

# The impact of meeting scientists: A public engagement literature review



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# 1

## Introduction

Directly meeting and interacting with scientists, listening to them, asking questions; discovering not just their scientific work but finding out about them as people, who they are and how they came to science, what motivates and excites them about their work, is often regarded as an especially powerful and flexible engagement strategy. It has the potential to deliver knowledge about the natural world as well as challenging stereotypes of scientists and demystifying the process of scientific enquiry leading to a more informed and scientifically literate populace.

'Meet a scientist' experiences vary greatly from simple presentations with question and answer sessions (such as the NHM Nature Live programme) to long term apprenticeship programmes where students work alongside scientists in laboratories. Barab and Hay (2001) consider these latter experiences to be powerful ways for students to learn about the nature of scientific investigation and imagine themselves as, or becoming, scientists. Unfortunately, the nature of public engagement with Museums mitigates against the deep, long-term immersive experiences that Barab and Hays recommend. The vast majority of NHM visitors attend the Museum for very short periods of time, only a few hours, and they may only visit once in their lifetime. It is thus not surprising that opportunities for long-term engagement with scientists are rare. Some activities at NHM, such as the Annual Science Lectures are entirely didactic and passively received by the audience. Most of what NHM offer in terms of direct contact with scientists can be categorised as presentations with attendant question and answer sessions. This mode of engagement is typical of the Nature Live format, and also of Science Festivals such as European Researcher Night (Science Uncovered) and the Lyme Regis Festival. A further category of engagement is that fostered by NHM Citizen Science projects. These may or may not facilitate direct contact with scientists, but they do have the potential to encourage longer-term involvement with Science and the processes of scientific investigation.

Many programmes, outside the NHM, introducing scientists to young people have focussed exclusively upon female students meeting predominantly female scientists in response to the widely held conviction that the low uptake and interest in science amongst girls is due to the lack of female science role-models and the perception that science conflicts with many girls' notions of femininity (ASPIRES report 2014), resulting in a clash between aspirations to develop a science identity with other aspects of the existent identity. Seakins (2015 pp80-81) states:

*“Two narrow identity constructs were identified by girls when navigating the ideas that science is masculine and clever; they either adopted a sexualised science femininity, which overplayed ‘girly-ness’ perhaps to compensate for their interest in science; or they took on an asexualised ‘bluestocking’ scientist which linked the hard-working and studious aspects of the girl’s existing identity with science ( )The findings from Buck et al. (2008) suggest that the only impactful way to initiate role model relationships is through face-to-face interaction – it was important for the girls in the study to have a personal connection with their role models, engaging in conversations and knowing about one another. In contrast, video representations of scientists had little impact and were not mentioned by the girls when talking about role models.”*

This review looks at the claims that have been made for engaging visitors with scientists including the range of benefits that are hoped to accrue to individual visitors, the scientists themselves and to wider society.

Research at the Natural History Museum (NHM) is presented, particularly from the in-depth evaluation and research conducted for Nature Live and Science Uncovered events. This is then augmented with other examples and with some evidence from external studies and published research.

# 2

## Meeting Scientists at the NHM



There are many opportunities through the year that offer visitors the chance to meet and interact with NHM scientists, curators and researchers. For example:

### **Nature Live**

Nature Live is a programme of events in the Attenborough Studio. Curators and researchers are interviewed about their work by a member of the Science Communication team and respond to questions from the live (and sometimes online) audience. The impact of meeting scientists through this programme was the subject of a PhD thesis, supervised jointly by the Museum and King's College London, by Amy Seakins in 2015. Seakins interviewed 81 adult participants and 38 A Level students. Participants were interviewed before, immediately after and two months after meeting scientists to explore the longer-term impacts of these events.

### **Science uncovered**

Since 2010 the Natural History Museum has been funded by the European Commission to stage a science festival; Science Uncovered (European Researcher Night), on the last Friday in September. Visitors to the events could talk with scientists about their research and careers, get privileged access to amazing specimens from our collections, learn about science and the natural world and ask their own questions. There have been a series of consistent findings from our annual evaluations of Science Uncovered that relate directly to the positive benefits of face to face interactions with scientists.



### **Fossil roadshow**

The fossil roadshow format features a number of Museum Earth scientists who set up 'market stalls' at a venue which feature illustrative specimens, technology used in science and text or audio visual explanations of findings. Such events are often set up as 'market place events' with visitors browsing between the stalls, examining the materials and engaging in conversation with the scientists staffing the table-top display.

