Review of Informal Science Learning

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Richard Lloyd, GHK Consulting

Ross Neilson, GHK Consulting

Dr Suzanne King, Brand Driver Ltd

Mark Dyball, Red Kite Advice and Consulting Ltd

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Executive summary

1   Introduction

In June 2011 the Wellcome Trust issued an invitation to tender for a review to characterise the value of informal science learning to science education in the UK. Focusing on children and young people aged up to 19, the study sought to provide:

- a better understanding of the scope of informal science learning, its theoretical base and the types of change it can bring about in the understanding of and attitudes towards science

- recommendations for robust methods for evaluating the impact of informal science learning, based on an analysis of practice in the field

- recommendations on reaching deprived learners, schools and families

- recommendations based on best practice in linking informal and formal learning.

The invitation to tender led to two separate but interlinked commissions: one based in the UK (delivered by GHK Consulting in collaboration with Brand Driver Ltd and Red Kite Advice and Consulting Ltd) and the second in the USA (delivered by a partnership of Stanford University and Oregon State University). Both teams worked closely to develop the study methodology and research tools, and data from fieldwork in the UK was shared with colleagues in the USA. Both teams also came together for a series of stakeholder events in the UK, which offered the opportunity to discuss progress and emerging findings.

The study methodology included the development of a typology of organisations to be used throughout the study and a series of activities, as summarised below:

- A literature and data review, reviewing the 'grey literature' on informal science learning, and the analysis of data from the Wellcome Trust Monitor and Public Attitudes to Science Survey.

- In-depth interviews with stakeholders and broadcasters, featuring interviews with 55 representatives of organisations with an interest in informal science learning[1].

- An internet survey of informal science learning providers. A sample of organisations involved in or with an interest in informal science learning was developed from sources that included the STEM directories, the Wellcome Trust, ASDC and stakeholder suggestions. The survey was also promoted through Psci-Comm, GEM, Visitors Studies Group and Big Chat distribution lists. A total of 196 responses were received from individuals across a range of organisation types, sizes and activities.

- Provider case studies, featuring ten informal science learning providers drawn from organisations responding to the provider survey. The case studies included site visits and qualitative interviews with staff and partners to explore their activities, the audiences they found challenging to engage and their evaluation practice.

- Family studies, including 12 sets of in-depth qualitative interviews with children and young people aged 11–16 from different social grades, supplemented by diary keeping, interviews with parents and peer-to-peer interviews. The Family Studies element explored how the young people spend their leisure time and the role of informal science learning within this.

2   Informal science learning in the UK

Although no single accepted definition exists in the UK, the term 'informal science learning' is commonly applied with reference to activities that take place outside of the formal education system and seek to raise awareness of, interest in and engagement with science and other STEM subjects. The term applies to a wide range of activities and services, delivered by

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[1] NB: the Stanford/Oregon team used 51 of the 55 interviews in their analysis, excluding four interviews with funders.

providers ranging from national broadcasters to not-for-profit organisations and sole traders, and available to individuals of all ages.

Although a spectrum of provision exists in terms of its proximity to more formal learning approaches, two broad categories of activity can be identified:

■ Provision that seeks to enhance formal science learning and takes place in more formal settings but is categorically different from formal, classroom-based science learning

■ A broader category covering provision accessed on a voluntary basis and taking place in formal settings (e.g. museums), informal settings (e.g. in the home) and settings in between (e.g. community centres).

Defining informal science learning

The stakeholder interviews identified a range of attributes that commonly featured in their definitions of informal science learning, including that it:

■ takes place outside of the formal curriculum, is non-compulsory and is not formally accredited, and while capable of reinforcing formal learning, this is not its core purpose

■ can take place in a range of settings outside of school, although not exclusively – including in museums, science centres, individual's homes and public spaces

■ can inspire, stimulate interest in, encourage positive attitudes towards and lead to a more thorough understanding of science

■ features learning that can be unstructured, unguided and led by the interests of the individual

■ can feature 'learning by stealth', a concept that was mentioned frequently throughout the study and described as "audiences learning without being actively aware of what they are doing".

The provider survey sought to explore these attributes further, testing agreement with a series of statements and showing that:

■ more than half the respondents considered that informal science learning should always actively engage learners and be available to people of all ages

■ between one-quarter and half felt it should always feature activities that are different to day-to-day formal learning, lead to outcomes that are less prescribed than formal learning, aim to bring about changes in attitudes to science through emotional engagement and start outside the formal curriculum

■ fewer than one-quarter considered that informal science learning should always take place in a setting outside school, involve an agent other than the regular teacher, support the efforts of other science learning providers and the achievement of formal education outcomes, and involve learning with a group of the learner's choosing.

However, the study concluded that it was unlikely that any single definition can be developed that would be both sufficiently straightforward to be useful and sufficiently flexible to encompass the diversity of the sector. Any single definition would need to address the areas where significant divergence in opinion was identified – namely, the extent to which informal science learning activities always involved 'free choice participation', could take place on school premises, and should be seen as supporting the formal science curriculum rather than as distinct activities.

The informal science learning sector in the UK

Both the stakeholder interviews and the provider survey illustrated the wide range of organisations that comprise the informal science learning sector in the UK. Responses were received from individuals in organisations providing a range of informal science learning services, either as their main or their secondary area of business. While 'suppliers of STEM services' were the most common respondent group, museums, science and discovery

centres, zoos and aquaria, universities, theatre and arts groups, and a range of other organisations provided data via the provider survey.

The diversity of organisations providing informal science learning activities was matched by the range of services offered and the ways in which they were delivered. In many cases larger organisations, such as museums and science and discovery centres, combined centre-based delivery with outreach provision, whereas smaller STEM providers delivered their services directly to schools. The most commonly reported services delivered by respondents to the provider survey were 'in school provision/enrichment' (80 per cent), but 'informal talks/debates', 'holiday or summer school programmes', 'after school provision' and 'science and engineering festivals' were all reported by 50 per cent of respondents or more. Interestingly, the providers commonly reported delivering multiple services, ranging from one to 16 distinct activities and most commonly between three and nine services each.

When questioned on the objectives and outcomes their services were intended to achieve, 'raising awareness' and 'understanding of and interest in science' were the most commonly reported main objectives. The majority of respondents described their main outcomes in terms of making science enjoyable and interesting, inspiring interest in and/or engagement with science, and changing attitudes to and/or raising awareness of the importance of science. A few reported outcomes such as encouraging or preparing individuals for future STEM study, or for future STEM careers, as their main outcomes.

Linking informal and formal science learning

As suggested above, a divergence of views emerged in terms of the extent to which informal science learning can, and should, be linked with and contribute to more formal learning – and the extent to which influencing the formal should be seen as the main role of the informal sector.

This was reflected in the provider survey, where responses to a series of statements on the ways in which formal and informal science learning relate to each other reflected the findings from the stakeholder interviews. While there was considerable agreement that informal learning can stimulate interest in the formal, there was an equally strong view that informal science learning has an inherent value of its own. Responses were more varied on whether the main purpose of informal learning is to support the formal: more than half the respondents disagreed with this statement.

The provider survey explored whether, and how, the informal science learning activities provided supported more formal learning. Almost two-thirds of the respondents considered that their work supported more formal learning, and three main routes were identified:

- through provision directly or indirectly supporting formal learning – more than half described delivering services or developing materials that directly linked to the formal curriculum, delivered either on or outside school premises and commonly but not exclusively during school time

- supporting formal learning by providing activities to stimulate interest in science – just under half reported providing stimulating experiences not directly linked to the curriculum to reinforce or contextualise formal learning

- providing continuing professional development (CPD) for teachers – around one in five respondents reported providing training to enhance teachers' skills and knowledge and, as one described, bring "informal science learning principles and approaches to the mainstream".

For many providers it was clear that services to support the formal curriculum, both directly and indirectly, were an important source of revenue. Indeed, the ability to show how their provision links with, and enhances delivery of, the curriculum was considered a strong selling point for those working with schools, as well as showing their distinctiveness from formal approaches.

3   Engaging audiences and communities

Data from sources including the Public Attitudes to Science Survey (PASS) and the Wellcome Trust Monitor show that interest in science among the general public is high. According to PASS data for 2011:

- 82 per cent of respondents considered that science is an important part of our everyday lives

- 43 per cent of respondents considered they were well or fairly well informed about science

- half (51 per cent) of respondents reported wanting to know more about science.

Engagement with science can be a passive activity (e.g. watching television) or more active (e.g. visiting a science centre). PASS data showed that television was the most common way in which respondents found out about science (more than half, or 54 per cent), followed by newspapers, the internet and on the radio. In terms of more 'active' activities, in the 12 months before the survey, 25 per cent of respondents reported visiting a zoo, 22 per cent had visited a science museum, and 11 per cent had visited a science and discovery centre, most commonly as part of family groups. In addition PASS showed that 12 per cent of respondents had attended a science lecture or talk and 3 per cent had attended a science festival. The Wellcome Trust Monitor provided data on engagement with science among people aged 14–16, and found that 29 per cent had visited a zoo and 12 per cent had visited a science centre in the 12 months before interview.

Informal science learning – main audience groups

The study fieldwork explored the main audience groups for different informal science learning providers and activities, and found that children and young people aged 5–11 or 12–16 and secondary schools were the most commonly mentioned main audiences, followed by families and primary schools. Children under five, young people aged 16–19 and adults aged over 19 were the least commonly mentioned main audiences.

However, analysis at the level of the individual provider and service showed that providers work with different audience mixes in different contexts. Museums, for example, reported their main audiences as children aged between 5–11 or 12–16 and primary and secondary school groups, but children aged 5–16 are the main audience for holiday provision, and people aged 12–16, adults and families are the main audiences for fixed exhibitions and displays.

Challenging to engage audiences

Provider views on the audience groups most challenging to engage with varied. Some considered that all groups could be reached if the right preparatory steps were taken, whereas others had not considered working with certain groups. The provider survey found that almost seven out of ten respondents had experienced difficulties engaging with one or more audience groups, and the high-level findings suggested that adults aged over 19, families and young people aged 12–19 were the most challenging groups.

