for the first time.

The Dundee Science Centre aimed to make a connection with families who were technologically deprived and had never visited before, by creating science kits using science capital principles. This was successful, and hundreds of the kits have been ordered by schools and other organisations.

> We've now got an established relationship with a community that we didn't prior to the Science Capital in Practice funding being available. I'm hopeful that [...] I might be able to set up an event specifically for the Deaf community."

> "Implementing science capital principles into these [kits] was crucial. We knew that if we present science in a way that we used to do, they would just not like it... We prepared the activities and the plans for those activities in a way that we knew they were going to be more engaged in.

IT TAKES THE FOCUS OFF TRANSFERRING FACTS AND TURNS IT TOWARDS BUILDING SKILLS.

Partners found that the science capital approach helped staff create activities that were less didactic, while being more engaging and attractive to visitors, developing curiosity, questioning, creativity, observation and communication.

At the Oxford University Museum of Natural History, the science capital reflection points prompted the team to change the focus of paper-based trails from finding out facts to using exploration skills and sharing ideas by talking.

Science Oxford delivered a six-week Expert Explainers after-school programme to Year 5 pupils who didn't access science outside school. Their teachers reported that the outcomes for the pupils were better teamwork, problem-solving, asking questions and presenting.

> It has reaffirmed the importance of focusing on the development of science enquiry skills rather than the transfer of factual information and the need to engage the whole family."

> "Traditionally people think science is about knowing stuff, about being clever and about lab coats. For me, science capital is a tool to help us dispel a lot of those myths.

IT EMPOWERS AUDIENCES WHO MAY BE DISADVANTAGED OR HAVE LOW SCIENCE CAPITAL.

By building science skills, confidence grows in relation to science. At Glasgow Science Centre, staff aimed activities at local parents with low science capital. There were examples of parents being more confident in supporting their children, more confident in looking at science-based employment, and at a minimum level there was a new spark of interest in science.

At Xplore! the science capital approach transformed a long-running work placement programme offered to young women from disadvantaged backgrounds.

The science capital approach also encouraged organisations to think about new ways to reach audiences, and how to meet audiences in the spaces they are already familiar with, rather than expecting visitors to come to them.

> When I first started working with primary school teachers and trying to develop their science skills, I was not expecting how low their confidence would be at all. It was such a wake-up call for me that now, about 90 per cent of what we do with our training with primary school teachers is building their confidence."

> "[The work placement] has turned into something that has more meaning and more longevity… 'Come along, really get to shape your own programme. Have a really good understanding of what we're about and how we're helping the local community, and help yourself.' That's lovely to see."

> "We've tried to get our Marketing Team to think about it a little bit more. If we want [to engage with] people with low science capital, they don't always want to advertise on the place where all the science events are.

EMBEDDING PRACTICE

How did participants find the science capital approach changed their way of working?

IT TRANSFORMS HOW STAFF VIEW AUDIENCES.

For many partners, the science capital approach offered a new way of thinking about their work, and how to give it maximum impact among audiences. Some said it had helped them develop a more nuanced, complex understanding of who visitors are, how they engage, and why some feel science, and museums, are not for them.

Partners used the Science Museum Group's **STEM engagement toolkit** (page 16) to reflect critically on their current work.

> It really helped us find a way to break those barriers that are created. We used it to set up challenges for ourselves, to improve and develop our practice."

> "It's taught me a lot personally on how we interact with visitors… I don't think it necessarily needs to be just in science […] I think science capital should be just engagement capital!"

> "I think it really helps as a way of visualising your audiences, and the young people that you work with, in maybe a more rounded way. The fact that it encapsulates how complex this is, feels quite important to me.

IT BRINGS THE IDEA OF EQUITY AND ACCESS TO THE HEART OF THE WORK OF DEVELOPING HIGH-QUALITY EXHIBITIONS, PRODUCTS OR ACTIVITIES.

The science capital approach helped inform the identification, choice and development of new products and activities (including those aimed at engaging new or under-represented groups). It also encouraged staff to reflect diversity in the examples chosen for role models and illustrations.

At Aberdeen Science Centre, the team reworked all their science show scripts and peer reviewed them using the science capital reflection points to ensure they related to everyday life, and encouraged conversation.