### **Big Nature Day**

This event at NHM was focussed on attracting and engaging a family audience. The format was very similar to the fossil roadshow events, but tends to be focussed upon Life Science rather than palaeontology.

### **Lates events**

The monthly Late offers visitors a variety of experiences including straightforward lectures, structured debates, as well as more innovative formats such as science story-telling.

### **Dinosnores (for kids and adults)**

The NHM sleep-over programmes often include structured input from scientists, most often in the form of a formal or semi-formal lecture in the Flett Theatre as well as other face to face interactive activities.



### **Dawnosaurs**

This early morning programme is specifically targeted at children on the autistic spectrum and their families. The programme varies but often includes opportunities to meet scientists at 'roadshow' style stalls where specimens and scientific ideas can be scrutinised and discussed.

### **Annual Science Lecture**

This is a formal lecture for a committed adult audience.

### **Lyme Regis fossil festival**

This event takes place over a weekend in Lyme Regis. It is specific to palaeontology. NHM contributions vary from year to year, but include sessions and workshops run by public engagement staff. Lectures, workshops and roadshow – style sessions are given by science staff.



### **RBKC festival of science**

This is a borough wide initiative within the Royal Borough of Kensington and Chelsea (RBKC) aimed at promoting engagement between schools and school age children and science. In some years NHM scientists have made half day outreach visits to primary schools to engage with the children and promote science. The outreach visits to date have been based upon a Nature Live format of presentations and question and answer sessions.

### **Generate Scientists of the Future**

This is a current three year project that NHM are running with 4 local schools. The same cohort of students will visit the Museum once per year for three years. The programme of events that we will provide for them will change and build. In year 1 of the project (the students are in year 7 of secondary school), the schools were given a science show, self-guided time in the Museum and a Meet the Scientist session involving staff from the NHM and engineers from Orsted (a sustainable energy company sponsoring the programme). Evaluation involving pre and post interviews with students and teachers is underway.

# 3

## What impacts might we see?

### CHALLENGING PERCEPTIONS OF WHO SCIENTISTS ARE

As Seakins (2014 p2) states

*“The notion of bringing experts into classrooms relies on the assumption that these experts may be able to counter stereotypical images of scientists, enable students to form more realistic and positive perceptions of scientists, and that meeting experts will aid the development of students’ own science identities.”*

The SPIRES Report (2014) makes a detailed examination of school children’s perceptions of science and relates these to issues connected with the identity determination interests of the children.

SPIRES notes the interest that primary school children have in science and the excitement they report about science. It further notes that this interest and excitement does not translate into pursuing science as they move through formal education. It seems that the children’s perceptions of science do not match against their perceptions of the ‘kind of person’ they are or want to become.

SPIRES identifies that school children:

1. Characterise science as being for ‘brainy’ people
2. Think of science as conflicting with notions of ‘girliness’. For them science is a male-dominated pursuit. Not just in that it is mainly males who are scientists, but also in that the activities of scientists are inherently male activities. The perceived conflict between science and the ‘identity’ to which they aspire is enough to convince many girls that science is not for them
3. Only see science leading to a very narrow range of options, typically limited to becoming a science researcher (working in a lab), a medical doctor or a school science teacher. It therefore follows for many that unless they want to be one of those three, there is little point in pursuing science

Seakins (2015) found that visitors and students identified more closely with scientists following their interaction in Nature Live through recognising common experiences. Visitors also developed a lasting interest in scientists and their career histories. Interactions with scientists led to impacts on identification of scientists, with two themes emerging – scientists as possessors of expert knowledge and scientists as ‘everyday’ and ‘people like me’. Meeting scientists brings ‘added value’ in terms of increasing scientific literacy: perceptions of scientists became more positive and less stereotypical and participants learned about particular areas of science as a result of the session. Visitors and students developed broader and more positive perceptions of scientists following their meeting at the Museum, further understanding the work of scientists and the nature of science careers, and learned about science topics.

This same feature has also been a consistent finding from 10 years of evaluating the Science Uncovered festival. In 2010, a baseline survey recorded that most visitors thought of scientists as ‘boffins’ and ‘lab workers’. A similar study at Science Uncovered 2011 revealed that 25% of visitors regarded scientists as ‘people like us’ as a result of the event. This category did not appear at all in the baseline survey. Results from subsequent years confirm a trend of more visitors reporting that scientists are likely to be female, young or ‘people like us’ after attending Science Uncovered. In 2014, 60% of feedback form respondents were surprised by the diversity of the scientists they met at SU.