When analysed in more detail, it emerged that individuals from disadvantaged areas or in households with low incomes were the most difficult to engage. This linked with the findings from PASS, the Wellcome Trust Monitor and the Family Studies research, which suggested that individuals from lower social grades or households with lower levels of education were less likely to engage with science and informal science learning opportunities. However, the fieldwork suggested that a series of social and cultural factors could also be an influence, dissuading certain individuals or groups from engaging – as one provider described, informal science learning activities were perceived by some potential audiences as "not being for the likes of us". Indeed, the findings from the study and wider survey work suggested that social and cultural factors may pose greater barriers to engagement than financial barriers – although factors such as transport costs and availability in rural areas can be influential.

The Family Studies research provided several insights into the attitudes towards – and the motivators and drivers for – engagement in informal science learning among young people aged 11–16, including:

- Young people in this age group saw leisure time as a time to have fun and had established leisure time preferences by age 11. Parents saw leisure time as important 'down time' and an opportunity for tweens to develop their own interests.

- Drivers for engaging with leisure time activities included personal contacts (friends and other adults), having fun (although this was not always easily defined), being with friends, physical activity and an element of competition (team rather than personal), and an opportunity to debate issues related to their lives.

Principles and practice for engaging challenging groups

When providers were questioned on approaches to engaging challenging audience groups, a series of principles emerged as underpinning effective practice. The principles included:

- making experiences and content relevant to audiences' interests, experiences and backgrounds, increasing the likelihood of both initial and subsequent engagement and the development of ongoing relationships

- conducting preliminary research with difficult-to-reach audiences, to ensure the accurate tailoring of services and to identify and negotiate social and cultural barriers

- establishing partnerships with other organisations or groups already engaging with the target audience, to help understand audience needs and actual and potential barriers, and to act as trusted conduits between the provider and the audience

- using community outreach methods to engage with target audiences – which, although resource intensive, can lead to embedding an organisation within its community

- ensuring experiences are stimulating, interactive and engaging for participants (particularly for young audiences), to stimulate initial engagement more broadly.

Examples of the above activities are presented in the main report, although the providers consulted considered that no single activity or approach in isolation was likely to be effective in engaging challenging audiences. Moreover, practice suggested that sustained engagement requires a strategic approach, working with challenging audiences through a range of activities over a sustained period of time. The providers showed that it can be possible to engage challenging groups if the effort is made to meet them on their own terms – whether through outreach, virtually or via broadcast approaches.

4　　Impacts and evaluation

The research explored evaluation practice across the sector and featured a review of the 'grey literature' collected from providers as part of the study. The review found that:

- Evaluation was commonplace across the sector. The methodologies and approaches used were largely appropriate for the scale of funding available to them.

- Topic coverage commonly included delivery processes, audience satisfaction and attempts to identify the immediate or short-term impacts of interventions, most commonly in terms of impacts on views of and attitudes towards science and potential future engagement with STEM learning or careers.

- Assessments of medium-to long-term impacts on changes in attitudes and corresponding behaviour were rare, however. There were several reasons for this, including budgets rarely being sufficient to support the follow-up work required to identify long-term impact, methodological challenges and the absence of accepted indicators or measures.

- The evidence base for the long-term impact of informal science learning activities in the UK is highly limited. Although more evidence on impact exists from studies in the USA (see the more comprehensive literature review presented in the Stanford/Oregon State report), a significant evidence gap exists for activities delivered in the UK.

The review, and consultations with the stakeholders and providers, also suggested that the sharing of learning from evaluation across the sector was limited. While lessons may be shared between individual organisations or networks of similar organisations, more could be done to encourage the sharing of learning across the sector for mutual gain.

Evaluation activities across the sector

Evaluation activities, methods followed, and barriers and challenges experienced were explored throughout the study. The vast majority of providers (87 per cent) reported undertaking some form of evaluation activity, and 44 per cent evaluated all the services they provide.

Providers most commonly described their evaluation work as formative (91 per cent), with the resulting learning informing service development, and far fewer (15 per cent) described their activities as summative – although this is likely to be an underestimate given the requirements of funders, which emerged as a key driver for four in ten respondents. Other drivers for evaluation included responding to concerns with service delivery. One in five described having annual programmes of evaluation activity.

A range of evaluation methods were described: surveys of users (individuals and teachers) and staff were reported by 98 per cent and 85 per cent of organisations, respectively. Other methods included participant observation, visitor exit surveys, group discussions with users and the analysis of visitor data, each of which were reported by more than 70 per cent of all respondents. However, surveys or consultations with individuals not using provider services were reported less frequently (25 per cent and 32 per cent of respondents, respectively). Where undertaken, consultations with non-users were found to provide helpful insights into reasons for non-engagement and approaches that may be effective in future.

Evaluation studies were most commonly conducted by provider staff, followed by a combination of internal and externally commissioned resources. Solely externally commissioned studies were comparatively rare, and where external resources were used they focused on exit surveys, group discussions and participant observations.

Barriers and challenges

The stakeholder interviews identified a series of barriers to evaluation, which were tested in the provider survey to explore the extent to which they were shared across the sector. The findings showed that the most commonly reported barriers were:

■ resource constraints, expressed as a lack of time to evaluate (reported by 80 per cent of respondents) and a lack of funding (76 per cent)

■ technical issues, namely a lack of clarity on evaluation methods (reported by 47 per cent of respondents, most commonly relating to assessing impact), and the availability of internal skills and experience (46 per cent and 37 per cent, respectively)

■ cultural issues and attitudes within the provider organisation, which were reported in around one-third of cases, included a lack of institutional support for evaluation and limited understandings of the value that it can provide.

Providers had taken a range of steps to negotiate their barriers to evaluation, which included:

■ Appointing staff with a specific remit for research and evaluation, although this response was more common among the larger organisations. Even there, several described financial pressures that meant new recruits had to prove their value.

■ Using existing staff as 'internal evaluators' – where existing duties were enhanced and training provided to support evaluation activities. In some cases this also offered the benefit of engaging delivery teams more closely in evaluation, from developing initial aims and objectives to interpreting and developing responses to the findings.

Methodological challenges were less easily addressed, however, and the providers reported that in addition to the availability of practicable approaches to measuring long-term impact they also faced implementation challenges (most commonly in terms of engaging individuals and schools in the evaluation process and poor response rates to survey questionnaires).

5 Recommendations

The recommendations of the study sought to address the four main study outcomes, as summarised below.

Recommendation 1: Defining the formal science learning sector

- To help funders to guide future investments in the sector, they should define the outcomes they are seeking to achieve rather than the delivery methods used, based on the two groupings of activity below:
  - where informal science learning services are directly and explicitly intended to contribute to the delivery of the formal science curriculum; and
  - where informal science learning services aim to inspire, enthuse and engage individuals with science but progression to qualifications is less relevant.

Recommendation 2: Linking informal and formal learning

- When funding programmes are designed to link with formal science learning, funders should be explicit in terms of their objectives, participant groups, outcomes and the evidence required to show the outcomes have been achieved.

- For informal science learning programmes intended to link with formal learning, funders should require the following issues to be addressed in proposals:
  - the potential links with the school and college curriculum to engage teachers, support planning and illustrate the contribution that informal learning can make
  - how the value of the different experiences that the informal sector can provide can be most effectively demonstrated to teachers
  - how it can be made easier for schools to take advantage of informal science learning experiences.

Recommendation 3: Evaluating informal science learning

- Our principal recommendation is the establishment of a forum for leading funders of informal science learning provision, the aims of which should include:
  - stimulating discussion among the funders of informal science learning at a strategic level
  - developing a strategic approach to supporting informal science learning, to guide investment in a coordinated manner across the sector
  - acting as an advocate for the sector, to exert influence as a collective and communicate opportunities identified
  - establishing, as far as possible, common performance management and evaluation requirements, with indicators and metrics, across different funding streams and services
  - supporting cross-sectoral programmes of research to ensure the sector can build upon lessons from the field in the UK and internationally.

- The funders' forum, in consultation with appropriate experts, should support a programme of research to provide an evidence base on the long-term impacts of informal learning in the UK.

Recommendation 4: Understanding and engaging challenging audiences

- Providers should consider whether there are groups within their communities not currently using their services. Acknowledging resource constraints, providers should seek to:
  - identify groups who are currently underserved by comparing data on their existing audiences to the demographics of their local communities

- – undertake research with non-user and challenging-to-engage groups, to identify why they do not attend and the type of activities that would be attractive to them

- – develop new provision or amend existing provision to address barriers to engagement

- – review the effectiveness of any new approach followed, with a view to 'mainstreaming' any revised approach or service.

- In developing new approaches to engage challenging audiences, providers should consider prioritising their resources and taking the following steps:

  - – ensuring that services and their content are relevant to audiences' interests, experiences, backgrounds and interests

  - – conducting research with challenging-to-engage audiences and groups not using their services

  - – establishing partnerships with other organisations or groups already engaging with the target audience in question

  - – employing community outreach approaches with challenging audiences.

- The Wellcome Trust, through the funders forum, should support a programme of research to explore demand for and participation in informal science learning, by:

  - – undertaking a more comprehensive audit of informal science learning providers to explore in detail the nature of audiences for different services, the audiences found challenging to engage and experiences of good practice approaches

  - – extending the Family Studies research with tweens aged 12–16 and including fathers as well as mothers to capture any difference in view

  - – undertaking exploratory ethnographic work with children of primary school age (aged 5–11), to explore the drivers and barriers to engagement as they are developing

  - – expanding the young people's element of the Wellcome Trust Monitor to include young people aged 12–13, to increase the sample size for the 12–18 group and to cover additional topics.

