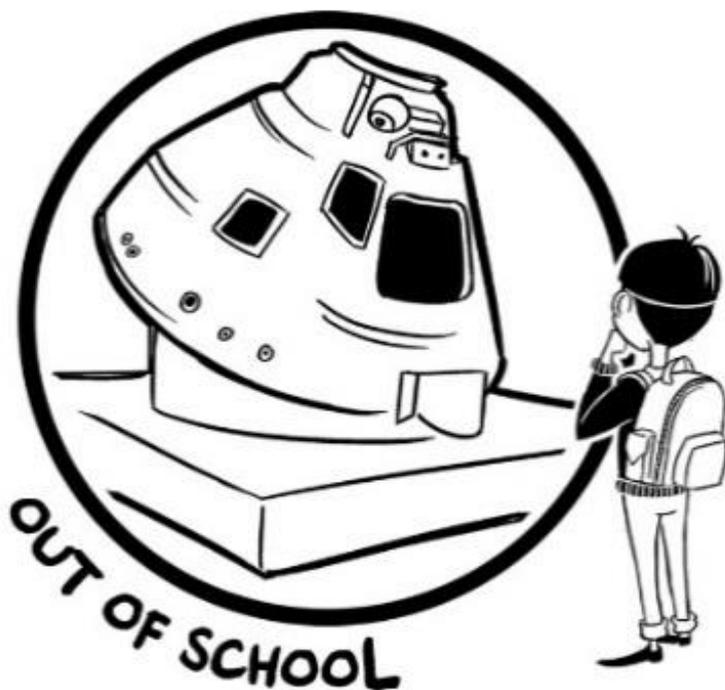


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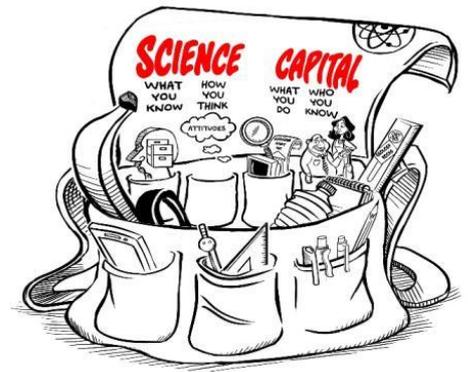
Engaging all our audiences

How the Science Museum Group
are applying science capital to their practice
- work in progress



Introduction

The Science Museum Group (*Science Museum, London; Museum of Science and Industry, Manchester; National Media Museum, Bradford; National Railway Museum, York*) has been working with King's College London and BP in the Enterprising Science project. This research and development project is using the concept of science capital to understand how people from all backgrounds engage with science and how their engagement might be supported.



The informal science sector can support the building of people's science capital by 'linking to, valuing and building on' the cultural experiences and resources they already have. This booklet documents how we are reflecting on and applying the science capital concept to our museum practice.

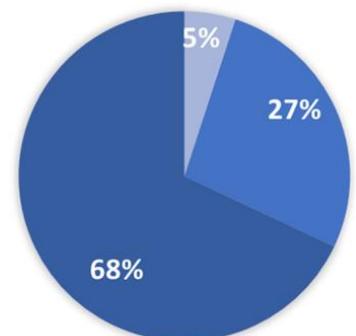
Science capital informed practice

Science capital can help us to understand what influences and shapes people's attitudes towards science (whether they see if science is for them or not). It considers all the science related knowledge, social contacts, attitudes, skills and experiences a person has and how they use those resources to their advantage in life.

