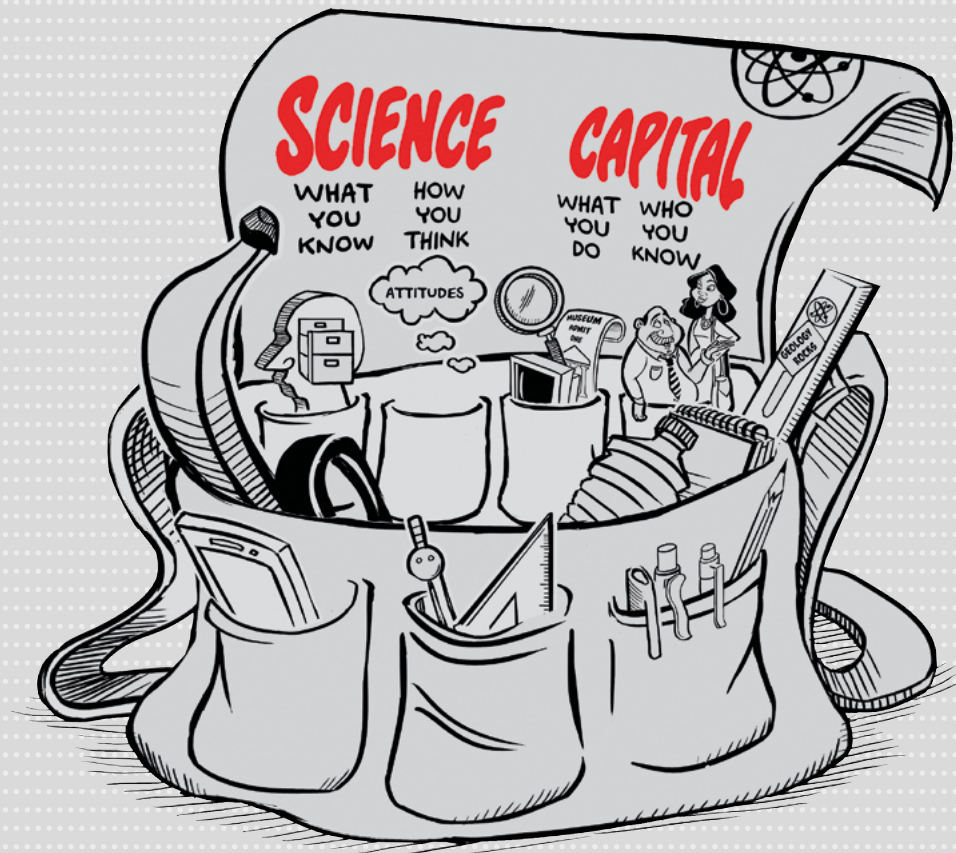


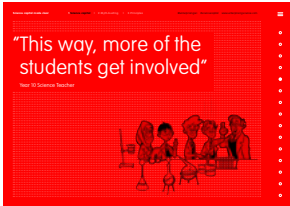
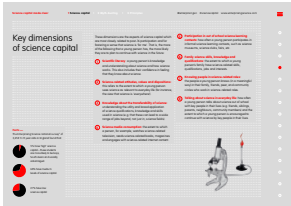
Science capital made clear



