

Report

Transforming practice:

Science capital seminar at the Science Museum

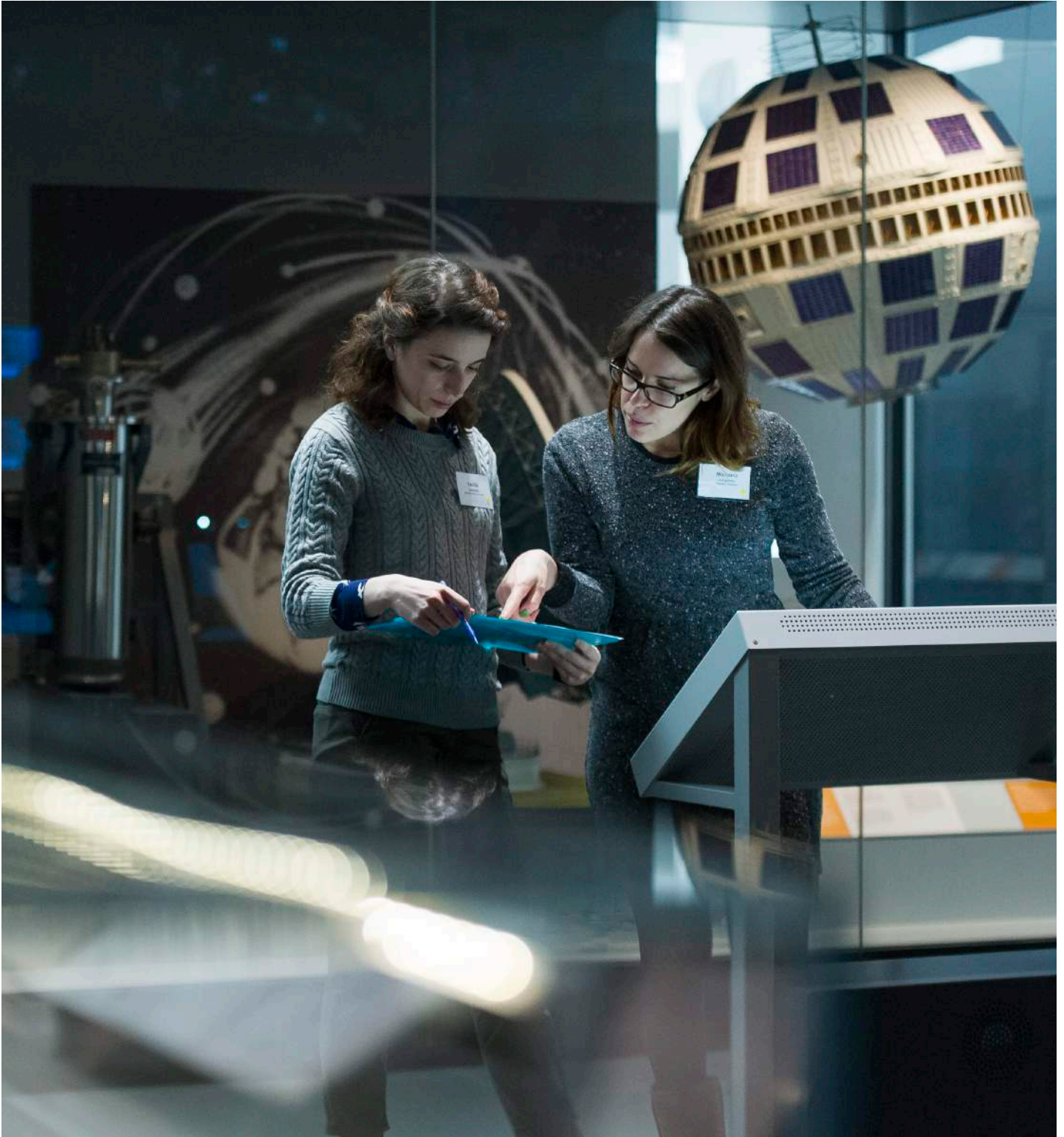
9 October 2015



SCIENCE
MUSEUM

KING'S
College
LONDON

Enterprising Science is brought to you by BP,
the Science Museum and King's College London



Executive summary

What can science capital do for the world of informal science?
And how can an understanding of science capital help foster social
mobility and science aspiration?