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

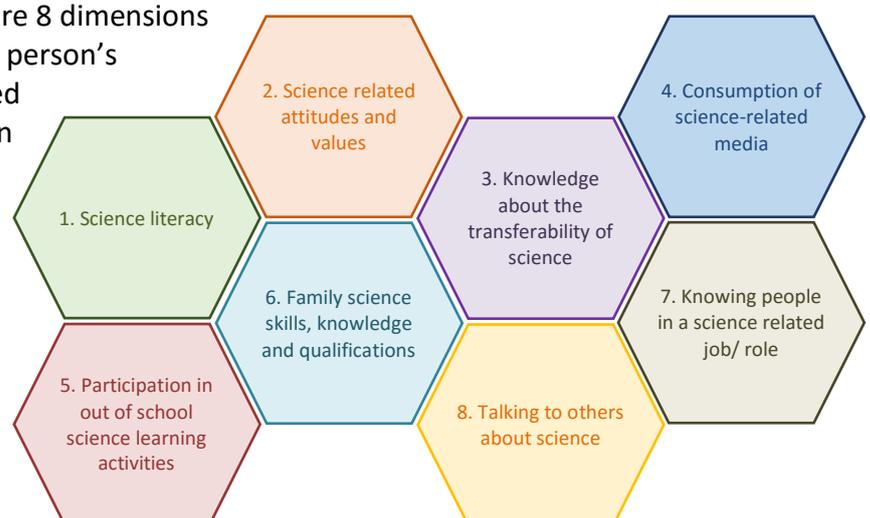
A nationally representative survey conducted with 3,658 11-15 year olds in England (conducted as part of the Enterprising Science project 2014) found that¹:

- 5% of young people have 'high' science capital
- 68% of young people have medium levels of science capital
- 27% of young people have low science capital



It is thought that science education and engagement experiences may unconsciously benefit the more privileged, so how can the informal sector ensure that its practice is as equitable/ accessible as possible?

The research has identified that there are 8 dimensions of science capital which can influence a person's perception of science. These can be used as guiding principles to shape the design of science engagement experiences in our museums.



¹ Archer et al... "Science Capital: A Conceptual, Methodological, and Empirical Argument". 2015

Why is science capital a useful principle for museums and science centres?

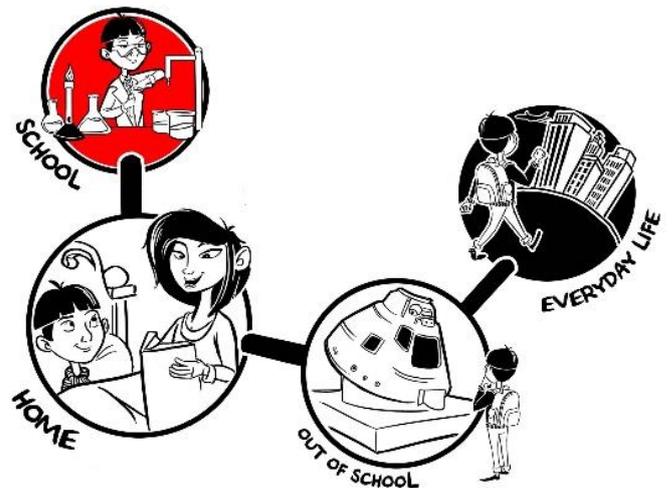
Science capital research builds on our understanding of the role and the value that museums and other out-of-school experiences play in society, and of the challenges some segments of our audiences have to access and engagement with our offer.

Science capital offers the sector a lens for understanding the differences in our visitor's engagement with science – why some people do or don't take part in (or engage with) the experiences we offer. It deepens our current understanding of how visitors' cultural references and values, including their interests and aspirations, might affect their engagement and experience with us, and that barriers to visiting us are more than language, financial and geographical.

Through awe-inspiring authentic objects, cutting-edge science stories, and hands-on activities, museums and science centres celebrate and showcase the past, present and future of science and technology. By connecting people's everyday lives and cultural experiences to science and encouraging science talk, we can create a space where people of all ages and backgrounds have an opportunity to explore and engage with the wonders of science.

People 'bump into science' in many different ways. Museums and science centres are part of a wider 'learning ecology' or eco-system. No single institution can build a person's science capital in isolation, it requires a holistic, joined-up approach. By developing science capital informed experiences and reflecting on our practice, we can help effect change.

Ultimately, we can create a space where science is inspiring, interesting, and enjoyable and promotes science engagement for all our visitors - in the museum and beyond, and will help us to reach out connect with those who aren't yet using us.