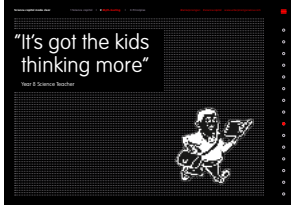


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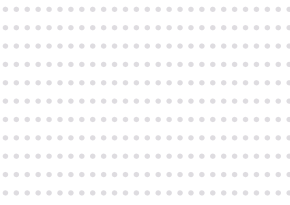
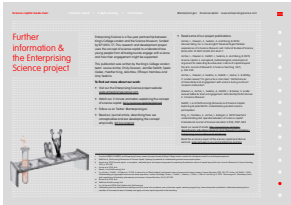
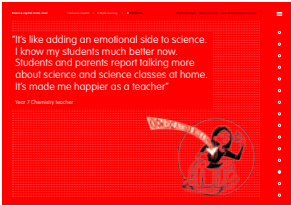
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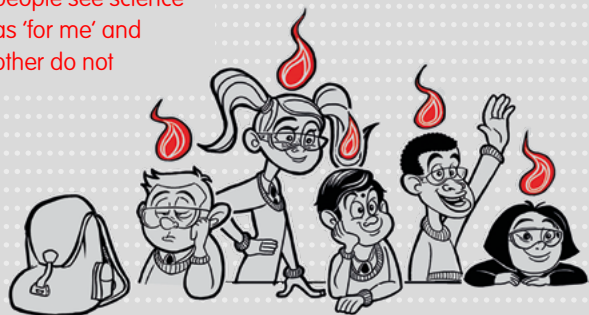
Science capital

– the key points

- Science capital is a concept that can help us to understand why some young people participate in post-16 science and others do not. In particular, it helps shed light on why particular social groups remain under-represented and why many young people do not see science careers as being 'for me'.
- The concept of science capital can be imagined like a 'holdall', or bag, containing all the science-related knowledge, attitudes, experiences and resources that you acquire through life. It includes what science you know, how you think about science (your attitudes and dispositions), who you know (e.g. if your parents are very interested in science) and what sort of everyday engagement you have with science.
- Research evidenceⁱ shows that **the more science capital a young person has, the more likely s/he is to aspire to continue with science post-16 and to see themselves as having a science identity.**
- The concept of science capital is drawn from the sociologist Pierre Bourdieu's concept of capital (referring to economic, cultural and social resources) – in short, Bourdieu proposes that **the more you have of the 'right sort' of capital, the better you are able to 'get on' in life.**
- In the Enterprising Science project we are developing our understanding of the concept of science capital and researching its implementation in practice. We are exploring ways to help **build young people's science capital through schools and informal science learning contexts.**
- To date, we have formulated and explored the concept in relation to **young people** (school students), but we think there is useful potential for further developing and applying the concept to adults.
- Our hope is that **building science capital** will have a positive effect on young people's lives. Building science capital could enable more young people to access jobs in science, technology, engineering and mathematics (STEM) areas. Most importantly, we hope that building science capital is a **tool for social justice**, to help improve people's life chances and to foster active citizenship.
- Science capital is a broad and diverse concept, which includes a wide range of knowledge, experiences, attitudes, behaviours and practices. However, our statistical analysis has identified eight key dimensions of science capital - see 'Key Dimensions of Science Capital'.



Science capital helps us to understand why some young people see science as 'for me' and other do not



Key dimensions of science capital

These dimensions are the aspects of science capital which are most closely related to post-16 participation and for fostering a sense that science is 'for me'. That is, the more of the following that a young person has, the more likely they are to plan to continue with science in the future:

- ① **Scientific literacy:** a young person's knowledge and understanding about science and how science works. This also includes their confidence in feeling that they know about science.
- ② **Science-related attitudes, values and dispositions:** this refers to the extent to which a young person sees science as relevant to everyday life (for instance, the view that science is 'everywhere').
- ③ **Knowledge about the transferability of science:** understanding the utility and broad application of science qualifications, knowledge and skills used in science (e.g. that these can lead to a wide range of jobs beyond, not just in, science fields).
- ④ **Science media consumption:** the extent to which a person, for example, watches science-related television, reads science-related books, magazines and engages with science-related internet content.
- ⑤ **Participation in out of school science learning contexts:** how often a young person participates in informal science learning contexts, such as science museums, science clubs, fairs, etc.
- ⑥ **Family science skills, knowledge and qualifications:** the extent to which a young person's family have science-related skills, qualifications, jobs and interests.
- ⑦ **Knowing people in science-related roles:** the people a young person knows (in a meaningful way) in their family, friends, peer, and community circles who work in science-related roles.
- ⑧ **Talking about science in everyday life:** how often a young person talks about science out of school with key people in their lives (e.g. friends, siblings, parents, neighbours, community members) and the extent to which a young person is encouraged to continue with science by key people in their lives.