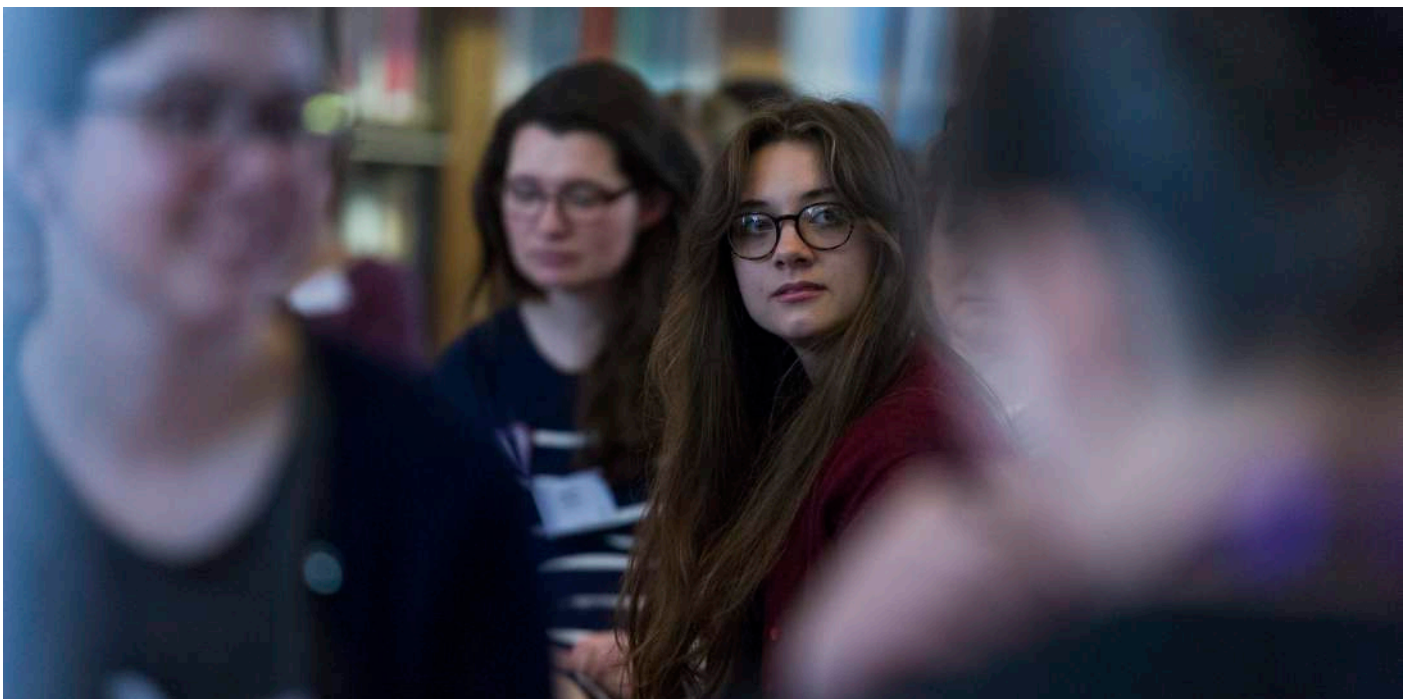
On Friday 9 October, delegates met at the Science Museum for a seminar and wide-ranging discussion of emerging research into science capital and its implications. The aims of the day were:

- to share the latest academic understanding of science capital - a measure of the science-related qualifications, knowledge, interest, scientific literacy and social contacts a person has.
- to explore the implications of this research for transforming practice in the informal learning sector.
- to hear, capture and seek to understand delegates' responses and feelings towards science capital.

The day's presentations were made by partners in the Enterprising Science project, who are King's College London, the Science Museum Group and BP. Together they are developing and testing concepts of science capital, and seeking ways to audit informal learning environments using the concept of science capital, in order to enable more young people to say that 'science is for me'.

In this report, the Science Museum and King's College London present a summary of the day's content and a reflection of the very lively discussions, feedback and questions gathered from participants on the day. With backgrounds in science museums and centres, scientific charities and professional bodies, educational organisations and agencies, the delegates gave valuable perspectives from their diverse areas of science communication.

As the Science Museum and King's College London continue with the work of the Enterprising Science project, they hope to inspire other informal science learning providers to join in the conversation about the value of science capital, helping to make a difference in more people's lives.





Science capital at the Science Museum - our current context

Tom O'Leary, Director of Learning
Science Museum Group

The powerful concept of science capital can change the practice of the Science Museum Group and potentially that of many people involved in informal science learning.