*“It has changed some of the students’ perceptions about who or what a scientist is. I think it was really important for some of our children to see that scientists are not all old, white, middle class men.”*

(Teacher who brought students to the event in 2014)

However, we at least need to ask the question about whether it is possible to go too far along this road? Following the school visits of the Generate project one teacher told us that:

*“Now the children will think that scientists are all female and in the 20’s!”*  
(joking tone).

The same teacher also said:

*“Just seeing the panel was good. It’s important that the students see a fresh face/s enthusing about science, not just their teachers. It’s more powerful coming from someone outside school”*

## INCREASING KNOWLEDGE ABOUT SCIENCE AND/OR THE NATURAL WORLD

Visitors to Science Uncovered were able to describe a multitude of direct benefits that science brings to society having been discussed at the event. In 2013, 85% of visitors left the event strongly agreeing that the work of scientists benefits society. 75% of 2014 poll respondents reported that they had significantly increased their knowledge of the benefits that science brings to society. 86% of feedback form respondents stated that the event had made them think more about the importance of scientists to society. Indeed, understanding the natural world and our place within it is central to what many visitors want from the Science Uncovered event.

In 2013 the majority of respondents identified the specimens on display and hearing from scientists about them as their single greatest highlight of the evening.

*“Scientists help to discover the cause and effect of global change. Solve crime. Help us learn about our surroundings.”*

Other evidence for this contention comes from research focused upon outreach to a primary school as part of the Science Uncovered outreach programme.

In 2015 NHM staff visited Avondale Primary school in Royal Borough of Kensington and Chelsea (RBKC). One year later we were able to return to the same school and interview the same children about what they remembered from their session with an NHM scientist. It transpired that they remembered a lot.

1. The vast majority of children remembered some correct details of the outreach visit.
2. The scientist himself clearly made an impact with many children remembering his name and details of his job; for example that he was a geologist and studies rocks from space. Particularly compelling evidences are some of the tiny details that have stuck with the children, such as that Ashley wanted to be an astronaut.
3. There are very few misconceptions. The greatest of these, that Ashley is an archaeologist was only represented by 6/41 individuals
4. The power and importance of seeing and handling real objects, both as a memorable event for the children (this was the top answer for 29/43) . and as a reason why Ashley’s job was thought of as exciting (this was the top answer for 17/43). Q3
5. The primary objective of the outreach we conducted was that ‘students will take away a sense of excitement about the work of our scientists’. The fact that one year later the majority of the children (33/41) still regard Ashley as having an exciting job is a testament to the power and effectiveness of the programme.

## INCREASED ENGAGEMENT WITH SCIENCE

Seakins' (2015) study of Nature Live showed that meeting scientists 'added value' in promoting science engagement: visitors reported continued engagement with science in the delayed post-session interviews two months after the visit. This continued engagement ranged from watching television documentaries, following science in the news to revisiting the Museum.

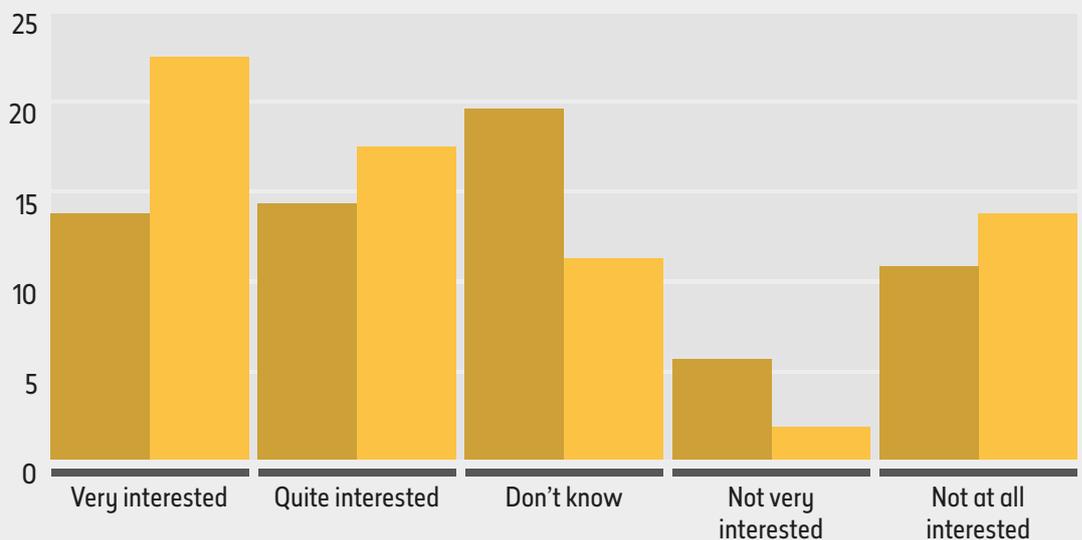
Findings from Science Uncovered support this finding with some visitors even encouraged to pursue science as a career or a qualification.