1   Introduction

In June 2011 the Wellcome Trust issued an invitation to tender for a review to characterise the value of informal science learning to science education in the UK. Focusing on children and young people aged up to 19, the invitation described four main outcomes for the study, namely:

■ a better understanding of the scope of informal science learning, its theoretical base and the types of change it can bring about in people's understanding, behaviour and attitudes to science

■ recommendations for robust methods for evaluating the impact of informal science learning, based on an analysis of practice in this and related fields

■ recommendations based on best practice in reaching deprived learners, schools and families

■ recommendations based on best practice in linking informal and formal learning.

The invitation to tender led to two separate, but interlinked commissions, with one based in the UK and another in the USA. In the UK, GHK Consulting, in collaboration with Brand Driver Ltd and Red Kite Advice and Consulting Ltd, led on data collection and the more practical aspects of the brief, including identifying current practice in terms of engaging challenging audiences, linking informal and formal science learning and evaluating informal science learning activities. The UK team also led the Family Studies element of the research. In the USA, Stanford University, with Oregon State University, led on exploring the theory underpinning informal science learning approaches and producing an 'ecological map' of the sector in the UK. Both teams collaborated closely to develop research tools, and the data collected across all stages of the study in the UK was shared with colleagues in the USA for analysis and interpretation. Both teams also came together for a series of stakeholder events in the UK, which offered the opportunity to discuss progress and emerging findings.

1.1   Study methodology

The methodology followed in the UK study featured five main components, which were developed in discussion with Stanford and Oregon State Universities and the Wellcome Trust. The method is described in detail in Annex I, and the main components are summarised below.

■ **Stakeholder and broadcaster interviews**: in-depth qualitative interviews with individuals in 55 organisations[2] with an interest in and involvement in informal science learning, using a sample developed from a stakeholder list provided by the Wellcome Trust.[3]

■ **A survey of informal science learning providers**: an internet survey of organisations delivering or supporting informal science learning, from a sample developed from sources including the STEM directories, Wellcome Trust, ASDC and suggestions from the stakeholders interviewed. The survey was also promoted through Psci-Comm, GEM, Visitors Studies Group and Big Chat distribution lists. While never intending to be statistically representative of the sector as a whole, the survey featured a broad distribution of respondents by organisation type, size and activity.

■ **Provider case studies**: featuring visits to, and qualitative interviews with, a sample of ten informal science learning providers to explore their activities and experiences in-depth, with a focus on the audiences found challenging to engage and evaluation practice.[4]

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[2] NB: the Stanford/Oregon team used 51 of the 55 interviews in their analysis, excluding four interviews with funders.

[3] The broadcaster group included national film, television and radio programme producers, providers of electronic media and online products, and games producers.

[4] The providers were selected from respondents to the provider survey.

- **Literature and data review**: a review of the 'grey literature' collected throughout the study and the analysis of data from the Wellcome Trust Monitor and Public Attitudes to Science Survey.

- **Family studies**: comprising 12 in-depth interviews with children and young people aged 11–16 and from different social grades, supplemented by diary keeping, interviews with parents and peer-to-peer interviews. The Family Studies aimed to identify the drivers and barriers to engagement with informal learning in leisure time, map the nature of informal learning experiences and reactions to them, and explore how engagement in informal learning relates to attitudes to formal learning.

1.2   Report structure

This report relates to the four required study outcomes as follows:

- section 2 introduces and describes the informal science learning sector in the UK and explores the findings of the study on the links between informal and formal science learning (outcomes 1 and 4)

- section 3 describes the audiences who engage in informal science learning activities, setting the context in terms of engagement with science more broadly, before exploring which audiences providers find challenging to engage and the approaches taken to address this (outcomes 1 and 3)

- section 4 reviews the level and nature of evaluation activity across the informal science learning sector, the methods and approaches followed, the main barriers and challenges faced and the steps taken to address them (outcome 2)

- section 5 provides our conclusions and recommendations, based around the four outcomes; outcomes 1 and 4 are addressed together.

The report also features two annexes:

- Annex 1 provides a detailed description of the study methodology

- Annex 2 provides the full report of the Family Studies element of the study.

2 Informal science learning in the UK

Key point summary

This section introduces and describes the informal science learning sector in the UK and reports the study findings in terms of links between informal and formal science learning.

The section shows that:

- Although no single, accepted definition of 'informal science learning' exists, the term commonly refers to activities taking place outside the formal education system that seek to raise awareness of, and interest and engagement with, science and other STEM subjects. Although views differed, several common attributes of informal learning were identified.

- A wide range of services and activities are encompassed by the term informal science learning. Providers range from international broadcasters to sole traders supplying enhancement and enrichment activities to schools.

- While a spectrum of provision exists in terms of proximity to formal learning, two broad categories of activity were identified:

  – where provision is intended to enhance formal science learning and takes place in more formal environments but is different to formal, classroom-based learning; and

  – a broader range of activities, which may take place in formal and informal settings, but are not explicitly linked to more formal approaches or outcomes.

- The provider survey further illustrated the diversity of the sector in terms of the range of organisations involved in it and the services it delivers. Providers commonly reported delivering multiple services (between three and nine services each).

- Views varied considerably on the extent to which informal learning could, and should, contribute to more formal learning. While there was much agreement that informal science learning can stimulate interest in the formal, fewer respondents considered that this should be the main purpose of informal learning, which has an inherent value of its own.

2.1 Introduction – What is informal science learning?

In the broadest sense, informal science learning refers to activities that take place outside of the formal education system and that seek to raise awareness of, interest in and engagement with science and the broader science, technology, engineering and mathematics ('STEM') subjects. Although this is the term the sector commonly uses to refer to itself, alongside other terms such as 'enhancement and enrichment' and 'public engagement', there is no single accepted definition of 'informal science learning' in the UK. As we describe below, while representatives of the sector agree on many of the characteristics that can be applied to informal science learning, there is disagreement in certain areas, not least the proximity of informal to more formal science learning approaches.

As this section illustrates, the term 'informal science learning' can be applied to a wide range of activities and services, and although this study focuses on audiences aged up to 19, informal science provision is available to individuals of all ages.

Informal science learning is provided in many formats, via different channels, and delivered by a wide range of organisations. These include private and not-for-profit providers whose primary business is to deliver learning activities, other organisations who contribute but whose main business interests lie elsewhere (such as large organisations whose informal learning services are part of their wider educational or corporate and social responsibility remits), science and discovery centres and museums (who combine fixed interactive exhibition space with onsite and outreach learning provision), universities, zoos, and aquaria. Broadcasters, film producers, publishers and, increasingly, new media producers (ranging

from web-based developers to gamers) also contribute, while arts organisations, community-based organisations, clubs and societies all play a part.

While specific activities encompassed by the term 'informal science learning' can be placed along a spectrum in terms of their proximity to more formal school- or college-based learning approaches, two broad categories can be identified:

- The first focuses on learning that explicitly enhances formal science learning and takes place in more formal environments. It is not entirely voluntary (e.g. a school trip to a science museum) but it is categorically different from formal, classroom-based science learning. For these activities the target audiences are schools and teachers, who generally only value this form of science learning if it is or can be related to the curriculum and engages their students.

- The second category is much broader and covers activities that are voluntary and that take place in formal settings (such as museums), informal settings (such as the home) and places in between (such as community centres). Within this framework, providers deliver several activity types to a range of audiences.

2.1.1 Defining informal science learning

When individuals participating in the in-depth stakeholder interviews were asked to define informal science learning from their own perspectives, the following attributes emerged with some consistency:

- Informal science learning takes place outside of the formal curriculum. It is non-compulsory, includes an element of free choice and is not formally accredited. While capable of reinforcing formal learning, this is not its core purpose.

- It takes place in a range of settings, including schools, museums, science centres, individuals' homes and public spaces.

- It encompasses a wide range of activities, as one consultee described, "ranging from enhancement and enrichment within the formal school setting to science learning outside of the classroom…to the learning that takes place in museums, science centres, zoos, etc., to a variety of media such as TV, books and online engagement".

- It can inspire people, stimulate interest in science, encourage positive attitudes towards science and lead to a more thorough understanding of science.

- It features learning that is often unstructured, unguided and led by the interests of the individual.

- It can feature 'learning by stealth', a concept that was mentioned frequently and described as "audiences learning without being actively aware of what they are learning".

These parameters were explored further in the provider survey, where a series of statements were developed and providers asked whether they 'should always', 'can' or 'should never apply' to informal science learning. The statements and responses are shown in Figure 2.1 below.

Figure 2.1   Statements to test key parameters of informal science learning activities

Legend: ■ Should Always Apply % ■ Can Apply % ■ Should Never Apply %

Statement	Should Always Apply %	Can Apply %	Should Never Apply %
Supports the efforts of other science learning organisations	16%	82%	2%
Supports the achievement of formal education qualifications in science	11%	80%	8%
Is available to people of all ages	54%	45%	1%
Starts outside the formal curriculum	25%	73%	2%
Takes place in a setting outside the school classroom	19%	80%	1%
Involves an agent other than the regular teacher	18%	81%	1%
Typically involves learning with a group of the learner's choosing	7%	90%	2%
Happens as a result of free choice by the learner	35%	65%	1%
Has outcomes that are less prescribed than formal learning	37%	61%	2%
Actively engages the learner	76%	24%	0%
Aims to bring about change through emotional engagement	26%	72%	2%
Aims to bring about changes in attitudes to science	26%	72%	2%
Involves activities that are different from day-by-day formal learning	40%	59%	1%

Source: Provider survey   Base: 164 to 167 by variable

The vast majority of respondents considered that each of these statements could apply to informal science learning. The statement most commonly rated 'should never apply' related to informal learning supporting formal education (8 per cent of respondents).

Consequently, the main differences in view were in terms of the strength of agreement (i.e. whether it 'should always' or 'can' apply). When grouped by percentile ranges, a hierarchy emerges, as shown in Table 2.1.