Facts —

The Enterprising Science national surveyⁱⁱ of 3,658 11-15 year olds in England found that:



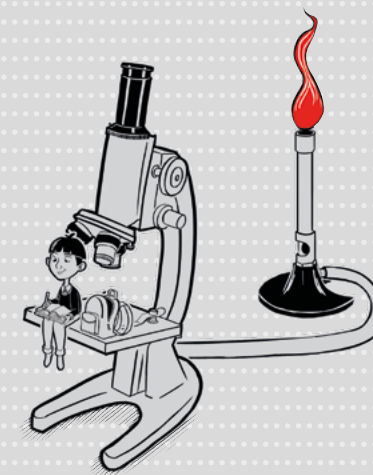
5% have 'high' science capital – these students are more likely to be boys, South Asian and socially advantaged.



68% have medium levels of science capital.



27% have low science capital



“This way, more of the students get involved”

Year 10 Science Teacher



Myth-busting

clarifying common misconceptions



The concept of science capital is gaining prominence within science education and informal science learning policy, practice and research. The concept is useful because it provides a common language and framework that resonates with the experiences and observations of many stakeholders across these fields.

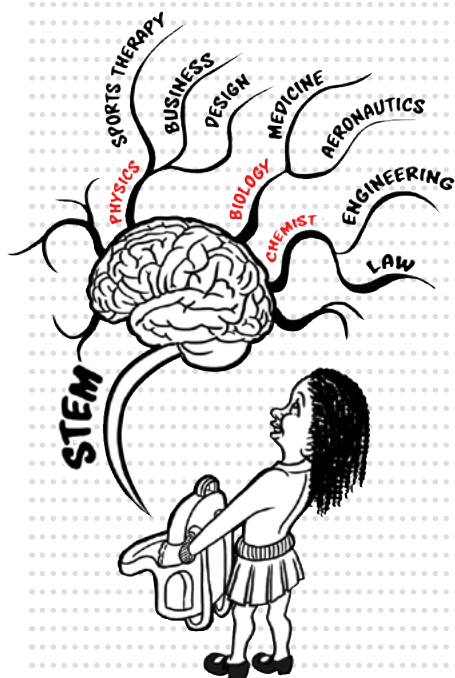
However, we have noted that, as its usage spreads, science capital is not always clearly understood and is often interpreted in different ways. Here we outline – and clarify – some common misconceptions.

Common misconceptions	Clarification
Science capital is the same as science literacy	<p>Science literacy (science knowledge, skills and appreciation of science) is an important part of science capital – but science capital is not just science literacy.</p> <p>Science capital also includes other practices including what you do, who you know, and what your family valuesⁱⁱⁱ.</p>
Science capital is just cultural capital	<p>Students with high science capital also tend to have high cultural capital^{iv} – that is, on the whole, students with high science capital are more likely to come from socially advantaged backgrounds and those with low science capital are more likely to come from disadvantaged backgrounds. However, this is not always the case. For instance, a socially advantaged student may have low science capital and a socially disadvantaged student may have high science capital, depending on their specific science-related resources.</p> <p>In other words, science capital is not reducible to cultural capital and statistical analysis shows that science capital produces a finer-grain analytic lens for predicting young people’s science aspirations and science identity, compared to cultural capital^v.</p>

Myth-busting

clarifying common misconceptions

continued



Common misconceptions

Science capital is the only factor affecting science participation

Clarification

Science capital is an important factor influencing science aspirations and participation in science but is not the only factor and it does not operate in isolation. Our research highlights the importance of multiple factors, including gender, ethnicity, teachers, educational systemic factors, issues of representation and the culture of science, and so on^{vi}.

In other words, a student with high science capital will not automatically pursue post-16 science – but students with high science capital are significantly more likely to aspire to post-16 science. Most importantly, they are more likely to see science as being ‘for me’^{vii}.