*"We had a fascinating evening. My daughter is now keen to become a scientist."*

*"Coming last year, basically gave me the last little nudge. That even though I'm quite old for it, I did sign up for a science degree"*

Visitors to Science Uncovered 2015

For the Generate project the students were polled immediately before and after their visit on whether they were now more interested in continuing with science beyond secondary school. Once averaged the results are very positive in terms of the power of the sessions to effect changes in student attitudes to science.



Generally the students became more interested in pursuing science with increases in the 'very interested' and 'quite interested' categories, but even more pleasing is the significant decrease in the 'don't know' category. The sessions clearly helped students to make more informed decisions about a future in science.

The efficacy of the project was also highlighted in the student focus groups that took place after the visit. One participant said:

*"I'm going back to the Museum this weekend. I pestered my mum. There was so much that we didn't get time to see".*

## **INCREASED UNDERSTANDING OF THE RANGE OF SCIENTIFIC CAREERS**

Research, such as the ASPIRES programme, highlights the importance to school students of widening their apprehensions about careers in science, but many adults have a low awareness of what careers in science can be too. Interviews with visitors to Science Uncovered have demonstrated the power of the event to widen such horizons.

*“Realising how specific jobs in science can be and that you can pursue a career in exactly what you’re interested in”*

Findings from a schools element of the Science Uncovered event support the conclusion that face to face interactions with scientists can promote positive attitudes in school students towards science careers. At the 2012 young person’s reception, students reported an increased understanding of what is involved in a science career as a result of the event. Both students and adults demonstrated an awareness of the diversity of jobs available in science. In 2014 we revisited this outcome specifically with regard to children and young people. The teachers that we surveyed after the event all agreed that their students found inspiration at the event and that more of them, more strongly, desired a career in science as a result.

The Generate project saw small, but consistent gains amongst students from all the schools in terms of their awareness of jobs in science. The pre-visit task mirrored the ASPIRES finding that children think that science only leads to careers in medicine, research or teaching. After the visits, the students added engineers, archaeologists, curators, public engagement and conservation workers and more specialised kinds of research jobs, such as marine biologists to their lists of science careers as these roles had been mentioned during the session.

## **INCREASED UNDERSTANDING OF THE ROLE OF SCIENCE IN SOCIETY**

Visitors to Science Uncovered have described a multitude of direct benefits that science brings to society, which were discussed at the events. In 2013, 85% of visitors left the event strongly agreeing that the work of scientists benefits society. 75% of 2014 poll respondents reported that they had significantly increased their knowledge of the benefits that science brings to society. 86% of feedback form respondents stated that the event had made them think more about the importance of scientists to society.

*“Scientists help to discover the cause and effect of global change. Solve crime. Help us learn about our surroundings.”*

*Scientists reveal our proper place in evolution and teach us to respect + care about all forms of life on our planet.*

# 4

## What facilitated these positive outcomes?

### Opportunities to ask questions

At Science Uncovered visitors valued the information they gained from the scientist and their experience and the opportunity to ask them questions. The direct, personal contact with scientists and researchers means that visitors can pursue their own interests, often with unexpected results

***“It’s so wonderful to be able to ask questions directly and have my preconceptions shattered!”***

Another initiative at the NHM saw primary school students connected to scientists in the field (in Borneo and Mexico) via video conferencing and ‘web chat’ technology. Findings from those evaluations indicate that:

Students being able to talk live to scientists was one of the major benefits of the programme identified by teachers. Teachers felt this enabled their students to see:

- A. Science in action
- B. The role of science in society
- C. What it is like to be a scientist
- D. The application of the science they are doing in school

***“It was great for the students to see and speak to real scientists. Often they don’t appreciate that what they learn about actually happens in the wild.”***

The evaluation of a video-conferencing programme between school students and scientists in Borneo and Mexico revealed that students really liked the opportunity to ask questions. Whenever the teacher asked the class for a potential question, there were always a lot of hands up. During the video conferences, engagement seemed to peak during the parts when students could ask their questions.