At Catalyst, science kits were created which aimed to upskill parents and carers to do science activities at home. About a third of families had never tried science activities at home before and they had never been to Catalyst.

> The area that we're based, we're in the top five per cent of disadvantage or poverty in the UK. Having the science capital approach, which is a social justice model, an equity driven model, can be quite powerful where we are in terms of kind of advocating a stand."

> "It brought equity to [the] foreground in conversations around our science development."

> "[The reflection points] helped staff to consider day-to-day engagement and how interaction with our audiences relates to the potential impact on social change for our more disadvantaged communities."

> "One benefit is that staff have a different message to bring to our visitors, and it's more a friendly, relevant, approachable message to them.

IT HELPS STAFF RECOGNISE AND DRAW ON THE EXPERTISE AND LIFE EXPERIENCE THAT VISITORS BRING.

In developing ways of making STEM ideas and content more relatable to audiences, partners considered lots of ways to link with everyday experiences visitors might have, or expertise they might not recognise as STEM-related. This helped create a sense that science is all around us.

Formal and informal products developed as part of Kew's project have helped to empower audiences and encouraged them to connect scientific concepts with their own life experiences, such as living in or visiting other countries, or hobbies such as gardening or cooking.

Similarly, Eden found success in looking for everyday examples of science which became touchpoints with visitors.

> We've noticed at the end of our sessions that the kids and the adults are fired up. [...] Even if they're excited by one small element of what you're delivering, the fact they've gone away bubbling is what we're looking for, and that's what science capital does and aids us in what we're doing."

> "The benefits [of a science capital approach] were to get the staff understanding that science is all around us and science can be seen in different ways."

> "Learning about science capital will change the way I explain exhibits to visitors, by making sure that I relate what I am saying to everyday examples.

IT LEADS TO MORE CONSULTATION OF STAFF THROUGHOUT THE ORGANISATION.

As a result of applying the science capital approach, some partners such as Thinktank began including more colleagues in consultations over activity development, recognising the value of different kinds of expertise.

> Many teams such as Visitor Services, Learning and Engagement, Marketing and Senior Management have had input into the creation of our Community Welcome Pass and training pack due to their understanding of the importance of this concept. Colleagues are also keen to ensure the future and potential expansion of this offer so an increased number of Community Groups can access Thinktank on their own terms.

STAFF TRAINING

What did partners learn about introducing and embedding the science capital approach?

EVEN FOR STAFF WITH MANY YEARS OF EXPERIENCE, THE SCIENCE CAPITAL APPROACH CAN BE REVOLUTIONARY.

Many participants, whether already familiar with the science capital concept or otherwise, appreciated gaining a deeper understanding of the approach and the evidence behind it. They became aware of their own science capital, and the ways in which they used it in everyday life.

In some cases, they realised for the first time how different their own attitude to science might be, compared to a colleague or visitor.

> I learned from the training, it isn't just people's knowledge but people's access and relationship with science. I've been doing this job for nearly eight years now and that was something I'd never considered before."

> "The science capital training helped me realise that [visitors] might not care at all about science. They might even be hostile towards it.

THE TERMS 'SCIENCE CAPITAL', EQUITY AND INCLUSION CAN TAKE TIME TO SINK IN.

Staff may have a misconception that they need scientific knowledge to participate in applying the principles of science capital. Some partners found it useful to explain during training that science capital isn't only about *what science you know,* and to show how science capital relates to us all.

Many partners found it effective to reflect on the ideas and adapt some of the terminology used so that it was more accessible, meaningful or acceptable to their staff, and connected with existing methods.

One participant organisation came together in small groups to consider terms like diversity, inclusion, equality and equity as well as vocabulary used in other funded projects, and to 'work out what these terms actually mean and in what context are they appropriate to use'.

Resources used in training are listed in the **Explore More** section (page 17).

> We felt that we needed a longer session [...] for people to chat amongst themselves to promote reflection – which participants valued – and give time for deeper conversations if people want to do this."

> "Actually, it's not the term that's necessarily important, it's the understanding behind it. When we are talking with people who aren't STEM experts, sometimes it is about us unpacking the language.