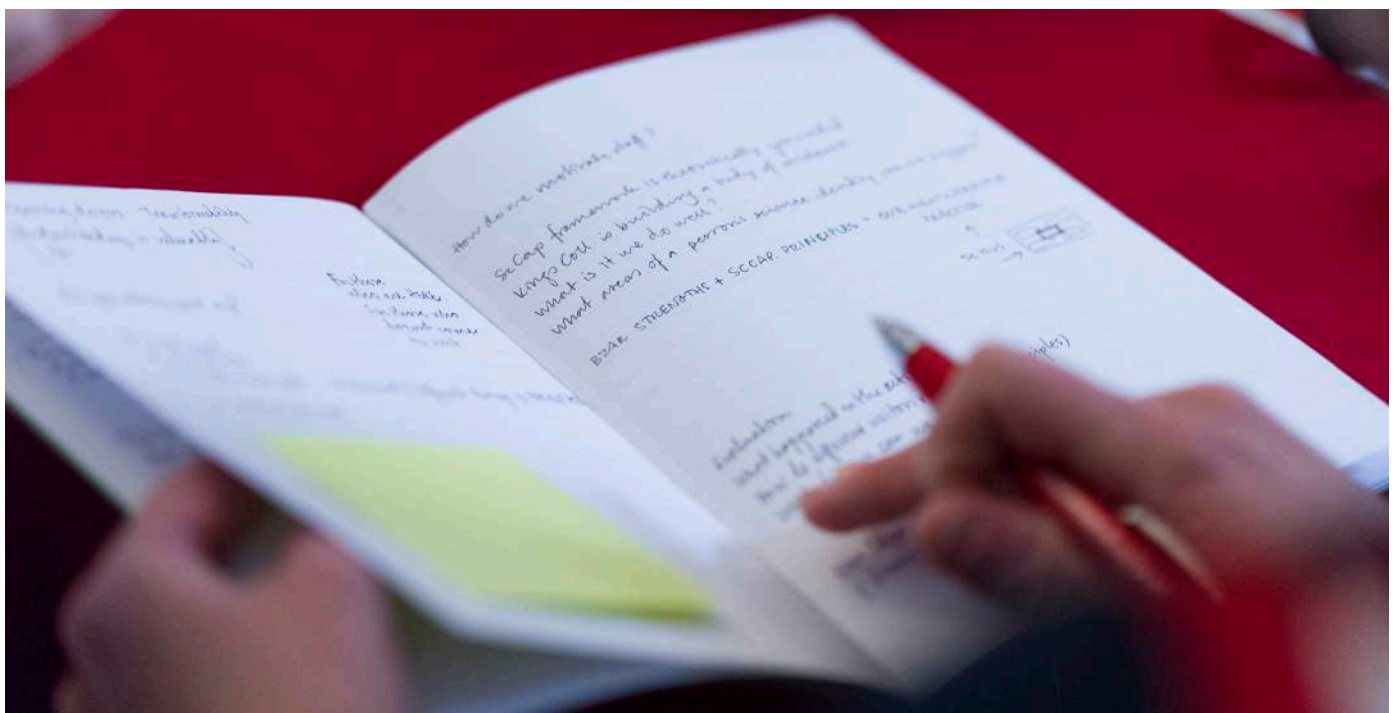
Tom O'Leary, SMG

Since 2013, the Science Museum Group (SMG) has been a partner in the Enterprising Science project with King's College London (KCL) and BP. By building on research from KCL's ASPIRES project and over twenty years of SMG's audience research, combined with practical expertise in delivering engaging learning experiences, we are seeking to understand how science capital can lead us to develop our practice and deepen our influence on our audiences.

Enterprising Science strands of activity so far have included:

- research with teachers and families
- professional development programmes with teachers and museum educators
- resource development
- dissemination and publication.

Although the Enterprising Science project is ongoing, and there is much more to learn and discover, Tom O'Leary, Director of Learning at SMG has put the concept of science capital at the centre of our approach to learning.



Research by our colleagues at KCL shows that the more science capital a young person has, the more likely they are to study science post-16 and to see science as 'for me'. Yet 27% of all 11 to 17-year-olds have low science capital, particularly those from disadvantaged schools and communities.

Informal science learning providers are in a good place to help make connections between teachers, young people, and their families, the crucial network that lies behind the development of science capital. The informal science learning sector can help secondary teachers tap

into their students' home-based knowledge and experiences to make science more meaningful and relevant - and ultimately show it to be achievable and attractive for further study or a career path.

SMG is deeply committed to applying what we are learning to the way we develop resources, programmes and exhibitions - using the concept of science capital to understand how we can help influence the lives of many more visitors. This is part of what success will look like - along with a commitment to sharing research and ideas so that they can be taken up by others.





Session 1: Understanding science capital

Professor Louise Archer, Enterprising Science research team director
 Dr Heather King, Enterprising Science deputy research team director
 King's College London

Why science capital?

Within the five-year Enterprising Science project, King's College London is providing the theoretical framework for discussions and the development of the science capital concept.

The UK has spent millions of pounds on interventions that seek to increase participation in STEM. But this hasn't radically changed the profile of the people who study science post-16 (particularly the physical sciences and engineering) or who take up careers in science. Why not?

In our longitudinal ASPIRES research, we have surveyed over 31,000 10-16 year olds to date. We've learned that it's not that students don't find science interesting, or that their families don't support them, or that they have negative attitudes towards scientists. A high proportion find science interesting, even 15-16 year olds (who are in the most intense stages of GCSE preparation).

But very few young people aspire to continue with science post-16. There is what we call a doing/being divide – they like doing science but don't want to be a scientist. And so we are seeking to understand this through the concept of science capital.