Table 2.1   Agreement that statements 'should always apply' to informal science learning

Strength of agreement	Statement (percentage of respondents agreeing)
Should always apply – 50 per cent plus	Actively engages learners – 76 per cent Is available to people of all ages – 54 per cent.
Should always apply – 25 to 50 per cent	Involves activities that are different to day-to-day formal learning – 40 per cent Has outcomes less prescribed than formal learning – 37 per cent Aims to bring about changes through emotional engagement – 26 per cent Aims to bring about changes in attitudes to science – 26 per cent Starts outside the formal curriculum – 25 per cent
Should always apply – fewer than 25 per cent	Takes place in a setting outside school – 19 per cent Involves an agent other than the regular teacher – 18 per cent Supports the efforts of other science learning –16 per cent Supports the achievement of formal education – 11 per cent Typically involves learning with a group of the learner's choosing – 7 per cent.

On the basis of the views expressed by the consultees, we consider that it is unlikely that a single definition of 'informal science learning' can be developed that is both straightforward enough to be clearly communicated and understood and flexible enough to encompass the sector's breadth, diversity and complexity. Any single definition would also need to satisfy the divergent opinions identified in the study, particularly in terms of:

■ Free choice participation. Some consultees questioned the extent to which children visiting museums and science centres on school or family trips were participating on a 'free choice' basis.

- Schools as settings for informal science learning. Although the majority conceded that informal approaches could be delivered on school premises (e.g. through after-school science clubs), others felt strongly otherwise.

- Proximity to the curriculum and/or supporting formal science learning. Here opinions varied on the extent to which informal science learning can and should contribute to more formal learning. While the majority agreed that informal learning could do much to stimulate interest in science, some argued that informal approaches could make a more direct contribution to formal learning, while others felt they should be seen as distinct activities.

2.2   The informal science learning sector in the UK

The characteristics of the informal science learning sector in the UK were explored through the stakeholder consultations and survey of organisations providing (directly delivering or funding) informal science learning activities. This section focuses on the findings of the survey and summarises the composition of the respondents in terms of broad organisation types, their characteristics in terms of size and status, and the nature of the services offered.

2.2.1   Organisation types

Although the size of the sector, by definition, is not known, the survey of providers sought to maximise coverage through the development of a comprehensive list of known providers and through postings on Psci-Comm, GEM, Visitors Studies Group and Big Chat distribution lists.

A total of 196 individuals from 187 different organisations responded to the survey, most commonly:

- STEM suppliers (as their main and secondary business) – 44 (22 per cent) and 25 (13 per cent) responses, respectively

- museums – 27 responses (14 per cent)

- science and discovery centres – 26 responses (13 per cent)

- not-for-profit education organisations – 13 responses (7 per cent)

- universities – 11 responses (6 per cent)

- learned societies – 10 responses (5 per cent).

Responses were also received from: zoos and aquaria; electronic media producers, including website and games developers; broadcasters, TV and film producers; science festivals; research councils; arts and theatre producers; and park, nature and field centres.

In nine cases responses were received from more than one individual within a single organisation, although in each case they represented different interests (e.g. in some cases senior managers providing responses alongside staff with a more audience facing remit) and so were included in the subsequent analysis.

2.2.2   Organisational characteristics

The majority of respondents to the survey worked for charities, charitable trusts or not-for-profit organisations (114 of the 196 responses, or 58 per cent). Thirty-seven described their organisations as private or public limited companies (19 per cent), and the remainder were a combination of local authorities, sole traders, schools and research councils.

Responses were received from individuals in organisations of different sizes, from sole traders to larger organisations with more than 250 employees, but more than half (52 per cent) employed fewer than ten staff. Table 2.2 below shows the distribution of responses by numbers employed, with the most common organisation types in each size band.

Table 2.2   Distribution of responses by organisation size

| No. FTE employees	Number (percentage)	Common organisational types by size band
Sole traders	28 (14 per cent)	STEM providers (main/not main business)
Fewer than ten employees (micro)	74 (38 per cent)	STEM providers (main/not main business), not for profit organisations, museums
10–50 employees (small)	47 (24 per cent)	STEM providers, SDCs, museums, zoo/aquaria, learned societies, charities
51–250 employees (medium)	26 (13 per cent)	Most SDCs and museums, and learned societies
More than 250 employees (large)	21 (11 per cent)	All universities, large museums, some STEM providers (all not main business), charitable organisations and research councils

Source: Provider survey   Base: 196 respondents in 187 organisations

The respondents also varied in their scale of operation. One in five (21 per cent) described their coverage as primarily local or regional and 27 per cent as national. However, more than half (52 per cent) described their coverage as national and international; the scale of coverage tended to increase with organisation size.

2.2.3   Services and activities

The nature and range of services reported by the respondents varied considerably, illustrating the breadth of the sector and the range of opportunities that the public have to interact with it. The provider survey sought to establish the types of services delivered across the sector: respondents were asked to describe what they considered to be their main and secondary services. A preselected list of service types was developed, although the providers could add to this list if required. The findings about the services provided by respondents are set out in Figure 2.2 below.

Figure 2.2   Main and secondary services provided
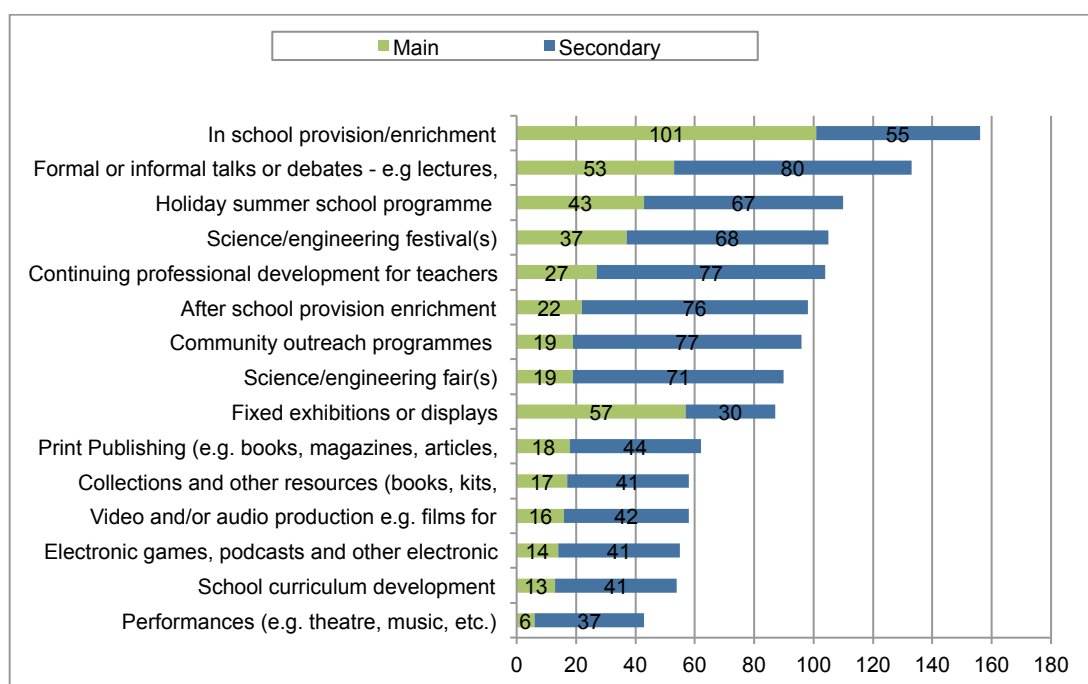
Source: Provider survey   Base: 196 respondents in 187 organisations

The delivery models reported related closely to the nature and size of the respondent's organisation. For example, museums and science and discovery centres combined centre-

based exhibition space with services targeted towards children and young people delivered onsite or on an outreach basis, while other, smaller STEM providers delivered their services directly to schools (some also on an outreach basis in a range of community settings).

The survey responses further illustrated the diversity of services delivered across the sector, but they also demonstrated the range of services provided by individual organisations.

In terms of the services delivered across the sector, 'in school provision/enrichment' was the most commonly reported (by 80 per cent of respondents) – half (52 per cent) reported it as a main service area. Other services reported by half of the respondents or more were 'formal or informal talks and debates' (68 per cent), 'holiday or summer school programmes' (56 per cent), 'science and engineering festivals' (52 per cent), 'continuing professional development (CPD) for teachers' (53 per cent) and 'after school provision' (50 per cent).

The survey also explored the number of services delivered by individual organisations. The findings showed that single organisations delivered between one and 16 different types of service, and although the scale of delivery for each was not explored, the number of service types most commonly ranged from three to nine. For organisation types where ten or more responses were received, the survey showed that:

■ Suppliers of STEM activities (as main business) most commonly reported delivering in-school and after-school enrichment services, science engineering festivals, CPD for teachers, and formal and informal discussions and debates (each reported by more than half of the 44 respondents). They also reported delivering the greatest number of services individually – between one and 16 different services – but most commonly nine services.

■ Science and discovery centres most commonly reported fixed exhibitions/displays, in-school enrichment services, holiday or summer programmes, lectures/debates and CPD for teachers (each by 20 or more of the 26 respondents). The individual centres delivered between three and 13 services, most commonly nine services.

■ Museums most commonly reported providing fixed exhibitions, holiday or summer programmes, lectures/debates and in-school enrichment services. Each respondent delivered between one and 15 services, most commonly three services.

■ Suppliers of STEM activities (not as main business) most commonly reported in-school enrichment services, lectures and debates, science and engineering festivals, CPD for teachers, and community outreach programmes (each mentioned by ten of the 25 respondents in this group). The individual respondents reported delivering between one and 11 services, most commonly between three and four.

■ The 13 not-for-profit education organisations delivered between one and 13 types of services, most commonly four services.

■ Of the 11 universities responding, in-school enhancement and enrichment, lectures and debates, and science and engineering festivals were the most common services (each provided by ten of the 11 respondents). The individual universities provided between four and 12 services, most commonly eight services.

■ Finally, each of the learned societies described directly providing or funding lectures and debates, in-school provision and the production of books and magazines. Individually they reported supporting between seven and 14 services, most commonly seven.

2.2.4 Objectives, outcomes and measures of success

The survey and interviews with stakeholders reviewed the objectives of each respondent's organisation, the types of outcomes they intended for participants and their main measures of success.