WITH SUITABLE TRAINING IN SCIENCE CAPITAL KNOW-HOW, ANY ORGANISATION CAN BROADEN ITS REMIT TO INCLUDE STEM SUBJECTS.

While some partners in the project had previously focused on heritage subjects and history, the science capital approach enabled their staff to see STEM subjects as part of their remit.

The National Coal Mining Museum adapted the training to allow staff to explore the STEM aspects of their offer, make connections with practical examples from their site, and think about how to broaden the relevance of their stories.

Staff at Woolsthorpe Manor found being part of the SCIP programme particularly valuable, enabling them to discuss new ideas and practices.

> All of our colleagues have been enthusiastic about the science capital approach and understood well how it links with what we are trying to do at Woolsthorpe Manor."

> "There are many things that museums can learn from science centres, and I can see those benefits happen also the other way around."

> "We have begun to change the way the Museum is viewed as a place for science as well as history.

AS A NEW WAY OF THINKING, THE SCIENCE CAPITAL APPROACH IS MOST POWERFUL WHEN EMBEDDED THROUGHOUT THE ORGANISATION.

Rather than being something relevant only to one project, science capital is most powerful if its principles are embedded into staff recruitment, induction and training, organisational mission and vision, and the language used at all levels.

Woolsthorpe Manor involved regional staff and consultants in their training in order to widen its impact.

One partner reported that their team was now 'thinking in a different way', taking a more consultative approach rooted in visitor needs.

> Every single staff member has their own reflective diary. It's not just the people engaging with the public. It is everybody. It makes a difference if you've got somebody like your finance officer doing it... They want to know what the point of the science centre is. It's not just about the accounts."

> "[Science capital is] now integrated into the way that we do things, and it's been displayed in many, many documents that are going to be used in further management and maintenance and development of the exhibits and the galleries that have been produced. So, I would see it's pretty much impossible that science capital just disappears from the way that Dundee Science Centre is now."

> "We have started working with managers, HR to embed [a] science capital awareness and approach in Induction and Performance and Development Review processes.

MEASURING SUCCESS

What are the best ways to track the impact of the science capital approach?

IT IS GOOD TO ACKNOWLEDGE THAT WE FUNCTION AS PART OF A BIGGER PICTURE, NOT AS A ONE-STOP SHOP FOR SCIENCE.

Winchester Science Centre held an internal workshop and distilled the overall science capital concept into the key areas that aligned best with their mission – where they felt they could have the biggest impact.

Science capital is not in itself an evaluation tool. We are unable to tell how a single visit or experience has increased someone's science capital as this will come from a combination of factors over time, but we can observe and measure people's engagement with STEM, which will help to grow their science capital.

> In the past we'd often have all these grand ideas about what we wanted to achieve and what we wanted to offer visitors because of our own experiences. But that wasn't necessarily what our visitors wanted. We didn't know that because I don't think we engaged with them as much as we do now in that consultation aspect.

BY USING A SCIENCE CAPITAL FRAMEWORK WE CAN PLAN MORE RIGOROUSLY AND CREATIVELY.

Partners found the science capital approach provided staff with a formal structure (where previously they may have relied on intuition) which helped them to plan, communicate and evaluate their ongoing work.

At Kew, staff felt that the project helped the Visitor Learning team to think differently about how to continue to make science meaningful and relevant to audiences, especially those harder-to-reach groups who are visiting for the first time and who might think of Kew simply as a public garden.

To help children reflect on their feelings towards science, Winchester Science Centre set up a flower graphic with the question 'What does STEM mean for me?' in the centre. Children could add stickers to the petals to indicate how strongly they agreed or disagreed with statements such as 'I enjoy science at school', 'I use science at home', and 'I feel that I could be a scientist'. Children enjoyed doing this and talked about it with their parents.

> If it was a form, the parent might be tempted to just sit there with a pen and do it, but because it was fun and interactive, they were actively giving the stickers to the kids and saying, 'Where do you think you fit in here?'

WE CAN ALSO MEASURE CHANGE IN OURSELVES.

We can't measure an increase in an individual's science capital from a one-off visit, but we can measure whether we are attracting a diverse range of people to our activities and making them feel as if they belong – even when they have lower science capital.