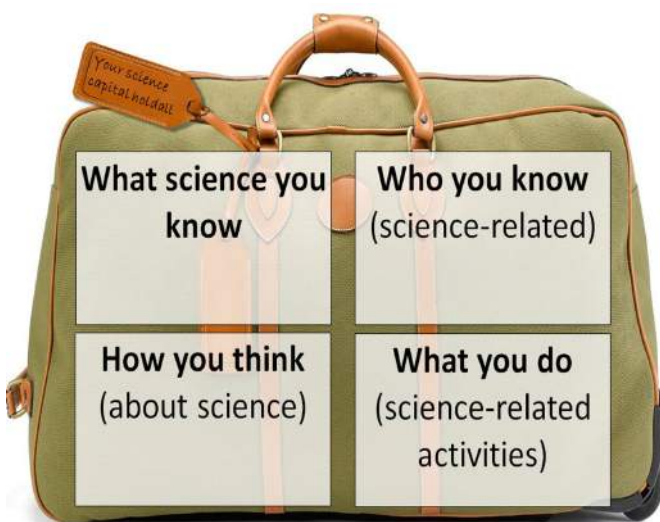
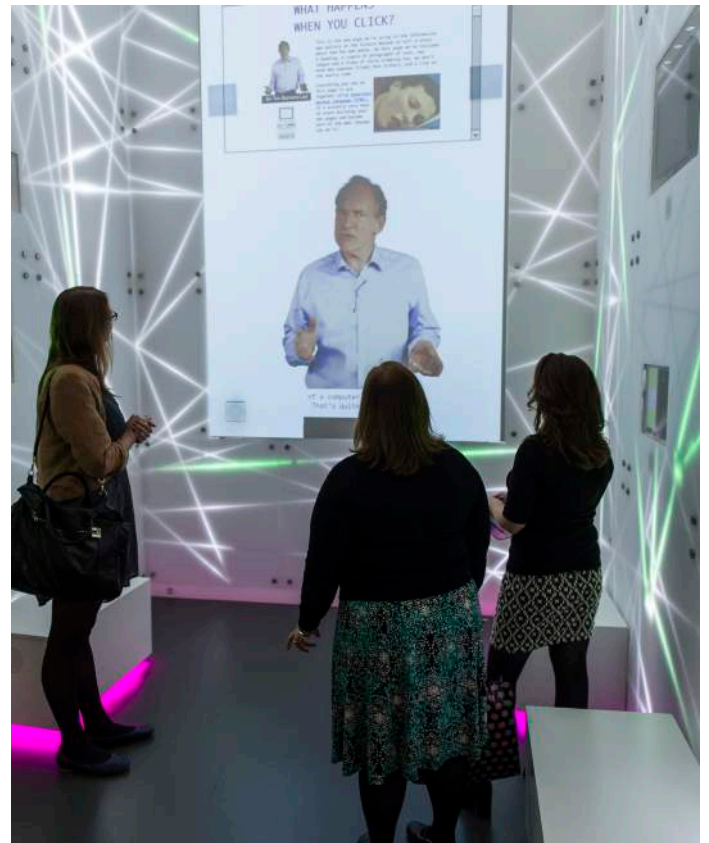


What is science capital?

In the ASPIRES project we proposed the concept of science capital as a way of helping to understand who does, and who does not, aspire to continue with science. Science capital can be conceptualised like a 'holdall', or bag, that contains all your science-related knowledge, interest, attitudes, contacts and resources. A statistical analysis of survey data shows there are many elements, but, roughly speaking, it can be grouped into four main 'pockets':

- what you know (your scientific literacy and how confident you are in your understanding of science and how it works)
- who you know (people you know with science-related jobs or knowledge; how often you talk with others – for example family members – about science in everyday life)
- how you think (your science-related dispositions and attitudes to science)
- what you do (science-related activities out of school, e.g. whether you go to science museums, read, watch science TV)

How much science capital you have, and what sort, is shaped across all of your life – home, school, everywhere. It's not fixed, you can acquire more (and different sorts of) science capital as you move through life. And its value is determined by context (like a foreign currency – its value depends on the local 'exchange rate' and conditions).



The science capital 'holdall' contains all your science-related resources.



Can we measure and increase science capital?

We still have a STEM skills gap in the UK and the same kinds of people are doing science as 20 years ago. To challenge this, we want to develop, measure and test how people engage with science and find out why they feel 'yes, science is for me' - or not. Science capital gives us the explanatory framework to do this - and can also be used as a tool to build young people's engagement with science.

We see science capital as a tool not just for facilitating the science 'pipeline', but more importantly as part of a social justice approach to improving public scientific literacy, to help more people, from more diverse backgrounds, have agency, choices and social mobility.

We have been working with:

- teachers, doing professional development, seeing how to implement a science capital approach in their teaching
- students, carrying out a longitudinal survey, doing interviews and discussion groups, and observing school museum visits
- families, observing family museum visits, to understand how families of all kinds experience these spaces.

We want to work with teachers and the informal science sector to help highlight to students the range of opportunities from as well as in science - that is, how science skills and qualifications are useful for any job. We also want to make use of family expertise - the knowledge, skills and experience that families and children bring, which they may not recognise as being science. If we can build on this it give us a better platform to go forward.

Science opens doors and can be incredibly valuable for any career.

Heather King, KCL

If we can improve their science capital - it will improve the life chances of all our children.

Louise Archer, KCL

How does science capital impact on the informal learning sector?

In our observations of families in informal science settings, we have seen that those who have higher science capital and can access family funds of science knowledge, are better prepared to benefit from opportunities for science learning in the museum.

Even though a visit may still be fun for those with low science capital, we found that much more needs to be done to help diverse visitors to connect with the science in museums.

Museums need to reach those who have low science capital - and also those who are unfamiliar with visiting museums and find the experience disorienting. One approach suggested by the science capital model is to leverage the other kinds of capital that families bring. How can we draw on this and help them translate it into science capital?

Perhaps there is scope for getting schools to engage more with out-of-school science learning. The issue is that many schools are not accessing the opportunities offered by science-related school trips. Our student data showed that:

- 69% never had a science-related talk
- 42% had never had a trip to museum
- 52% had never taken a science-related school trip.

We are very clear that no single sector can fix the problem alone. We need common messages across sectors. But science capital offers a useful reflection tool to help us understand what to do and how.

Resources and references:

Aspires project report:
<http://goo.gl/Asmhk2>

KCL Enterprising Science page:
<http://goo.gl/ssnK1G>

Animation: Science capital – an introduction:
<https://youtu.be/A0t70bwPD6Y>





Session 1: Responses to science capital

During a roundtable discussion following session 1, we captured these questions from delegates as they sought to understand the concept of science capital and what it offers the informal science learning sector. The project team from the Science Museum Group and King's College London is now developing more detailed responses to these questions (which will be shared in the new year) to enable conversations to continue.