Organisational objectives

The review of objectives focused on the organisations' informal science learning activities, although in some cases (notably the STEM providers – not main business) these were a

subset of their wider organisational objectives. While the language used and the precise nature of the objectives varied considerably, three main groups could be identified:

■ More than half of the respondents described their objectives as to have positive attitudinal impacts on their audiences. Many wanted to elicit positive emotional responses and to "fire the spirit of discovery while unlocking the science and creativity in everyone through innovation, imagination and integrity" (survey respondent). This was often cited in the context of overcoming negative perceptions of science, with the intention of enthusing audiences through fun, stimulating and memorable experiences – inspiring audiences' interest in science was a commonly reported objective. Many respondents targeted children and young people, although not exclusively; a significant proportion sought to achieve this objective with the general public.

■ A significant objective for around a quarter of respondents was stimulating young people's interest in science to encourage them to consider further study or a career in STEM. Many respondents saw their objectives as linking explicitly to helping "secure and sustain a supply of future researchers to support the research base that is critical to the UK economy" (survey respondent). A second described how they "aim to inspire the next generation of scientists and healthcare professionals, stimulate interest, excitement and dialogue about biomedical research, and raise educational and career aspirations" (stakeholder interview).

  However, there were differences within this group regarding the extent to which they saw further study or career choices as a direct or an indirect outcome of their work. For some this was based on informal science learning directly contributing to more formal outcomes (i.e. in supporting achievement), while for others this was more about making audiences aware that such opportunities existed and inspiring them to explore the options for themselves.

■ Creating a wider understanding, and appreciation of, the importance of science was mentioned by around one in five respondents and linked to efforts to support a more scientifically literate society. Organisational objectives were commonly explained as being "to stimulate interest in science and to encourage better understanding of the application of science to our everyday lives" (survey respondent), with provision regularly involving communicating scientific research to the general public in a manner that allows "opportunities for all ages to discuss, investigate, explore and challenge science" (survey respondent). A similar proportion of respondents also cited that they wish to impart scientific knowledge to children and the wider public for these reasons, and did this through in-school and out-of-school activities.

Consultations with the broadcasters established that some considered that they had an educational role. Some saw themselves primarily as educators in the informal learning context, although audience numbers were key in discussions about which programmes to commission at an organisation level. Consequently, the large public and private networks considered that engaging large audiences requires a 'science by stealth' approach (e.g. programmes such as *Embarrassing Bodies*, which is factual but still entertainment). This was based on experience that showed that programmes dealing more overtly with science (such as BBC Two's *Horizon* programmes) tend to attract smaller audiences. Some of the broadcasters considered there was a clear link between their work and formal education. They hoped that watching their programmes would spark further interest in science and lead to further engagement in terms of study and potential career options. In some cases this included the production of materials for use in schools, in educator CPD or to support higher education courses.[5]

Outcomes and measures of success

The providers participating in the survey were also asked to describe the outcomes their services intend to achieve. A predefined list, with the opportunity to suggest additional

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[5] We spoke to heads of science and programme producers, most of whom had been educated in science to at least first degree level.

outcomes, was used to identify providers' main and secondary outcomes. The statements and responses are shown in Figure 2.3.

Figure 2.3   Main and secondary outcomes reported
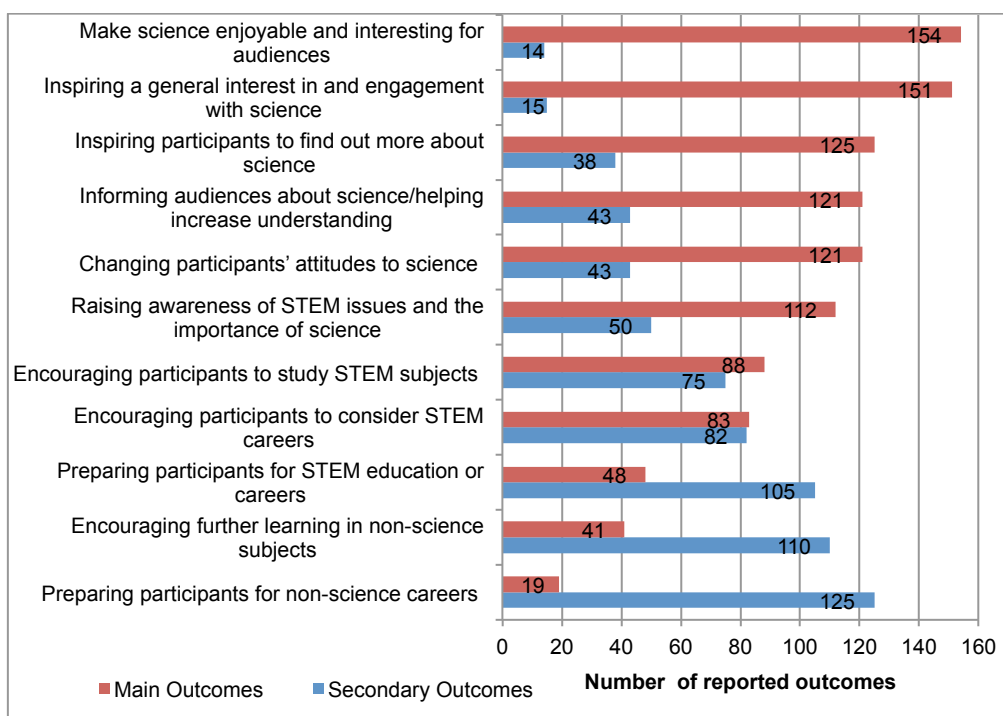
Source: Provider survey   Base: 196 respondents in 187 organisations

The responses can be clustered into three groups, based on the level of emphasis on outcomes reported as main or secondary:

- The first group comprises the six outcomes most commonly reported as 'main' outcomes, namely 'make science more enjoyable and interesting for audiences', 'inspiring a general interest in and engagement with science', 'inspiring participants to find out more about science', 'informing audiences about science/helping increase understanding', 'changing participants' attitudes to science' and 'raising awareness of STEM issues and the importance of science'. These were reported as main outcomes by between 112 and 154 organisations.

- The second group featured two outcomes where the balance between those reporting as 'main' and 'secondary' outcomes was closer – namely 'encouraging participants to study STEM subjects' (reported as 'main' by 86 organisations and 'secondary' by 75 organisations) and 'preparing participants for future STEM education or careers' (reported as 'main' by 83 and 'secondary' by 82).

- The third group comprised three outcomes more commonly reported as 'secondary' outcomes, namely 'encouraging participants to consider STEM careers', 'encouraging further learning in non-science subjects' and 'preparing participants for non-science careers'. While two of these relate to effects outside the STEM subject areas, more than twice the number reporting 'encouraging participants to consider STEM careers' did so as a 'secondary' rather than a 'main' outcome (48 as 'main' and 105 as 'secondary').

The outcomes reported in the survey linked closely with the organisations' reported objectives and suggested that for the majority of providers their activities are intended primarily to raise awareness and understanding of science and interest in science. Progression to further learning and potential careers in STEM were seen more commonly as secondary outcomes.

The interviews with the television and radio broadcasters identified that audience size, audience appreciation and impact are three key measures of success, although some consistently conducted the in-depth research required across all programmes to establish

appreciation and impact. While formal audience targets are not set, programme makers consider the sort of audience that should be achievable for a particular time and station slot. If this audience is not achieved, questions are asked about whether the right programme is in the slot, so both internal and external programme makers must convince channel controllers that the audience for any programme idea will be sufficiently large. Different channels have different audience profiles and programmes are tailored to these profiles.

Some broadcast respondents viewed themselves as educators, even those with a less overtly educational remit, although this was not necessarily reflected in their expectations of outcomes. For example, some would not expect their audiences to 'learn' facts or be able to repeat details after viewing their programmes. Rather, they aim to inspire audiences to go further, read more, or visit an exhibition linked to the programme – in that sense aligning closely with the inspirational objectives and outcomes cited by the other informal science learning providers. As several described, they want to: "be a window onto a very familiar world that can give you a much deeper and more satisfying understanding of what's going on around you" and "provide pure entertainment, which is appropriate at this slot in the channel; to provide empowerment…so that people have a better understanding and are better equipped to make choices in their everyday lives" (broadcaster interviews).

Others were more direct in their expectations and believed that their work would progress from raising awareness and interest to encouraging more formal learning. As one described, "informal learning is the first step for all…the first step to getting people to engage in formal learning."

Another described how "we're starting to see the turn; we're seeing more people, and more women especially, taking technology and science courses at university, and we can only hope that we're part of that."

2.3 Linking informal and formal science learning

The links between informal and formal science learning were explored in the stakeholder interviews, which showed that opinions varied on the degree to which supporting formal learning should be seen as the main role of informal science learning – although for some the two activities were distinct and not necessarily linked. The provider survey asked respondents being asked to show the extent of their agreement with a series of predefined statements, which are shown in Figure 2.4.