The science capital approach encompasses everything from the welcome visitors receive to the signage and images they see, and the staff they meet.

> I think everybody's able to take something from it, because it went from very small steps and very tangible changes or approaches that you could implement straight away, to connecting with the more sort of strategic and broader aims that you might have. So, I think it connected with lots of people at lots of different levels.

STAFF FEEL CONFIDENT IN NEW WAYS OF WORKING, KNOWING THE SCIENCE CAPITAL IS BUILT ON A STRONG EVIDENCE BASE.

Partners felt it was significant that the science capital work is underpinned by academic research and data.

> They've done an important piece of work that is putting data on something that I felt or observed. When research can do that for you, it's really nice."

> "It's actually very helpful for me because it makes my work a bit more robust. I can see I've measured it against this or compared it with this. You feel that we must be doing the right thing. So, I would continue to use it.

NEXT STEPS

All museums and science centres aim to *grow* audiences and reach more visitors. The science capital approach gives insights into how to *broaden* audiences – becoming increasingly relevant to a wider range of visitors.

By using the science capital approach, the informal learning sector can actively seek a huge missing audience of people with medium science capital (68 per cent) and low science capital (27 per cent).

Success can come in a variety of forms and on a number of scales – from working in new ways to recruit and grow fresh talent in your organisation, to forming a fruitful relationship with an entire new visitor community. Participants in the SCIP programme plan to continue working with the science capital approach, for example by mapping science capital in local schools and evaluating the impact of activities over the long term.

But whatever it looks like for you, the science capital approach will make you more effective in your practice and help you build for the future.

Every aspect of an experience or visit is an opportunity to shape someone's feelings about and relationship with STEM and we all have different opportunities in the work that we do. The way to apply the research to practice is by continually reflecting on what we do every day through the eyes of our audiences, by asking questions such as:

- Are we doing all we can to make everyone feel welcome and confident?
- How can the communication methods and language we use help everyone to feel that they are part of science and will feel at home experiencing it here?
- How do the experiences we offer connect and relate to our audiences' rich and diverse interests, experiences and everyday lives?
- How do we value and build on the STEM knowledge and experiences that visitors bring with them?
- Have we assessed whether exhibits, programmes, websites, marketing, communications and recruitment are inclusive?

A community of good practice is growing, starting with the organisations who participated in this project, and based in the ASDC, and you are all invited to join.

APPENDICES

LIST OF PARTICIPANTS AND THEIR PROJECTS

Aberdeen Science Centre used the training to develop a common language for their staff around science capital, and created events and activities on and off site. They worked with a range of audiences and disadvantaged communities across Aberdeenshire. **aberdeensciencecentre.org**

Cambridge Science Centre embedded science capital principles through training, and created and distributed accessible science magazines *OpenUpScience* and *Art of Science* to young people in areas of multiple deprivation. **cambridgesciencecentre.org**

Catalyst Science Discovery Centre ran training sessions with staff and community partners, and then created workshops to give adults the confidence and tools to run 'easy science' activities at home using the Catalyst Kits they provided. **catalyst.org.uk**

Dundee Science Centre aimed to embed science capital values through staff training and learn more about barriers to engagement. They also produced a ten-week programme of Science@Home activity boxes for distribution in food parcels during the pandemic. **dundeesciencecentre.org.uk**

The Eden Project focused on creating an Eden Science Capital Group representing every team in the organisation, to share ideas and seek opportunities to make STEM accessible to visitors, schools and local communities. **edenproject.com**

Glasgow Science Centre delivered a science capital training programme as part of the organisation's annual conference, along with workshops, and followed this up with an online learning module for staff after the pandemic began. **glasgowsciencecentre.org**

The International Centre for Life aimed to work with the Deaf community to learn more about barriers to maximising the STEM learning opportunities available. A new relationship has formed with local Deaf groups resulting in new and more family visitors. **life.org.uk**

The National Coal Mining Museum participated in training for staff, volunteers and contractors, and then created digital learning content for families plus workshop activities that blended art and science. **ncm.org.uk**

The Oxford University Museum of Natural History worked with early career researchers and PhD students to develop new resources that focused on developing scientific habits of mind rather than transferring knowledge. These were trialled by schools and families. **oumnh.ox.ac.uk**