SMG learning philosophy, framework and opportunities

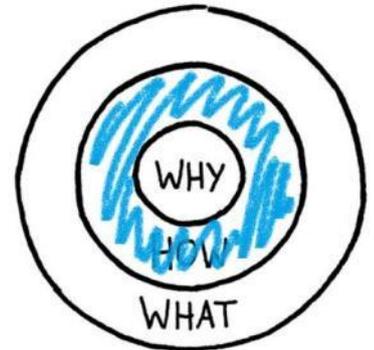
The SMG learning vision is **to enrich the lives of a large and diverse audience by igniting their curiosity in science.**

The learning and engagement experiences that we develop and deliver are designed around the SMG philosophy and framework and our learning opportunities:

Philosophy & approach: to encourage and promote curiosity and questioning; to 'assist discovery'. Through active participation and reflection; social interaction and in context.

Framework: science experience ingredients are: to hook, inform, enable and extend (see Appendix 2)

Science capital dimensions can help to shape and inform **how** we deliver our science engagement experiences to achieve our vision. By having a better understanding about the differences in our visitor's engagement with science, we can develop experiences that will be more effective at offering them meaningful and 'personal' connections with science.



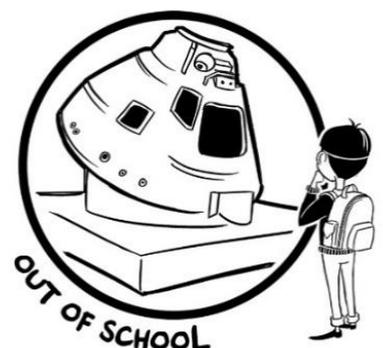
Museum learning opportunities

Across SMG, we have a fruitful combination of both contemporary and historical science which uses authentic objects, cutting-edge science stories and hands on experiences to reveal how science and technology has transformed and improves all of our lives. The learning opportunities we can maximise include:

- **Applications of science** in everyday life (and in context through our authentic historical collections)
- Promote the **relevance of science** to people's lives and communities
- Introduce how **people** (the inventors and users) have **shaped science** (through stories and social context).
- Use and recognise the **skills* used and developed through doing science** (and help build self-efficacy of these)

***museum skills...** We have identified five core skill areas that can be used and developed in our Museum. Wider skills may still be used in specific activities and wider 'soft' skills (such as team work, creativity, imagination) are implicit in the experiences we offer.

- **Making observations (close attention)**
Look for patterns, changes, make comparisons, collect data and take measurements.
- **Communication**
Discussion, sharing knowledge and ideas and listen to others.
- **Asking questions (curiosity)**
Find out more by asking questions such as; *What if...? How? or Why does it...?*
- **Creative problem solving (creative thinking)**
Seek out imaginative solutions to challenges/ critical and creative thinking.
- **Using evidence**
Use evidence to support ideas and theories, reason/ make predictions etc.



Putting the research into our practice

Working out the most effective way to apply the research to our practice is still in progress. There is not a 'single' approach or method when applying the science capital principles to the different functions and activity of the museum (visitor experience, exhibitions, café, learning resources, commercial etc.) – one size (approach) does not fit all. To date, we are using the research to:



- **Audit and reflect** on our current offer to help us recognise our strengths, identify challenges and find new opportunities and gaps in our offer.
 - Audit and reflection tool (see Appendix 1)
- **Shape the development and delivery of new and existing experiences** using the dimensions of science capital.
 - Science capital dimensions in museum context (and examples) (see Appendix 2)
 - Learning outcomes with science capital lens (see Appendix 3)
- **Review and (re)define what success should look like** (visitor engagement/learning outcomes).
 - Learning outcomes with science capital lens (see Appendix 3)
- **Review and improve the support and information for key audiences** (onsite and digitally). How they build confidence and skills, especially for families and teachers (who are our gateway to young people and to those families who do not yet visit) to make full use of our experiences.
- **Research and identify examples of good practice across the sector** and share. (See our Transforming Practice Seminar report and new Transforming Practice blog)

Measuring impact (what does science engagement look like?)

Building someone's science capital happens over time; and we believe, also requires a change in the environment we invite someone into so their existing capital is valued. Therefore it is not, in itself, an evaluation or impact measuring tool. We cannot easily measure a change in visitors' science capital through a short term museum/ science centre experience; embedding science capital needs to have belief in the long game.