Figure 2.4   How informal science learning relates to formal science learning
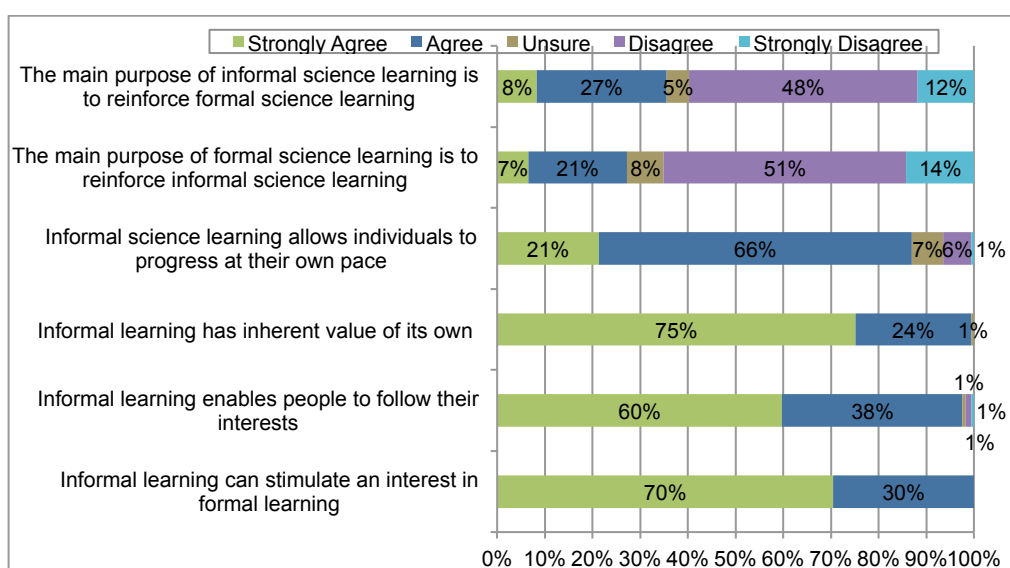
Source: Provider survey   Base: 196 respondents in 187 organisations

The responses reflect those in the stakeholder interviews:

- The strongest agreement was with the statements "informal learning can stimulate an interest in formal learning" (100 per cent), "informal learning has a value of its own" (99 per cent) and "informal learning enables people to follow their interests" (98 per cent).

- Strong agreement was also reported with the statement "informal science learning allows individuals to progress at their own pace" (85 per cent).

- Opinion was more varied regarding the purpose of informal learning (and, interestingly, formal learning):

  - 60 per cent disagreed or disagreed strongly with the statement "the main purpose of informal science learning is to reinforce formal science learning", although more than one in three (35 per cent) agreed or strongly agreed with the statement.

  - 65 per cent disagreed or disagreed strongly that "the main purpose of formal science learning is to reinforce informal science learning", although more than one in four (28 per cent) agreed or strongly agreed with the statement.

The survey responses suggest that while there was strong agreement that informal science learning can stimulate interest in formal learning, views were more mixed on whether its main purpose is to directly contribute to more formal outcomes.

The survey also explored how respondents considered their work linked with formal science learning. Three main routes were identified from the 129 responses received:

- Half of the respondents (51 per cent, or 67) reported that their provision directly or indirectly supported the delivery of the formal science curriculum. A common response was that "anything done in schools' class time needs to support formal science learning" (survey respondent), and therefore provision should be tailored to complement the aims and outcomes of the formal curriculum. This included developing materials for teachers, developing content, and sessions and/or activities that map onto and complement the curriculum. The respondents reported that efforts to support the formal curriculum can take place inside and outside the classroom – for example, an activity that is delivered during the school day but takes place in a science and discovery centre or other location. However, many activities also took place outside the school day but were still linked to the curriculum because respondents saw this as a good way to reinforce and embed scientific knowledge into young people's lives.

- Just under half (48 per cent or 62) described providing activities or events that were not directly linked to the curriculum to raise and stimulate young people's interest and motivation in science. Many highlighted that providing fun and stimulating experiences outside of the formal curriculum can help reinforce or contextualise formal science learning. Activities were delivered inside and outside schools, and during and outside of the school day.

- Around one in five respondents (19 per cent or 25) reported that they provided continuing professional development for teachers. Services encompassed specific training workshops and sessions to enhance teacher's skills and knowledge in science learning and teaching. They also included the development of training resources – such as training manuals or websites – that teachers could use to improve their science teaching practice and that included materials directly linked to, as well as distinct from, the formal science curriculum. In some cases providers also described how they were attempting to bring "informal science learning principles and approaches to the mainstream" (STEM provider, stakeholder interview).

The provider experiences suggested a series of factors that were effective in supporting their engagement with schools, most commonly:

- ensuring that the contribution their provision could make to delivery of the school curriculum was made explicit, to be clear on the benefits for schools and pupils and where their interventions could be most useful

- providing a range of pre- and post-intervention materials, to allow schools to prepare in advance and for continued study on the return to school to embed learning

- establishing long-term relationships with schools, to provide continued rather than one-off experiences, which can be planned into the school year with inputs from providers and teachers

- sharing the principles of informal science learning with teachers, through formal CPD provision or by observation, to allow practice to be shared and elements of the informal learning approach to supplement existing teaching practice.

However, all approaches to working with schools need to consider the practicalities of working with teachers, as, for example, the uptake of pre- and post-intervention materials can be variable.

It was clear that for many providers supporting the formal curriculum, either directly or indirectly, was both a key part of their activities and an important means of securing revenue. While emphasising links to the formal curriculum emerged as a strong 'selling point' for the providers working with school audiences, a tension was recognised between contributing to the formal curriculum and retaining a degree of distinctiveness from it. The challenge for providers working more closely with schools is therefore to provide services that can 'inspire and enthuse' children and young people to generate interest, while being sufficiently relevant to the curriculum to be attractive to teachers.

3 Engaging audiences and communities

Key point summary

This section draws on the stakeholder interviews, provider survey, family studies research and Wellcome Trust Monitor and Public Attitudes to Science Survey (PASS) data to describe the audiences engaging with science and informal science learning and those which providers find more challenging to engage. It shows that:

- National survey data reveals that interest in science among the general public is high and engagement can be passive (e.g. watching television) or active (e.g. visiting a science centre).

- Although differing by provider type and service, the most commonly reported audience groups were children and young people aged 5–16 and secondary school groups. Children under 5, people aged 16–19 and adults aged over 19 were mentioned less commonly.

- Views and experiences of challenging-to-engage audience groups varied. Some providers consider that any group can be engaged if the right steps are taken. However, seven out of ten providers reported experiencing challenges, most commonly in engaging adults aged over 19, families and people aged 12–19.

- Further analysis showed that individuals from disadvantaged areas, or in households with low incomes, were the most difficult to engage. The fieldwork also found that social and cultural issues can represent barriers to engagement.

- A series of principles were identified that underpinned the effective engagement of challenging groups, including making experiences and content relevant to audiences (as well as stimulating and engaging), conducting research to identify barriers and enabling service tailoring, establishing partnerships with organisations or groups already engaging with the target audience, and using community outreach methods.

- However, providers stressed that a single approach to engaging challenging audiences was less likely to be effective and that a combination of approaches was required.

3.1 Public interest in science

As the most recent Public Attitudes to Science Survey (PASS) has shown, interest in science among the adult population is high.[6] Eighty-two per cent of respondents agreed that science is such an important part of our everyday lives that all should be interested in it. Approaching half (43 per cent) of all PASS respondents felt very or fairly well informed about science, although men (49 per cent) are more likely to say this than women (37 per cent). Moreover, those from social grades A and B (56 per cent) are more likely to feel very or fairly well informed than those from social grades C1 (48 per cent), D (33 per cent) and E (31 per cent).[7]

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[6] Public Attitudes to Science Survey 2011, Ipsos MORI for the Department for Business, Innovation and Skills. PASS is a nationally representative survey commissioned by the Department for Business, Innovation and Skills. We use only the findings from the 2011 wave, but there have been three earlier waves, in 2000 (funded jointly with the Wellcome Trust), 2005 and 2008. The 2011 survey interviewed 2103 adults aged 16 and over about their behaviour, attitudes and knowledge of various aspects of science and UK science governance. The data have been analysed primarily by social grade for this report.

[7] Social grade definitions: A = higher managerial, administrative or professional (4 per cent of UK population); B = intermediate managerial, administrative or professional (22 per cent of UK population); C1 = supervisory or clerical and junior managerial, administrative or professional (29 per cent of UK population); C2 = skilled manual workers (21 per cent of UK population); D = semi and unskilled manual workers (16 per cent of UK population); E = casual or lowest grade workers, pensioners and others who depend on the welfare state for their income (8 per cent of UK population). Pensioners with occupational pensions are classified according to their last occupation. The percentages are sourced from the National Readership Survey (NRS) 2010 (www.nrs.co.uk/lifestyle.html). Due to the sampling method and sample size, NRS is taken as a definitive source of population data between censuses by the market research industry. In addition, about 2 per cent of the population is upper class (the nobility, super rich, etc.) and excluded from this classification. The total comes to more than 100 per cent as a result of rounding.

There would seem to be an appetite for more science, with 51 per cent of respondents saying they see and hear too little information about science. Interestingly, those from social grade C2 were the most likely to say this (56 per cent).

3.1.1 Public engagement with science

Engagement in science can be active or passive. For example, watching television is a relatively passive activity – it requires little effort and programmes are planned and executed by others. Some programmes are becoming interactive, with websites and opportunities to email comments, questions and answers and/or to vote, but this level of participation is optional and not essential to enjoyment. There is also a growth of dual screening, where viewers comment to friends about programmes using text or online routes. Visiting a science centre requires more active engagement – the decision to visit must be made, action needs to be taken to travel, and some exhibits are interactive.

Most public engagement with science is passive, but active engagement is more common among social grades A and B than others.

PASS reveals that respondents mainly found out about science from television (54 per cent) and newspapers (32 per cent), with a fifth (19 per cent) saying they found information on the internet and one in seven (14 per cent) getting information from the radio. Men were more likely to look on the internet for information than women. Television was more important as a source of information about science for social grades C2 (62 per cent) and D and E (64 per cent) than for social grades A and B (42 per cent). Scientific journals were much more important for those from social grades A and B, with 13 per cent of this group giving these as a source of information compared with an average of 7 per cent.[8]

PASS also asks about engagement with scientific leisure activities, or what might be termed informal science learning activities. It found that 22 per cent of respondents had been to a science museum in the previous 12 months. As with many other activities outside the home, visits were far more common among those from social grades A and B (33 per cent) than those from social grades D and E (9 per cent). While around a quarter (27 per cent) had been to a science museum with their partner, similar proportions went as a family group (28 per cent) or as a lone adult with children (23 per cent). Those visiting only with their partner tended to be older and from social grades A and B.