Royal Botanic Gardens Kew worked to embed science capital across the organisation and reflect this on the website. They provided teacher training activities, as well as developing informal and formal learning materials. **kew.org**

Science Oxford created staff training that linked the science capital approach to their existing learning strategies. They delivered a six-week Expert Explainers programme to lower-science-capital local schoolchildren, as well as family activities. **scienceoxford.com**

Thinktank included staff from across their Museum Trust in their training, as well as leaders from community groups and charities, to embed the idea of science capital widely and to equip a diverse range of people to lead group visits. **birminghammuseums.org.uk/thinktank**

Winchester Science Centre worked with the Noel Turner Science Festival to help make physics and STEM relevant through talks and hands-on activities. After the pandemic they plan to reconnect with contacts to offer CPD and community events. **winchesterssciencecentre.org**

Woolsthorpe Manor brought together volunteers, students and staff from the University of Lincoln, along with National Trust regional managers, to participate in science capital training and develop ideas for reaching wider audiences. **nationaltrust.org.uk/woolsthorpe-manor**

Xplore! Science Discovery Centre carried out training and created a new ten-day work experience programme aimed at young people from disadvantaged backgrounds or with low science capital, in which they can focus on business areas of particular interest. **xplorescience.co.uk**

STEM ENGAGEMENT TOOLKIT

This toolkit was used in the *Science Capital in Practice* programme. It includes practical tools that can help us to critically reflect on different aspects of our work through the eyes of a broader range of people.

TOOL	DESCRIPTION	WHEN BEST TO USE
Engagement reflection points (page 18)	Action-led considerations that outline good practice around STEM and cultural engagement	When delivering or developing any STEM experience (e.g. an event, exhibition, resource, show)
Visitor learning outcomes	Defines what you want your audience to feel, do or understand as a result of an experience	When planning and developing an experience, and to evaluate and measure its success
Audit and reflection tool	A science capital-informed reflection framework to help critically review an experience	To review or audit an existing experience, resource or exhibit
Essential elements of engagement (Hook, Inform, Enable, Extend and Reflect)	The five core elements central to any audience experience	When developing and delivering a STEM experience
See, Link, Wonder	A question framework to help audiences to think, talk and make connections with a STEM experience	When writing questions for activities or for visitor interactions
Science engagement measure	Evaluation questions that can help to capture visitors' engagement	For use in exit surveys, feedback forms and evaluation work

EXPLORE MORE

FROM THE SCIENCE MUSEUM GROUP

Information about the Science Museum Group's science capital approach, including the *Engaging All Audiences with STEM: An equitable approach informed by science capital* booklet:
sciencemuseumgroup.org.uk/sciencecapital

Transforming Practice blog. Practical examples and reflections on what research into STEM engagement means for day-to-day practice:
sciencemuseumgroup.org.uk/transformingpractice

Science Museum Group Academy. Research-informed training and resources to support and inspire STEM engagement practitioners:
sciencemuseumgroup.org.uk/academy

Science Museum Group's equity framework:
sciencemuseumgroup.org.uk/equityframework

Animations:

'What is science capital?'
bit.ly/sciencecapitalintroduction

'Science capital and the informal learning sector'
bit.ly/scicapinformalsci

'A science capital approach to building engagement'
bit.ly/scicapengagement

FROM THE UK ASSOCIATION FOR SCIENCE AND DISCOVERY CENTRES

Find out more about the UK Association for Science and Discovery Centres network.
sciencecentres.org.uk

FROM THE LEAD ACADEMIC RESEARCHERS

STEM Participation and Social Justice Research projects and research from University College London:
ucl.ac.uk/ioe-sciencecapital

Archer, L, Dawson, E, DeWitt, J, Seakins, A and Wong, B, 2015, 'Science capital: a conceptual, methodological, and empirical argument for extending Bourdieusian notions of capital beyond the arts', *Journal of Research in Science Teaching*, 52/7, pp 922–48

Archer, L, DeWitt, J and King, H, 2018, *Improving science participation: Five evidence-based messages for policy- makers and funders* (London: UCL Institute of Education)

GET IN TOUCH

The full evaluation report, from the *Science Capital in Practice* programme, including case studies from all of the project partners, is available on request.