The concept of science capital:

- are all four 'pockets' of the holdall equally valuable?
- how do the four elements of science capital influence one another?
- how does science capital support or extend cultural institutions' Generic Learning Outcomes?

The value of the idea of science capital

- does science capital help us understand our audience better?
- could science capital offer new approaches to the problem of inequality of opportunity?
- is science capital an aspect of cultural capital, or a separate concept?
- is it possible or helpful to try to measure and track changes in science capital?

The role of the informal learning sector

- could science capital give us a unifying concept across all institutions working with science?
- could science capital help teachers see the links between the classroom and the museum?
- how can we reach people with low science capital if they aren't coming through our doors?
- do we need an integrated approach to science capital through all our exhibitions, programmes, shop, café etc?

Potential issues and barriers

- how do we get whole institutions to buy in, so it isn't just the learning department?
- how do we strengthen the link between research and practice across the sector?
- how much will the potential of museums be limited by teachers' own science capital?



Session 2: Applying science capital in informal settings

Micol Molinari and Jane Dowden, Enterprising Science project coordinators
Science Museum

■ We believe the informal science sector has vital strengths in making people feel more at home with science. ■

Micol Molinari, Science Museum

How can the informal learning sector apply the concept of science capital?

Science capital is a way of thinking about all the science influences on someone's life - how much they feel 'at home' with science. The research shows that if you have higher science capital, you place greater value on science and see the science in a diversity of experiences you might have in your life.

The informal sector can seek to raise science capital by leveraging the things it is particularly good at doing. We can reveal scientific themes and stories that captivate our audiences. We are not limited by the curriculum. We can help families learn together and normalise science talk outside of school.

We act as a bridge between schools and families, connecting the classroom to the everyday. We support a person's science identity throughout their life.

Building our audiences' science capital is not about filling an empty holdall. We are helping them recognise, value and apply science in the areas they already know about.

We can't really say one exhibit or experience builds science capital. But we can monitor and chart our practice. Are we transforming? Are we changing to reflect what the research suggests?





How can the concept of science capital help us reflect on our practice?

One of the Science Museum's first attempts at thinking about what we currently do has been to develop a simple reflective framework. It is helping us spot opportunities for, and successes in, good science capital-related practice.

For the initial framework, we selected questions that were shaped by the four pockets which KCL research suggests influences someone's science capital.

So, the framework asked, does the exhibit:

1. improve a visitor's science knowledge or skills? (What you know)
2. help a visitor recognise they know people who use science in their life or work? (Who you know)
3. encourage a visitor to have a positive feeling about science? (How you think)
4. encourage a visitor to do science-related activities outside the museum? (What you do)

■ We are in a really good position in the informal sector because we can reveal the science in themes and stories that affect our visitors - we're not restricted by formal curricula. ■

Jane Dowden, Science Museum

We are continuing to develop this reflective framework, working alongside the research team, and we will share the updated framework in the new year. The main change is that we have now 'unpacked' question 3 to explicitly address the elements that can influence someone's attitude about science. Based on suggestions from the research, we now propose additional questions around how the content is presented, whether the exhibit links to visitors' culture and experiences, and whether it shows that science is useful in the visitor's everyday life. But even as an initial attempt at reflecting on science capital, the process validated some of what we do, and gave us the chance to extend or change what we do, too.

For example, we often seek to make science exciting and dynamic, and so this might be reflected in the answer to question 3.

We also try to design for discussion, so we are aiming to encourage visitors to talk about science and find it normal to discuss scientific ideas and questions, even after they go home. So this might be reflected in answers to question 4.

The framework applies to programmes, events and workshops in just the same way as exhibits. It helps you to ask yourself about all four of the pockets in the science capital holdall and whether you are addressing them. Applying the framework to exhibits, or programmes, or any aspect of our work, helps us to reflect – in a joined-up way – on our practice, identify issues, and make changes as necessary.



'Opportunities for good practice' initial reflective framework

Opportunities for good practice in the gallery

- 1) Find an exhibit/display that you are drawn to, interact with it for a few minutes. Then, fill in the blue box of this sheet
- 2) Discuss with your group which of the 4 opportunities you feel the exhibit addresses, and/or how it could be improved (you could suggest changes to the exhibit, or ideas for supporting activities/resources). Fill in your notes ready to share when we regroup.

1. Does it... **improve a visitor's science knowledge and/or skills?**

Yes, because it...

No, but you could improve that by...

2. Does it... **help a visitor recognize they know people who use science in their life/work?**

Yes, because it...

No, but you could improve that by...

Exhibit/display chosen:

Because it...

3. Does it... **encourage a visitor to have a positive feeling about science? ***

Yes, because it...

No, but you could improve that by...

4. Does it ... **encourage a visitor to do science-related activities outside the museum?**

Yes, because it...

No, but you could improve that by...

**Update this box to include:*

Does it...

...present the content in a fun/
interesting/engaging way?

...link to and value your visitors'
cultures and experiences?

...show that science is useful
in the visitors' everyday life,
including work?



Session 2: Responses to reflective framework

During session two, delegates participated in an exercise in the galleries, using the Science Museum's initial framework to reflect on exhibits. Through the framework they asked themselves the questions shown, suggested ideas for applying good practice to an exhibit in terms of science capital, and gave responses that will help us develop and improve the framework.