The Family Studies element of this study found that respondents were unfamiliar with the term 'science centre', including two who had visited a specific centre. However, PASS found that 11 per cent of respondents said that they had been to a science and discovery centre in the 12 months before interview. While a fifth (18 per cent) of PASS respondents who had been to a science and discovery centre went with their partner, this was primarily a family activity with 42 per cent of those attending as a family group and a further 26 per cent going alone with children. The Wellcome Trust Monitor survey of people aged 14–16 found that 12 per cent of respondents said that they had been to a science centre in the 12 months before interview.[9] This activity was more common for 14-year-olds (19 per cent) than for 15- and 16-year-olds (10 per cent and 7 per cent, respectively), and respondents whose parents had higher educational qualifications (19 per cent).

PASS found that a quarter of respondents had been to a zoo in the previous 12 months. Compared with many other activities this was more evenly balanced by social grade, with 29 per cent of A and Bs having visited and 21 per cent of D and Es. This tended to be a family activity: 45 per cent of those who had been to a zoo attended in a family group, while a further 22 per cent went as the sole adult with children.

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[8] 21 per cent of respondents had a Bachelor's degree. Of these, 21 per cent were in science/mathematics, 9 per cent were in engineering and 10 per cent were in medicine. 8 per cent had a Master's degree or PhD.

[9] The Wellcome Trust Monitor is a survey of UK adults' and young peoples' views of medical research, to understand trends in public interest in, knowledge of and attitudes towards medical research and associated applications. The survey collects data to provide a broad baseline of measures for the future, repeated every three years to build a robust, high-quality evidence base and to explore trends over time. As well as incorporating questions about medical research, the Monitor tracks changes in young peoples' (14–18 years) attitudes to school science education and careers in science. The survey was conducted by NatCen, with 1179 adults aged 18+ and 374 young people aged 14–18 interviewed in 2009 following a random stratified sampling approach.

The Wellcome Trust Monitor found that zoos were the most commonly visited attraction of those listed, with just under a third (29 per cent) of respondents aged 14–16 having visited one in the 12 months before interview. This was less common among 16-year-olds: only 18 per cent had been in the 12 months before interview.

PASS found that 12 per cent of respondents had been to a lecture or a talk on a science topic, 11 per cent had been to a science-related activity at a school, community centre or university outside regular classes, 8 per cent had visited a laboratory and 7 per cent had been to a public meeting or debate on a science subject in the 12 months before interview. The sample sizes for each activity are small, but these seem to be activities undertaken with friends rather than family and so seem to be perceived as activities for adults.

PASS also found that 3 per cent of respondents had been to a science festival in the 12 months before interview, but this rose to 8 per cent of those in the A and B social grades. The sample size is too small to comment further on behaviour. The Wellcome Trust Monitor found that 2 per cent of people aged 14–16 had been to a science festival in the 12 months before the interview.

3.2   Main audience groups – provider survey

The audiences for informal science learning were explored on a qualitative and quantitative basis in the stakeholder interviews and provider survey, respectively. The survey of providers explored audience composition across the following groups:

■ children/young people – aged under 5, 5–11, 12–16 and 16–19

■ adults – aged over 19

■ families

■ primary school groups

■ secondary school groups.

Respondents were asked to describe which groups represented their 'main' and 'secondary' audiences. Table 3.1 shows the most commonly reported main and secondary audiences for provider types where more than ten responses were received.

Table 3.1   Main audiences – organisation type and services

Provider/ service examples	Under 5	5–11	12–16	16–19	Families	Adults over 19	Primary school	Secondary school
Museums :	Sec	Main	Main	--	--	Sec	Main	Main
Fixed exhibitions	--	--	Main	--	Main	Main	--	--
Holiday provision	--	Main	Main	--	Main	--	--	--
In-school enrichment	--	--	--	--	--	--	Main	--
Science and discovery centres	Sec	Main	Main	Sec	Main	Sec	Main	--
Fixed exhibitions	--	Main	Main	--	Main	--	Main	Main
In-school enrichment	--	Main	Main	--	--	--	Main	Main
Holiday/summer school provision	--	Main	--	--	Main	--	--	--
STEM suppliers (main business)	Sec	Main	Main	Sec	--	Sec	Main	Main
In-school enrichment	--	Main	Main	--	--	--	Main	Main
After school provision	--	Main	Main	--	--	--	Main	Main
Science/engineering festivals	--	Main	Main	--	--	--	Main	Main
STEM suppliers (not	--	--	Main	Sec	Sec	--	--	Main

Provider/ service examples	Under 5	5–11	12–16	16–19	Families	Adults over 19	Primary school	Secondary school
main business)								
In-school enrichment	--	--	Main	--	--	--	--	Main
Formal/informal talks and debates	--	--	--	Main	--	Main	--	--
Universities	--	**Main**	**Main**	**Main**	**Main**	**Main**	--	**Main**
Formal/informal talks and debates	--	--	--	--	Main	Main	--	Main
In-school enrichment	--	Main	Main	Main	--	--	Main	Main
Science/engineering festivals	--	Main	Main	Main	Main	Main	--	--
Learned societies	--	--	Sec	**Main**	Sec	Sec	--	**Main**
Formal/informal talks and debates	--	--	--	Main	--	Main	--	Main
In-school enrichment	--	--	--	Main	--	--	--	Main

Key: Main, most commonly reported main audience; Sec, most commonly reported secondary audience.

Source: Provider survey

Across the providers, children and young people aged 5–11, 12–16 and secondary schools were the most commonly reported main audience groups, followed by families and primary schools. Children aged under 5, young people aged 16–19 and adults aged over 19 were the most commonly reported secondary audiences.

Analysis at the level of the individual services shows that providers work with different mixes of audiences in different contexts. Services such as in-school enhancement and enrichment are clearly targeted towards children and young people in schools, and here differences between primary and secondary schools emerged. For example, museums described their main audiences as children aged 5–11 or 12–16, and primary and secondary schools. These audiences varied by service, from those aged 5–16 and their families for holiday provision to young people aged 12–16, adults and families for fixed exhibitions and displays. Conversely, providers supplying STEM services consistently reported their main audience groups as children and young people aged 5–16 in primary and secondary schools.

The survey data also suggests potential gaps in provision that may present opportunities for the future. Children aged below 5[10], young people aged 16–19 and adults aged over 19 were the least commonly reported main audience groups.

The findings from the survey broadly tally with the experiences reported in the stakeholder interviews and case study fieldwork, although in some larger museums and science and discovery centres, secondary schools emerged as a more difficult to engage audience. These interviews also explored the challenges faced in engaging with certain audience types, as the organisations sought to provide services that were inclusive and accessible.

3.3 Working with challenging audiences

Views on the most challenging audience groups varied considerably across the sector, with some consultees reporting that no groups were more difficult to engage than others if the right preparatory steps are taken. Other providers had clearly not considered working with some audience groups – either because of the nature of their offer or because of the resources available to them. Nevertheless, while provider motivations, drivers and activities differed, all who completed the survey aimed to be inclusive in their offers.

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[10] Although children aged under five are also likely to attend as part of family groups.

The major broadcasters had difficulty in engaging some audiences. Their strategy for inclusivity involved using different voices to attract different audience groups, with some focusing on characters who already had a high profile with the target audience and using them as 'hooks' by which to draw in the audience. Whether smaller providers should use a similar variety of tones of voice, or whether individual organisations should focus on specific audiences, is an issue providers and funders need to consider.

The provider survey found that seven out of ten (69 per cent) providers had experienced difficulties in engaging with one or more audience group(s), as shown in Table 3.2.

Table 3.2   Main audience groups reported as being challenging-to-engage

Audience group	Number	Percentage of all respondents reporting difficulties
Children up to 11	63	46%
Young people aged 12–19	94	69%
Adults, 19+	101	74%
Families	95	70%
Primary school groups	55	40%
Secondary school groups	73	54%

Source: Provider survey   Base: all organisations reporting hard to engage audiences, 136

As the table shows, adults aged 19 and over were the most commonly reported challenging-to-engage group (74 per cent of respondents), followed by families (reported by 70 per cent of providers), and children and young people aged 12–19 (69 per cent). Conversely, primary schools were least frequently mentioned as challenging – although 40 per cent reported experiencing difficulties engaging with them.

To explore the nature of challenging audiences in greater detail, providers were asked to describe their single most challenging audience and other challenging audiences against the following variables:

■ the main audience groups: children aged up to 5, 5–11, 12–16, 16–19 years, adults aged over 19, families, and primary and secondary schools

■ specific characteristics: those residing in disadvantaged areas, those on low incomes, those from minority ethnic groups, those with low levels of education or attainment and those with physical or learning disabilities.

The responses showed that generally within each audience category it is those from disadvantaged areas, or in households on low incomes, that are the most difficult to engage. This is not surprising given the findings from the Family Studies, PASS and the Wellcome Trust Monitor, which showed that respondents from the lower social grades are less likely to engage with science and have a smaller range of leisure activities or informal learning opportunities.

Specific challenging audiences by provider type were as follows:

■ STEM providers (main business)

– families from disadvantaged areas or with low incomes (by 12 of the 25 providers reporting challenges)

– adults across all subgroups (reported by 9 of the 25 organisations reporting)

– children, young people and adults with physical and/or learning disabilities were reported as challenging more frequently by STEM providers than by any other organisational group.

■ STEM providers (where not main business)

- families with low levels of education and from disadvantaged areas (seven and six of the 22 reporting challenges, respectively)
- adults from disadvantaged areas or with lower levels of attainment (nine and seven of the 22 reporting challenges, respectively).

■ Not-for-profit education organisations

- children aged under 11 from disadvantaged areas (five of the nine reporting challenges)
- young people aged 12–19 from disadvantaged areas (six of the nine reporting challenges)
- adults from disadvantaged areas and from minority ethnic groups (five and four of those reporting challenges, respectively).

■ Science and discovery centres

- adults from disadvantaged areas and with low levels of education (11 and ten of the 22 respondents reporting challenges, respectively)
- families from disadvantaged areas (12 of the 22 reporting challenges)
- families from ethnic minority groups (ten of the 22 reporting challenges).