However, science capital principles can be used to shape the learning outcomes of our experiences that will lead to greater visitor engagement with science, which we can observe.



Engagement can be observed and measured as visitors having:

- a meaningful connection
- link with self and sense of belonging
- persistence; positive emotions
- purposeful and focused participation
- competence and mastery

Another aspect that we can monitor is the changes in our practice, to create an environment and experiences that reflect the principles of science capital and value what our audiences 'bring with them'. The impact of the concept on our practice will be visible in our everyday work.

Appendix 1: Audit and reflection tool

SMG is piloting an auditing tool to help us reflect on our current offer and to shape the design of our experiences and resources. Informed by the science capital dimensions, this practical tool can help identify best practice and highlight opportunities for improvement.

We hope that this will enable us to provide a space and experiences where science is inspiring, interesting, and enjoyable and promotes science engagement for all our visitors.

How are we creating a welcoming and equitable space?

- How is the content/ science presented?
- Who is presenting the science?
- Does it assume prior experience or knowledge?
- Who is included/ absent? (Does it exclude any gender/ ethnicity etc?)

*How does it... **acknowledge and build visitors' science knowledge and/or skills?**
(i.e. what science you know)*

Currently...

How might it be improved...

*How does it... **help visitors recognise (that they know) people who use science in their everyday lives?**
(i.e. who you know)*

Currently...

How might it be improved...

*How does it... **link the science to everyday life/ personal experiences?**
(i.e. how you think)*

Currently...

How might it be improved...

*How does it ... **encourage visitors to talk and do further science-related activities?**
(i.e. what you do)*

Currently...

How might it be improved...

Appendix 2: Science capital dimensions in a museum context

SMG have reflected on the science capital dimensions for our museum context and are using them as guiding principles to inform the design and outcomes of our varied experiences and resources.

Science capital dimensions	Museum context
<p>1. Scientific literacy</p> <p><i>(Knowledge and understanding about science and how science works. Confidence/ ability to use and apply science knowledge, principles, language and scientific processes into everyday life)</i></p> <p>What science you know</p>	<ul style="list-style-type: none"> · Give opportunities for visitors to use/ apply their existing science knowledge and skills through a wide range of activities. · Use common/ correct science language and content (national curriculum level) to enable visitors to recognise and reinforce their prior science knowledge with their museum experience. <p><i>Knowledge and Understanding</i></p>
<p>2. Science related attitudes, values and dispositions</p> <p><i>(Seeing relevance and value of science in your everyday life. Seeing that science has value/ Can you see yourself as a science-y person)</i></p> <p>How you think</p>	<ul style="list-style-type: none"> · Frame all experiences around SMG learning vision · Recognise that every visitor will come with a different experience, knowledge and attitudes towards science · Help visitors to see where science is useful and relevant to their everyday lives (don't make assumptions of prior experience/ attitudes). · Challenge visitors' perceptions of science through surprising experience/ content delivery. E.g. <ul style="list-style-type: none"> – Present science content in different and relevant formats (invite and excite) – Include multiple voices and perspectives to enable visitors to make personal connections. – Share personal stories/ connections which invite others to share their own. – Highlight the diversity of people using and working with science (widen perceptions). – Give positive reinforcements/ validation of science knowledge and behaviour. <p><i>Attitudes and Values, Behaviour and Progression, Enjoyment, Inspiration & Creativity</i></p>
<p>3. Knowledge about the transferability of science qualifications (skills, knowledge) in the labour market</p> <p><i>(Awareness of where and how science skills, knowledge and understanding are <u>useful for any job</u>)</i></p> <p>How you think</p>	<ul style="list-style-type: none"> · Give opportunities to use/practice scientific skills when interacting in the museum –observation, asking questions, using evidence, communication, problem solving etc. · Help visitors to recognise the skills they have and to make use of them in the museum · Highlight how the skills visitors are using are transferable/useful for science jobs and beyond). · Show where and how skills are used by people who use science in their work. <p><i>Skills, Knowledge and Understanding, Attitudes and Values</i></p>
<p>4. Consumption of science-related media</p> <p><i>(Unstructured science activities -exposure to science through TV programmes, books, games, online etc.)</i></p> <p>What you do</p>	<ul style="list-style-type: none"> · Provide opportunities to extend the museum experience through accessible digital media, e.g. games/ films/ books/ kits which will extend and add value to the visit. · Link to platforms/ content that are used/ familiar with target audiences. <p><i>Enjoyment, Inspiration & Creativity, Behaviour and Progression</i></p>