1. Does it improve a visitor's science knowledge or skills?

- exhibits need to be relevant to everyday life (not abstract)
- better links between related objects, interactives, galleries, would help build knowledge
- do we need areas of a gallery where families learn how to talk at a deeper level - games, experiments, discussions?

2. Does it help a visitor recognise they know people who use science in their life/work?

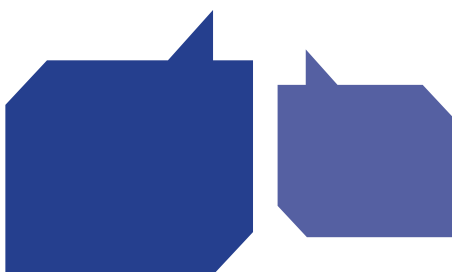
- exhibits should tell stories about people behind discoveries - although these people are often not very diverse
- include a wider range of jobs (not necessarily in science) that might use an aspect of science
- include diverse audiences in a positive way.

3. Does it encourage a visitor to have a positive feeling about science?

- the historical story may provide a more exciting and intriguing 'way in' than the science
- exhibits should make links to familiar things that real people (from a range of backgrounds) do and experience
- we need to value the attitudes visitors bring in to the museum
- art exhibits can be useful but some require a lot of cultural capital to access and appreciate.

4. Does it encourage a visitor to do science-related activities outside the museum?

- an exhibit can build valuable emotional science capital if it has a shock value that leads to reaction and discussion
- galleries could have 'do this at home' extensions
- display 'rules of engagement' - like some bars tell you how to order food
- link to other science centres, and more science media where they might find this content e.g. TV, blogs.



General comments about the framework:


- perhaps it would be fruitful to ask 'does the exhibit make use of visitors' existing knowledge and skills?
- should/can all exhibits address all four of the science capital elements?
- are we just improving the experience of those who already visit?






Session 3: Monitoring our progress

Chris Whitby, Senior Audience Advocate
Science Museum



The science capital principles give you a way to understand visitors and potential visitors, how they engage with science, what they bring to the table and what they want from you.



Chris Whitby, Science Museum

How can we audit what we are offering?

Science capital is a very powerful way of looking at what we offer in the informal learning sector, with a robust academic model and research behind it. However, our long-term impact is hard to evaluate. We are just one part of a web of influence in people's lives. We don't know an individual visitor's science capital when they come in, and can't measure the effect we've had during their visit.

So, rather than a way of evaluating visitors, science capital offers a way of auditing ourselves and what we are offering. It gives a way of understanding different visitors, the different ways they engage with science, the things they bring to the table and what they want from us in that experience.

The Science Museum has started to look at its practice through 'science-capital-coloured glasses'. We've found that we don't have to overhaul everything and become a different institution. We already do some things really well, and there are areas where we can see the opportunity to change and improve.

It also makes us think about how we might engage with those people who don't visit. Science capital can help the whole sector think more deeply about how we could change and develop what we do to meet different people's needs. How can we value the knowledge, the capital, that people who don't currently visit already possess, to help them feel welcome, and see the museum as a space for them.

And science capital helps us to think more effectively about ways in which museum, home and school might interact. For example, when we reflected on an activity we had developed for families to do at home, we realised we were presenting an idealised picture of families. Now, we want to think again about what families look like, and really do. Then we won't be making assumptions about the kind of families who are 'at home' with science - but will be working towards making it accessible to all.

How can we spread the influence of science capital?

We are excited about the potential of science capital to help us develop what we offer. But how can we influence colleagues, firstly in our own institutions, to work with us?

Colleagues need to find the theory of science capital useful and relevant to their work.

When we developed our initial framework for reflecting on opportunities for science-capital-informed practice, we found this was a very helpful tool for making the concepts tangible to colleagues in the Learning team. People started to reflect immediately on what they normally did and how they might approach it differently.

By creating a reflective framework we could audit what we are offering, reflecting on whether we were adhering to best practice in terms of science capital. We found the framework helped formalise how we reflected on new activities, leading to a more robust development process.

What's a good starting point for embedding science capital?

If we are to influence the broader educational and political sectors, the idea of science capital needs to be embedded and tested across our institutions.

To begin embedding science capital in your setting, we suggest you identify the challenges you want to overcome - and apply science capital to help you tackle them. What can you do, what can you do more of? Maybe outside the museum?

A useful first step could be to ask staff to go on accompanied visits to see what your setting looks like to different people. Then, develop a reflective framework with the challenge you want to overcome in mind. And share results with other institutions in the sector, so that we can all learn from each other.





Session 3: Where do we go from here?

In a third discussion session, delegates responded to all they had heard on the day, and contributed ideas and questions on integrating science capital in specific areas in their organisation. The project team from the Science Museum Group and King's College London will develop responses to these in more detail.



Influence in your organisation

- need to think what would persuade non-learning staff to come on board
- how do we communicate the value and purpose of science capital in our organisation?

High and low science capital

- perhaps there are schools led by people with high cultural capital but low science capital. Could we have a big impact quickly here?
- many kids who we might consider to have low cultural capital are actually bilingual. Maybe we need to understand different kinds of cultural capital, including pop culture, popular science alongside science capital?

Careers

- how do you highlight STEM subjects without implying that only STEM careers lead from there?
- we can use the science capital framework to highlight people who use science in their work, and broaden the understanding of how many jobs actually use science.