Science capital can be measured by a single survey question

Our analyses of a large number of survey questions (“items”) have identified a set of smaller c.14 items^{viii} which have the strongest statistical relationship to science aspirations and science identity. We suggest that these items represent a useful ‘backbone’ to the concept of science capital, which is amenable to measurement. However, it would not be meaningful to measure science capital quantitatively through a smaller number or subset of these questions (for instance via a very short ‘exit poll’).

We also believe that an interest in quantitatively ‘measuring’ science capital should not over-shadow the importance of qualitatively understanding the ways in which science capital ‘works’ in practice.

The main value of science capital is as a quantitative ‘instrument’ for measuring change

We see a key value of science capital being its potential as a reflective tool to help us to understand the influences affecting a young person’s participation (or not) in science.

It is also equally valuable as a concept for informing policy and practice.

We hope that our science capital surveys offer practitioners and researchers a concrete way to explore, compare and map changes in science capital (e.g. as the result of an intervention) – but this needs to be approached with care, recognizing that surveys are relatively blunt instruments.



Myth-busting

clarifying common misconceptions

continued



Common misconceptions

Clarification

Science capital is fixed

Science capital is not fixed: what capital you possess will change over time and will depend on context.

Our argument is that educators are able to help to build a student's science capital, by valuing and linking students' experiences from home with science, and by addressing the different science capital dimensions in their practice.

A science capital approach only focuses on changing students

Because science capital incorporates a number of dimensions, building science capital will inevitably require a holistic approach.

But it also requires changes to the wider context – because the value of a student's capital will be shaped by the context that they are in. It is therefore important to focus on changing institutional and system-wide structures and policies to enable more forms of science capital to be recognized and valued. Our final section ('Adopting a science capital approach in practice') provides more detail.

A science capital approach is only beneficial to particular social groups/types of student

Our research, and findings from teachers who have been adopting a science capital approach with diverse groups of students (from socially privileged, high attaining students in the independent sector to socially disadvantaged low attaining students in urban comprehensive schools), shows that it can be beneficial for all young people and teachers.

We know everything we need to know about science capital

Understanding science capital is a work in progress!

We are studying the ways in which educators can most effectively build science capital. From our data so far, it seems that small but cumulative changes in practice – e.g. valuing students' home experiences; encouraging science-based conversations out of school – are effective.



"It's got the kids thinking more"

Year 8 Science Teacher



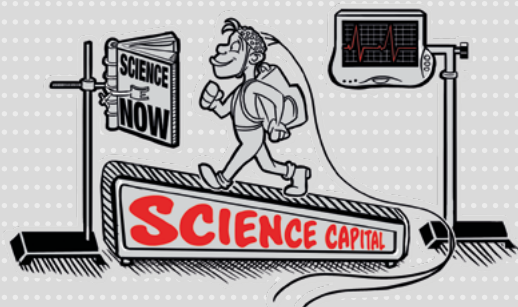
Adopting a science capital approach: Principles to guide practice

There is no single 'science capital approach', however, the following are some core principles that characterise what we would consider to be a useful and authentic science capital approach that could be enacted in policy and practice.

Key principles for adopting a science capital approach

- **Reflective** – a science capital approach is about a change in mind-set and pedagogy. It is not reducible to resources or activities.
- **Comprehensive** – a science capital approach means recognising and addressing, as far as possible, all the key dimensions of science capital (e.g. not simply focusing on, say, science literacy).
- **Holistic and structural** – a science capital approach requires recognising that efforts need to be targeted as much at systems, institutions, local areas and families as at the young people themselves.
- **Nuanced** – a science capital approach entails an understanding of the complexity of the concept and the issues involved. It seeks understanding of the issues, and does not just focus on quantitative 'measurement'.
- **Addressing the eight dimensions of science capital** – a science capital approach means ensuring that initiatives do not work against the key dimensions of science capital. For instance, only promoting the value of science as leading to careers in science would negate efforts to explain the transferability of science qualifications for all sorts of jobs and careers.
- **Fundamentally concerned with social justice** – a science capital approach is about trying to understand, identify, monitor and challenge inequalities. It means recognising the importance of power and how inequalities are perpetuated in society. A science capital approach is primarily concerned with helping to achieve improved life chances and outcomes for diverse individuals and communities.
- **Focused on trying to improve the wider system** – because the value of science capital is determined by the context, a science capital approach means paying meaningful attention to the institutions, systems and social relations within which people are located. It is about making sure that science contexts are supportive and offer value for everyone – not just the few. For instance, schools or museums could find ways to recognise, value and promote the varied interests, skills and experiences that diverse individuals, families and communities bring with them.
- **Collaborative and realistic** – building science capital is a challenging and complex endeavour. It means recognising that improving science participation entails changes and challenges for the whole STEM ecosystem and that there is no silver bullet (that is, a single approach or stakeholder is unlikely to be able to change the world alone). It is best attempted in partnership and with a long-term mind set!