### **Passion and enthusiasm of scientists**

The feedback we've had from visitors to Science Uncovered shows that the passion and enthusiasm of scientists is the single most important driver for the success of the event.

### **Uniqueness of the experience**

The experience of meeting researchers and scientists face to face is unusual enough to be memorable, but relaxed enough to be accessible.

### **Links to real life and real objects**

Students involved in a programme of video conferencing with scientific fieldworkers in Borneo and Mexico really liked the fact that the sessions were linked to real life so they could see the actual equipment used; see the real volcano; and find out what it is like up volcano from people who have experienced it for themselves.

# 5

## Barriers to engagement

### **Technical issues**

When the scientist meet up involves technology, e.g. video conferencing, technical issues such as the sound quality of the connection to the scientists, faulty cabling and website crashes can cause problems. For example, as well as these positive impacts, the evaluation of the video-conferencing programme identified some barriers to engagement - most of which were related to technology.

### **Complex terminology**

In the video conferencing evaluation it was found that sometimes the scientists' answers were long and complicated, with some higher level vocabulary used (e.g. isotopes). Students' engagement levels were seen to reduce towards the end of the scientists' answers and the use of unfamiliar vocabulary was mentioned by the teacher. This same barrier to engagement was also observed in outreach sessions for the RBKC celebration of science. Here the year 5-6 students were observed to disengage by the use of the term 'invasive species'.

### **Failing to meet visitor expectations**

Scientists not being able to answer the students' questions, for example during the Borneo video conference, can be a frustration for younger children. Despite lichen being mentioned during the programme, one of the scientists couldn't answer the students' questions about lichen because he wasn't a specialist. That science does not always have an answer is an important message about the nature of science, but this needs to be presented carefully, especially with younger audiences, to avoid the risk of disappointment and to communicate the excitement that the opportunity of unanswered questions brings.

# 6

## Negative Impacts

Our experiences at the NHM paint a largely positive picture of the impact of meeting scientists but this is not always the case. Seakins' review of 2014 cites examples of programmes that failed to achieve a noticeable impact or actually had a detrimental effect upon the learners. There are important lessons to learn from these examples where it didn't work as planned.

Seakins (2014) cites:

Buck, Leslie-Pelecky, & Kirby, (2002) who found that interaction with experts may not challenge stereotypical perceptions. In this study the female students ended up questioning whether the female scientists they had met were actually real scientists rather than revising their conceptions of what scientists are like.

Likewise, Stout et al., (2011) found that while meet the scientist programme did increase positive attitudes towards the subject, the participants (female STEM subject undergraduates) continued to regard, and describe, STEM subjects as being masculine.

Bamberger (2014) found that interactions with scientists as part of a role model programme in Israel actually had negative impacts on girls' perceptions of women scientists/engineers, their attitudes towards STEM jobs and how able students felt to deal with the challenges of a STEM career. Girls seemed "frightened" by their experiences.

Bamberger goes on to list potential reasons why meeting science experts may have either no or a negative effect upon the attitude of participants:

- » Too large a cognitive gap between what the scientist knew about the area of science and what the students knew and understood.
- » Scientists could only operate as role models if a caring relationship had been developed between the scientists and the girls – intensive and informal, opportunities for formal as well as informal interactions.
- » Scientists' identities clashed with students' cultural contexts. E.g. students in Bamberger's study (2014) were Jewish modern-orthodox, family life is strongly valued in their culture, and students were sceptical about how the scientist could balance work and family life. Only two of the 12 scientists in study were modern-orthodox, so may have been beneficial to have more role models from same cultural background as students.

- » Potential effects of there being too large a gap between role models being “successful” and students’ perceived short-term success for themselves (Betz & Sekaquaptewa, 2012).
- » Location and learning environment and activities may play an important role: research found that whilst students did identify with student ambassadors and learnt about higher education in “informal contexts” they did not when learning contexts were “formal” (Gartland, 2014). It was important for students to be able to identify with ambassadors on the same level, as equals, and both as learners, in order for them to be seen as role models and learn from them.