Impact on live events

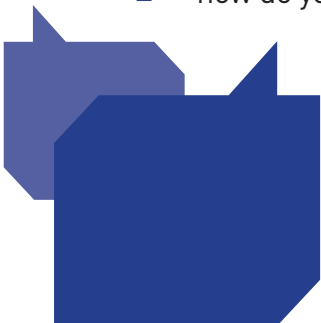
- how can I make an emotional and relevant connection with an audience of 100+ people with different backgrounds?
- events have a higher impact if the child is personally involved or there is a memento for example, a photo which helps the experience endure.

Impact on exhibitions

- create a reflective framework that works as an exhibition development tool
- we need to find how to value visitors' own knowledge- and it's not about making exhibitions that highlight a specific culture to speak directly to that audience.

Influence on home

- how do you monitor effectiveness of take-home activities?
- how do you engage parents in school science? Awards?



Self-led and digital activities

- trails - the whole family can work together and use existing funds of knowledge
- cross-curricular activities could hit art and science, making science more transferable.

Monitoring progress

- we need a change of learning ecology across the sector- a coherence across institutions would be valuable
- we need to be reflective practitioners!
- we don't want to just have articles of faith. Would like to see and have evidence of what is really working.



Next steps

For the first time, the informal science learning sector has a strong research base on which to build strategies for more effective projects, programmes and exhibitions.

Emerging from the seminar day are ideas about how science capital could influence our thinking. If we work collaboratively, and cohesively, linking up home, school and leisure time, could we see science flourish in people's lives and careers, improving their life chances? Could we start to understand the interactions between science and other domains in an individual's learning landscape? Could we learn to use people's existing capital to help them access science?

Although it might seem initially that science capital is a way of measuring impact on audiences, the Enterprising Science team's position is that it could be more powerfully used as a tool to develop what we offer and improve social equity.

As the KCL team continues their research, they want to understand more about how a science capital perspective can transform science learning, and ultimately, lives.

This work will have enormous influence on the way informal learning practitioners plan, develop and deliver projects - and reach groups currently under-represented in our audiences.

At the Science Museum Group, the learning strategy now has science capital principles embedded throughout. As time goes on, the galleries, programmes, shop, IMAX and café will all start to plan with visitors' science capital in mind, and staff will understand the thinking behind it.

There is still much to learn, but with so much to gain for so many, we invite you to join us on the journey.

This report is a snapshot of progress so far on the Enterprising Science project. The project team will be responding in more detail to the questions and discussions raised at the seminar day.

We invite you to share your experiences of applying science capital principles within your own organisation. Look out for our online channel for ongoing conversations and reflections, as well as project updates.