In the Enterprising Science project we are developing, trialling and researching ways to enact a science capital approach in practice for teachers^{ix} and for science museums^x. At the time of writing, this work is still underway, however, below we summarise some of the key practical aspects of these approaches.



Pedagogical approach – schools

In 2015/16, the Enterprising Science project is piloting a science capital pedagogical approach with 10 teachers in 6 secondary schools across London⁴. In 2016/17, the pilot is being extended to schools in Manchester, Bradford and York.

The science capital pedagogical approach aims to support teachers in delivering their usual curriculum content. It seeks to complement existing practice.

In particular, the science capital pedagogical approach includes:

- Addressing the eight dimensions of science capital across existing schemes of work.
- Eliciting, valuing and linking students' prior knowledge and experiences from home, family and social contexts to school science.
- Highlighting the relevance and transferability of science for students' daily and future lives.
- Building young people's sense that 'science can be for me'.

Emerging feedback from teachers shows that they believe the approach can enhance student engagement in lessons, and reduce behavioural problems.

A forthcoming publication will provide case studies and will detail the mechanics of the approach in practice.

"It's got the kids thinking more"

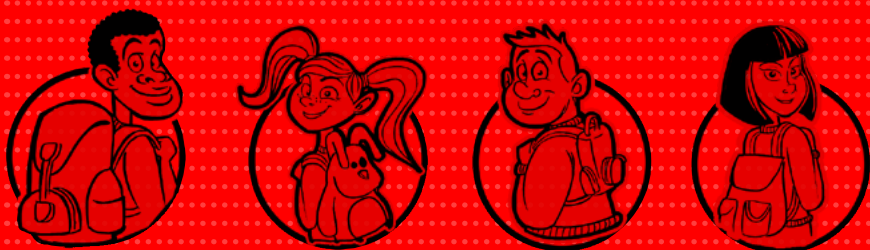
Year 8 science teacher

"When I've used a science capital approach with the class they don't misbehave, they're all very engaged and enjoy the discussion. The class are an absolute nightmare to teach but every time I've done science capital there's been no behavioural issues"

Year 10 science teacher

"When one student starts, they all want to talk. They can lead the discussion"

Year 9 science teacher



Pedagogical approach – museums

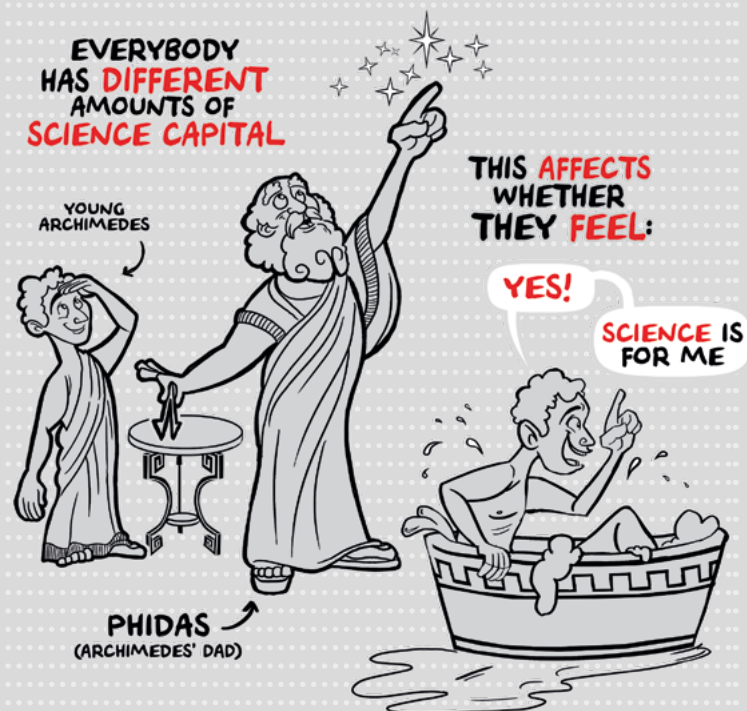
"The science capital principles give you a way to understand visitors and potential visitors, how they engage with science, what they bring to the table and what they want from you"