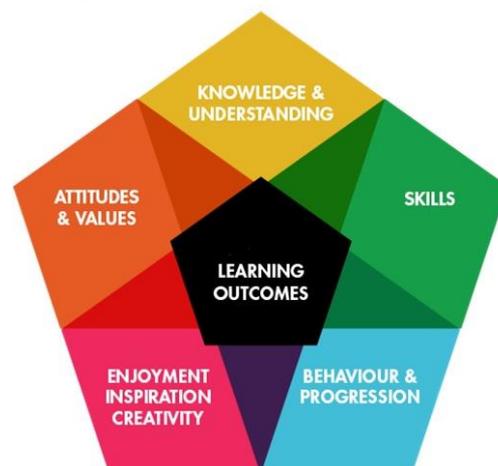
<p>5. Participation in out of school learning activities</p> <p><i>(Taking part in informal science activities outside of school.</i></p> <p><i>Enable the museum learning experience to extend back to school, home & local community, doing experiments, science kits/ tinkering etc.)</i></p> <p>What you do</p>	<ul style="list-style-type: none"> · Help visitors recognise where they are using science in activities they do beyond the museum/ classroom · Support teachers and families to make best use of the museum visit. Through: <ul style="list-style-type: none"> · Good communication/ advocacy of museum experiences and value of learning opportunities for all students/ families (not just top sets etc.) · Easy/ intuitive access to museum support resources (pre visit/during/ post visit). · Link science learning experiences between school, the museum and home. · Encourage and enable the museum experience to extend beyond the museum/ activity through discussion and participating in further linked science activities. · Encourage repeat visits <p><i>Attitudes and Values, Knowledge and Understanding, Enjoyment, Inspiration & Creativity, Behaviour and Progression</i></p>
<p>6. Family science skills, knowledge and qualifications</p> <p><i>(How much families and community are interested in science and have science-related skills interests, qualifications and jobs)</i></p> <p>Who you know</p>	<ul style="list-style-type: none"> · Empower parents/ guardians to feel confident using the museum and to participate in activities. · Provide opportunities for students to talk/ question family members during and beyond their visit (for family members to share their existing knowledge and experiences that they have). · Provide opportunities for families to complete challenges/ activities together which share everyone’s existing knowledge and experiences. · Extend the museum experience at home with wider members of their families and community. <p><i>Attitudes and Values, Knowledge and Understanding, Behaviour and Progression</i></p>
<p>7. Knowing people in science related roles and jobs</p> <p><i>(Recognising the science skills and knowledge used in the everyday activities and work of people you know)</i></p> <p>Who you know</p>	<ul style="list-style-type: none"> · Help visitors to recognise where people they know use science and science skills in their everyday lives. (E.g. in their family, community). · Provide opportunities to meet and talk with a wide range of people who use science in their work (in and from science) and help build/ recognise a personal connection with them. · Highlight skills and experiences of museum staff and of others working at events. <p><i>Knowledge and Understanding, Attitudes and Values</i></p>
<p>8. Talking to others about science</p> <p><i>(Talking about science outside of school, e.g. with friends, siblings, parents, community members.)</i></p> <p>Who you know</p>	<ul style="list-style-type: none"> · Empower/ build confidence for visitors/students to share (science) knowledge with others. · Design experiences which promote science talk both during and beyond the visit, between peers and family members. · Enable visitors to continue those conversations beyond the museum experience/activity and build confidence for them to do that. · Provide activities which reflect/ recognise that all family units are unique and different. <p><i>Behaviour and Progression, Skills</i></p>

Appendix 3: Visitor learning outcomes with science capital lens.