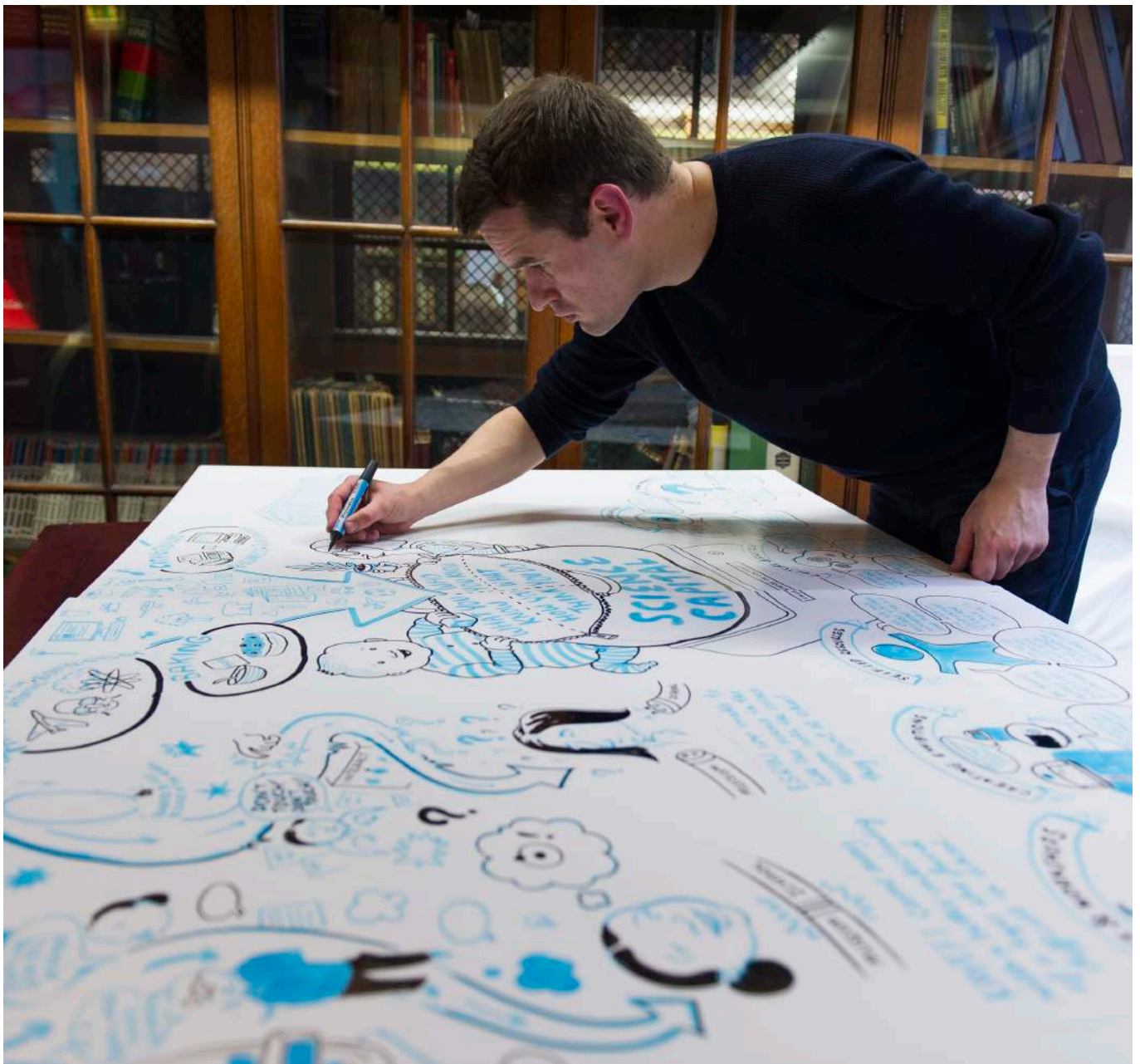


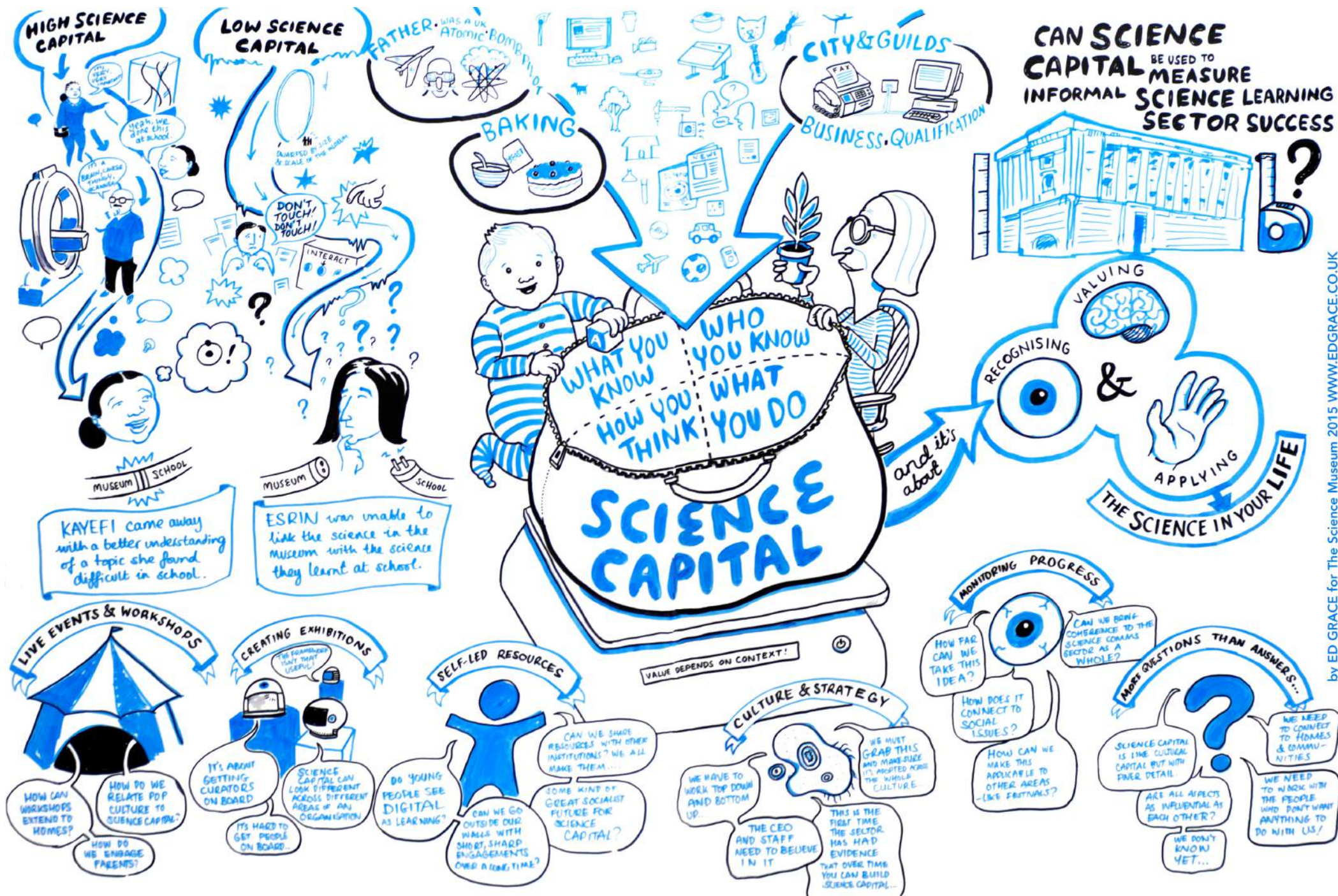
With thanks to:

BP for their support of the Enterprising Science project.

Ed Grace, Chris Lobina and Rebecca Mileham for beautifully capturing the day.

And of course, everyone who attended the seminar and participated so enthusiastically in the activities and discussions.





Illustrator Ed Grace captured the day's conversations.



Enterprising Science is brought to you by BP,
the Science Museum and King's College London 32