Senior audience researcher,
Science Museum

Over the course of the Enterprising Science project, the teams at King's College London and the Science Museum Group have been exploring ways to develop and adapt a science capital approach for the informal science learning (ISL) sector. At the time of writing, work is still underway, but the main tenets of this approach to date include:

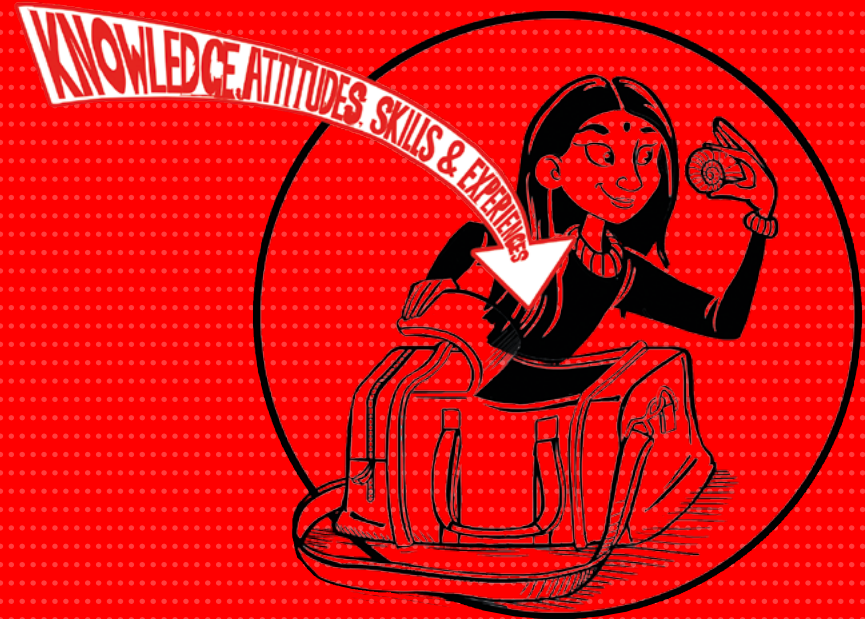
- Using the eight key science capital dimensions as a reflective tool to inform the design of programmes and exhibitions.
- Finding ways to elicit, value, reflect and link the varying experiences and knowledge of a diverse audiences with programmes/exhibitions and to create a more comfortable and inclusive space for more visitors.

- Working in collaboration with schools to make better, more effective and inclusive use of museum visits and resources, which centre on eliciting and valuing the cultural knowledges and interests of diverse students within ISL contexts and linking these with science.
- Conceiving a science capital approach in the ISL sector as complementary but integral to the wider science engagement ecosystem (which includes formal education, careers guidance, industry outreach etc).