By secondary school, most students’ views on science are relatively fixed. If we are to challenge widely held stereotypes of science and scientists, ASPIRES recommends that we need to start earlier, in primary school.

ASPIRES research shows that short, one off meetings with scientists have little effect upon the perceptions of young people.

The Generate project as well as facilitating a wide range of benefits to the students also highlighted the need for careful planning and an appreciation of the needs and wants of the audience.

One of the MtS sessions was considerably less successful than the other two. The observations, survey responses, mind maps and focus groups indicated that this was due to:

1. A lack of passion and enthusiasm from the presenters and host about their work.
2. Too great a similarity of roles of the featured presenters.
3. Too little structured (inter) activity for this age group

# 7

## Recommendations for practice

1. In planning interactions with scientists we need to present not just the science that is done, but the scientists as 'people'; including their interests, motivations, career pathway/history. This brings the scientist into greater resolution for visitors helping to demystify them and aid visitor identification and personal connection.
2. Allied to the point above is the importance of showing diversity in science and of scientists.
3. Scientists are not just researchers. We need to seek out and present career options that use science rather than just within science. Research, especially with school age children shows that there is little awareness of the jobs and careers that depend upon science. In the ASPIRES research, students were only able to name researchers, medical doctors and teachers as careers to which science leads. Widening this perception to show the value of science to other 'life-paths' can reduce stereotyping and raise awareness that science underpins and is valuable for a huge range of careers.
4. Present science as a set of skills and a way of thinking/asking questions that solves problems. Presenting scientists as expert 'learners' rather than expert 'knowers' is likely to have a more powerful impact.
5. The novelty of meeting scientists can bring significant impact to visitors, but this needs to be carefully managed to ensure that this unfamiliarity does not become a barrier to visitors identifying with scientists. As with recommendation 1, it is important to show scientists as people rather than 'remote' experts. One example would be to avoid scientists wearing lab coats. This is an unusual form of dress for most visitors (especially children) and is likely to be associated with doctors and dentists of whom many, especially children, are likely to be frightened.
6. It's not just about the people. Activities that use (or ideally in which visitors can try out) real scientific techniques, tools and equipment are powerful ways of engaging visitors with what scientists do.
7. Explanations by scientists need to be pitched at an appropriate level. Too much technical language or unfamiliar concepts is likely to result in disengagement and contribute to the perception of science as impenetrable.
8. When planning activities, be very cautious with claims that meeting scientists can provide role models for visitors. Research shows that even with engaged students this is a rare event; one that relies upon a longer term relationship with the scientist rather than resulting from a single meeting. There is research evidence to suggest that role-modelling is only effective with face to face interactions. Video presentations of scientists do not have the same power.
9. ASPIRES recommends building the science capital of young people by valuing science as a 'way of knowing'. Science needs to be presented as a process of creative enquiry rather than a body of knowledge to be memorised.

# 8

## References

ASPIRES report 2014 Department of Education & Professional Studies.  
King's College London

Bamberger (2014) *The Laboratory for Making Things: Developing Multiple Representations of Knowledge*. Part of the *Models and Modeling in Science Education* book series (MMSE, volume 8)

Barab and Hay (2001) *Doing science at the elbows of experts: Issues related to the science apprenticeship camp*. *Journal of research in science teaching* vol. 38 issue 1

Betz & Sekaquaptewa, 2012 *My Fair Physicist? Feminine Math and Science Role Models Demotivate Young Girls*. Volume: 3 issue: 6, page(s): 738-746 Article first published online: March 27, 2012; Issue published: November 1, 2012

Buck, Leslie-Pelecky, & Kirby, (2002) *Bringing female scientists into the elementary classroom: Confronting the strength of elementary students' stereotypical images of scientists*. *Journal of Elementary Science Education* 14:1

Gartland, 2014. *STEM strategies*. Institute of Education Press

Seakins 2015 (pp80-81) *Meeting scientists: Impacts on visitors to the Natural History Museum, London*.

Seakins 2014 (p2) *Bringing science experts into classrooms: Issues and opportunities* Research into practice briefs from *Enterprising Science* Paper 05

Stout et al., (2011) *STEMing the tide: using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM)*. *J Pers Soc Psychol*. 2011 Feb;100(2):255-70. doi: 10.1037/a0021385

Wormald D. (2018). *Summative, end of year 1 evaluation report for Generate Scientists of the Future*