SMG are using the science capital dimensions to inform our learning outcomes. These help practitioners to shape experiences and create outcomes that are measurable and observable.

Our learning outcomes are used to:

- Shape and inform the development of an experience or resource
- Reflect on practice during delivery
- Monitor progress against (outcomes that are observable and measurable)
- Audit the breadth of experiences that we offer to identify any gaps



<p>Knowledge and Understanding</p>	<ul style="list-style-type: none"> · Learn something new · Reinforce/ make sense of prior knowledge · Make new links and associations · <u>Understand the relevance (of science) to people’s everyday lives</u> · <u>Understand the learning opportunities of museums/ science centres as a resource</u> · Understand how museums (and science centres) operate
<p>Skills</p>	<ul style="list-style-type: none"> · <u>Knowing how to do something</u> · Being able to do new things · <u>Recognise using (scientific) skills Inc. observation, asking questions, using evidence, communication, creative problem solving</u> · Use wider subject skills e.g. numeracy, literacy, IT, physical skills · <u>See the transferability of these skills to everyday life (and future jobs)</u>
<p>Attitudes and Values</p>	<ul style="list-style-type: none"> · Challenge beliefs and values · <u>See that the Museum is a ‘place for me’</u> · <u>See there is a wide diversity of people who use science in their work</u> · <u>See (science) as something ‘I can do’ (in my life today and the future)</u> · Appreciate a range of viewpoints and empathy with others people · Increased motivation/ self-worth
<p>Enjoyment, Inspiration & Creativity</p>	<ul style="list-style-type: none"> · <u>Inspire interest and curiosity</u> · <u>Make a personal/ emotional connection with a (science) experience</u> · Having fun · Being surprised · Inspire awe and wonder · Be creative · Exploration, experimentation and making
<p>Activity, Behaviour and Progression</p>	<ul style="list-style-type: none"> · <u>Increase self-confidence and self-efficacy (belief you can do it)</u> · <u>Motivate to investigate further</u> · <u>Inspire people to take part in (science related) activities in their own time</u> · <u>Talking (about science) to others</u> · Share/ recommend their (museum) experiences with others · Have or intend to return after their visit

Appendix 4: Museum learning framework

SMG believe a good museum science engagement experience needs 4 simple ingredients: **hook**, **inform**, **enable** and **extend**, whether it is an interactive show, exhibition, teacher resource or event.

Hook

How the experience or resource **captures people's attention** and helps them to make a personal connection. A good hook can be achieved through:

- Introducing the content in surprising ways (e.g. games, humour, and popular culture).
- Sparking curiosity ('did you know...?')
- The awe and wonder of our authentic objects, of 'seeing the real thing'
- Linking the content to people's lives, local community and current events.
- Being thought-provoking and opinion-generating.

Inform

How it provides **science content knowledge and context** at an appropriate level to help visitors link to and **build on their existing knowledge**. Ideas include:

- Provide information through a variety of formats e.g. video, animation, images etc.
- Use objects or working models to highlight the underlying science principles and concepts.
- Stories - social/ historical and personal stories which help put science into context.

Enable

How it gives the opportunity for **people to actively do something** and interact with the (new) content (not passive absorption of information).

Enabling approaches include:

- Thought-provoking questions which get people thinking and talking. (e.g. see, link, wonder)
- Hands-on activities
- Challenges to 'gamify' the learning experience.
- Self-discovery/ learning (take ownership of knowledge)

Extend

How it provides the opportunity and a reason to **continue the learning experience** in other parts of the museum and/ or back at home and in the classroom. Making the experience last longer than the experience itself and helping embed the science in audience's everyday lives. Ideas include:

- Activities and questions to completed on way home/ on way back to school
- Advocate activities to be completed by families at home/ in local community



Further information

About Enterprising Science

Enterprising Science is a five-year partnership across the Science Museum Group, King's College London and supported by BP. This research and development project uses the concept of science capital to understand how young people from all backgrounds engage with science and how their engagement might be supported

enterprisingscience.com

The Science Museum Group and science capital

sciencemuseum.org.uk/enterprisingscience

sciencemuseum.org.uk/sciencecapital

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