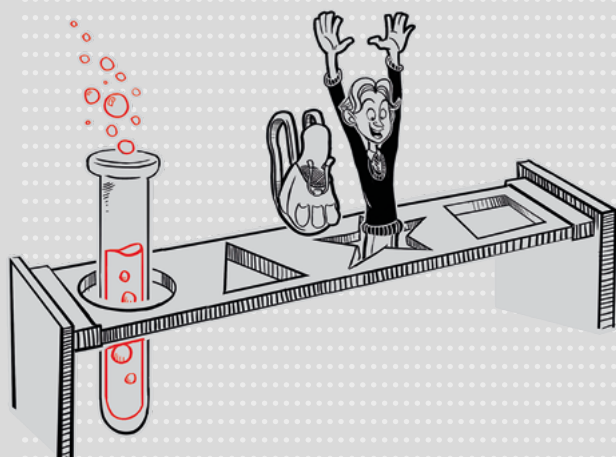


"It's like adding an emotional side to science. I know my students much better now. Students and parents report talking more about science and science classes at home. It's made me happier as a teacher"

Year 7 Chemistry teacher



Further information & the Enterprising Science project



Enterprising Science is a five-year partnership between King's College London and the Science Museum, funded by BP (2013-17). 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.

This publication was written by the King's College London team: Louise Archer, Emily Dawson, Jennifer DeWitt, Spela Godec, Heather King, Ada Mau, Effrosyni Nomikou and Amy Seakins.

To find out more about our work:

- Visit our the Enterprising Science project website: www.enterprisingscience.com
- Watch our 2 minute animation explaining the concept of science capital: bit.ly/sciencecapitalexplained
- Follow us on Twitter: @enterprisingsci
- Read our journal article, describing how we conceptualise and are developing the concept empirically: bit.ly/scicapjrst

• Read some of our project publications:

Archer, L., Dawson, E., Seakins, A. and Wong, B (2016) Disorientating, fun or meaningful? Disadvantaged families' experiences of a Science Museum visit. *Cultural Studies of Science*, (iFirst), DOI: 10.1007/s11422-015-9667-7

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); p. 922-948

Archer, L., Dawson, E., Seakins, A., DeWitt, J., Godec, S. & Whitby, C. (under review) "I'm gonna be a man here": Performances of masculinity and engagement with science during a school/ museum intervention

Dawson, E., Archer, L., Seakins, A., DeWitt, J. & Godec, S. (under review) Selfies & Science Engagement: Girls Identity Performances in a Science Museum

DeWitt, J. et al (forthcoming) Dimensions of Science Capital: Exploring its potential for understanding student science participation

King, H., Nomikou, E., Archer, L. & Regan, E. (2015) Teachers' understanding and operationalisation of 'science capital'. *International Journal of Science Education* 37(18), 2987-3014

Read our research briefs: <http://www.kcl.ac.uk/sspp/departments/education/research/cppr/Research/currentpro/Enterprising-Science/Research-Briefs.asp>

Read the summary report of the science capital practitioner seminar: sciencemuseum.org.uk/transforming-practice

- i From the ASPIRES/ ASPIRES2 and Enterprising Science research projects, based at King's College London: www.kcl.ac.uk/aspires www.kcl.ac.uk/enterprisingscience
- ii DeWitt et al., (forthcoming) Dimensions of Science Capital: Exploring its potential for understanding student science participation
- iii Archer et al. (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); p. 922-948
- iv Archer et al (2015), *ibid.*
- v Dewitt, J. et al (forthcoming), *ibid.*
- vi E.g. Archer, L., DeWitt, J. & Osborne, J. (2015). Is science for us? Black students' and parents' views of science and science careers. *Science Education* 99(2): 199-237. Archer, L. & DeWitt, J. (2016) Understanding young people's science and career aspirations. London, Routledge. Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. and Wong, B. (2012). "Balancing acts": Elementary school girls' negotiations of femininity, achievement, and science. *Science Education*, 96 (6), 967-989
- vii Archer et al (2015), *ibid.*
- viii DeWitt et al (forthcoming), *ibid.*
- x E.g. Archer et al (2016), *ibid*; Seakins et al. (forthcoming)
- xi Participating teachers attend three workshops over the course of an academic year and receive regular mentoring support (e.g. lesson observations, feedback, collaborative planning) from members of the research team to develop and apply a science capital approach to their teaching.



Thank you