If you are interested in finding out more about the work and the training that the Science Museum Group delivers, please contact us at:

SMGacademy@sciencemuseum.ac.uk

ENGAGEMENT REFLECTION POINTS

A science capital-informed approach is about reflecting on your science, technology, engineering and maths (STEM) experiences through the eyes of your audience using these key considerations.

USE INCLUSIVE LANGUAGE

Use visual and verbal language that acknowledges diversity and is sensitive to differences, to help everyone feel that they can do and be a part of STEM.

Try not to use expressions, words or imagery that might exclude individuals or groups, and be sure to avoid or at the very least clearly explain any jargon.

BUILD CONFIDENCE AND OWNERSHIP

How can you ensure that everyone feels welcome and confident to take part in your experiences?

Allow people to follow their interests. Give them choice and control in the activities you create while providing opportunities to contribute and share their knowledge and experiences with you and each other.

HIGHLIGHT AND DEVELOP SKILLS

Help people recognise that they already use a wide range of STEM skills in their everyday lives. Highlight how these skills are transferable to jobs in and beyond science.

Give examples of where and how STEM skills are used by different people in daily life.

PROMOTE STEM TALK

Spark discussion and encourage people to think and talk about the STEM in their lives.

Invite people to share their own stories and viewpoints through questions which generate conversations among families, peers and communities.

EXTEND THE EXPERIENCE

Provide ways to help people to continue making STEM connections in their everyday lives.

Make your experiences last longer by giving people simple ideas and activities that they can do afterwards, such as questions to think about or research further, or challenges to do at home, at school or while out and about.

BROADEN PERCEPTIONS OF WHO USES STEM

Show diverse examples of the people who use and benefit from STEM in their work and everyday lives.

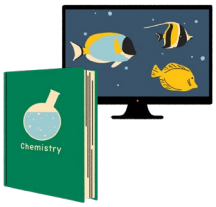
Help people to recognise that they already know people who use STEM skills and knowledge, while encouraging them to reflect on how STEM is shaped by everyone in society.

USE EVERYDAY EXAMPLES

Think about how you can support people to link STEM content to their own diverse interests and experiences.

Show examples of where and how STEM has helped solve real-life challenges. Don't make assumptions about people's interests and experiences – everyone is different.

BUILD ON STEM CONTENT KNOWLEDGE



Value and build on people's existing STEM knowledge and experience. New information should feel like a natural extension of what people already know.

Broaden people's ideas around what science and maths are. Communicate that they are more than content knowledge, they are a way of thinking, working, and exploring the world.

GIVE POSITIVE REINFORCEMENT

Help people to feel that science and maths are something they can do.

Highlight and reward when people use STEM skills or knowledge. Empower them with the feeling of 'I can do this' and 'I want to find out and do more'.

The *Science Capital in Practice* programme was made possible through the Science Museum Group Academy in collaboration with the UK Association for Science and Discovery Centres.

SCIENCE MUSEUM GROUP

UK Association for Science and Discovery Centres

The Science Museum Group Academy founding partner:

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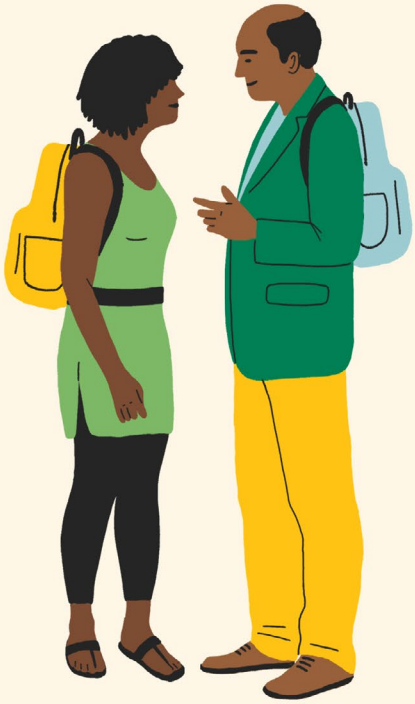

Illustrations by Michael Parkin