■ Museums

- families from minority ethnic groups and from disadvantaged areas (11 and eight of the 23 museums reporting challenging audiences)
- young people aged 12–19 (nine of the 23 museums reporting)
- adults from minority ethnic groups (nine of the 23 museums reporting).

■ Universities

- children aged up to 11 with physical or learning disabilities (three of the six universities reporting challenging audiences)
- all adults (three of the six universities reporting challenges).

In addition, the most commonly reported challenging-to-engage groups in the broadcaster interviews were:

■ women, especially young women

■ younger people (especially young people not in education, employment or training)

■ minority ethnic groups

■ those without internet access (only for some channels or programmes);

■ those in social grades C2 and D.

While the responses across all the providers emphasised the financial aspect of socioeconomic disadvantage, they also suggested that disadvantage was accompanied by a series of social and cultural factors that compounded the financial barrier to engagement. One respondent described their service as "not something they [challenging-to-reach audiences] naturally engage in", and elsewhere providers described that informal learning was perceived by some audience groups as "not being for the likes of us".

The PASS data shows a strong correlation between attitudes and behaviour which results in some groups being unlikely to visit science and indeed, non-science, venues. Based on a series of attitude statements, PASS categorises respondents into six groups according to their attitudes to science: Concerned, Indifferent, Late Adopters, Confident Engagers, Distrustful Engagers and Disengaged Sceptics. As shown in Table 3.3 below, analysis of these groups by social grade shows that those in social grades A and B are much more likely to be Confident Engagers than the other social grades. By contrast, the social grades C2, D

and E were much more likely to fall into the Concerned and Indifferent categories than social grades A and B.

Table 3.3   Relationship between social grade and attitude to science

Attitude group	Total (%)	A (%)	B (%)	C1 (%)	C2 (%)	D (%)	E (%)
Concerned	23	16	17	21	**24**	**30**	**28**
Indifferent	20	11	16	17	**23**	**27**	**24**
Late Adopters	18	15	16	20	16	17	19
Confident Engagers	14	**38**	**23**	16	8	4	5
Distrustful Engagers	13	13	19	14	10	6	9
Disengaged Sceptics	13	6	9	11	18	16	16

Source: PASS Base: 2,103

The box below describes the characteristics of the Confident Engagers, Indifferent and Concerned groups identified above.

PASS Survey – Population groups based on their attitudes to science

The characteristics of the Confident Engagers, Indifferent and Concerned groups, drawn from the PASS Summary Report produced by the MORI Social Research Institute, are summarised below.

Confident Engagers make up 14 per cent of the population and tend to be the most affluent and well-educated cluster. They have a strongly positive attitude towards science and various scientific developments, are confident that scientists are well regulated and more likely to trust that these regulations will be followed. They want to get more involved in decisions about science but are also keen for the Government to put expert advice and evidence above public and media opinion. Their concerns tend to be about the media's influence over science policy and the way in which science is reported. They are more likely than average to read broadsheet newspapers and use a variety of media to find out about science issues, including science blogs and other websites on science and technology. They also tend to be users of social networking websites.

One in five (20 per cent) belong to the **Indifferent** group, who tend to be much older than any of the other groups, with a quarter being aged over 75 and half being retired. While less likely than some groups to feel informed about science, they are not especially negative or worried about it, and tend not to be as interested in science as other groups. The Indifferent might engage more if they had a better understanding of the extent to which science affects their lives, so that they feel less isolated from it. Many might also require a better basic understanding of how scientists conduct their work before they can engage. Communications about science should therefore attempt to demystify science for the Indifferent, explaining that it can be simple and that anyone can 'do' science. The most important media for the Indifferent are television and newspapers, as they tend not to use the internet. They also tend not to actively seek out science information, so they would be more likely to find out about science if it were incorporated into the non-science television programmes they already watch or magazines they already read.

The **Concerned** are the largest cluster, with around a quarter (23 per cent) of the population belonging to this group. Religion tends to play a more important part in their lives than for other clusters. The strong presence of people from ethnic minority backgrounds also suggests they are subject to a different set of cultural influences to other clusters. They have strong views on the limitations of science relative to others and are among the least convinced of the economic benefits of investing in science, so focusing on the economic impact of science might help to improve their

The Family Studies found that more limited social experiences among the lower social grades compared with the higher social grades also constrained activities. For the most part those who participated in the Family Studies were not on very low incomes, and only one was on benefits. Nevertheless, there was an underlying feeling that some activities were out of reach for those in the lower social grades. Parental concern about the likelihood of a new activity bringing either short-term enjoyment or long-term engagement for their child was a barrier to willingness to spend when family budgets were tight.

The provider case studies also identified a lack of confidence among those from the lower social grades to engage with activities. Limited awareness of similar activities and a lack of previous involvement in similar activities were barriers to engagement. This also links with the Family Studies findings – where aspirations may be limited or families may lack the confidence or knowledge to engage – and the view that provision is in some way elitist or the preserve of the middle classes.

Taken together, the provider case studies, Family Studies and PASS strongly suggest that social and cultural factors may pose greater barriers than financial resources to engagement in activities, whether passive or active, although other factors such as the availability and cost of transport for audiences living in rural areas can be important. PASS shows that those in the lower social grades were less likely to engage with a range of activities related to science and other cultural experiences such as visiting the theatre, art galleries, and so on, and even going to sporting events. The Family Studies found those from lower social grades took part in a smaller range of activities.

Even more passive activities, such as watching television, are possibly divisive, when the interviews with broadcasters suggest that those from lower social grades watch less 'serious' programmes and that science has to be introduced by stealth to generate a mass audience.

3.4   Engaging audiences

3.4.1   Engaging tweens

The Family Studies focused on those aged 11–16, and we use the term 'tweens' to refer to this age group throughout this section. The term 'young people' is commonly used to refer to those aged 16–24, who are attitudinally and behaviourally quite different from tweens. Young people have a greater degree of independence compared with tweens; they often live away from home, are able to drive and have some degree of financial independence.

Although the sample size for the Family Studies was small, data from the Wellcome Trust Monitor and PASS were used to verify the findings where possible. The findings were also fairly consistent across the sample, and we consider them reliable for mainstream tweens.

The tweens participating in the study regarded their leisure time as primarily a time in which to have fun, and by the time they entered secondary school aged 11 they had already established leisure time preferences, which were respected by their parents. As a group their favourite activities tended to be sport, TV, gaming and probably music (although this was not explicitly recorded on a large scale).

We did not find a culture of self-education with tweens using their spare time to support their school work or to learn about other topics, nor did we find that parents supported a more educational focus to their children's free time. Indeed, parents (or at least mothers) were concerned that tweens had some 'downtime' as they believed that pressure at school meant tweens needed time to relax and explore their own interests. Any learning was serendipitous

– for example, if a television programme was educational in some way or if they improved in a sport. This did not differ by gender, age or social grade.

The main drivers for engaging with activities were broadly found to be:

■ personal contacts

■ fun

■ being with friends

■ being physically active

■ an element of competition

■ collecting facts

■ an opportunity to debate views on issues related to their lives.

Personal contacts were an important driver, especially in terms of sustaining interest and commitment to an activity and in facilitating access. The activities of adult friends of the family, teachers from primary school and friends from primary school (and their parents) are the main drivers for tweens to take up activities, especially sports and dancing. Influences also came from secondary school contacts, but much was set before tweens left primary school. The influence of younger siblings is negligible, but the influence of older siblings is oddly perverse: younger siblings tend to look for activities that have not been taken up by older siblings.

Fun is also an important driver – activities must, above all, be 'fun'. However, tweens found it very difficult to define 'fun'. They did not necessarily mean funny, although in some cases entertainment was funny; rather, they meant enjoyable, which could also be challenging. Consequently, television, music, films, and so on were used to fill time, but so was sport.

Tweens like to take part in competitions, so an element of competition was a driver to take part in some activities. However, some tweens were afraid of personal failure and preferred to compete as part of a team rather than individually. The definition of 'competition' needs further exploration, but science competitions might lack the thrill of a race against time, and a science competition was not necessarily seen in the same light as a sporting competition by tweens.

Another key driver is the opportunity to meet with friends. This was especially true for those towards the older end of the age spectrum. Tweens also enjoyed being physically active, and sport was enjoyed by most respondents. This was also reflected in the list of favourite lessons, where PE, doing experiments in science and art all featured because they do not involve sitting still, writing and listening.

Learning was not a conscious driver of the activities tweens chose to undertake outside of school, but some boys like to collect 'facts' and this is a motivator to watch television programmes such as *QI* and to read non-fiction books.

Talks were enjoyed because the issues they covered were interesting and allowed discussion, but they were not regarded as explicitly educational.

Apart from household chores the tweens did not report being asked or forced to do things they did not want or like to do. Parental attempts to interest tweens in new activities tended to be focused on social rather than educational issues.

The main barriers to taking up any activity were:

■ personal interest

■ a tendency to assume that something would be boring

■ parents

■ homework.

Parents tended to want their children to be happy and for some this was more important than academic achievement, even among the higher social grades. For the most part the tweens

had not decided on careers and parents did not expect them to have done so. However, we spoke almost exclusively to mothers; fathers may have different ambitions for their children.

Parents provide money, transport and access to IT and limit the time spent on specific activities, such as gaming. They also limit where young people spend their time, with some parents from the lower social grades preferring their child to stay at home rather than go out because of safety fears. The higher social grades, especially in London, were keen for their children to take advantage of the facilities of the city.

Homework is not a major barrier to informal learning activities, although it may be a barrier to the types of activities tweens want to do for the remainder of their time and reduce the desire to spend their free time explicitly 'learning'. While tweens said that homework squeezed out other activities (particularly reading) as they grew older, they did not feel that homework was too onerous – even those in Year 11, although those in Year 7 expected the volume of homework to increase.

A recent Joseph Rowntree Foundation Round-up paper concluded that tweens and their parents from poorer backgrounds do not, generally, have lower aspirations; the barrier to social mobility is in the ability of these parents to support their children with knowledge about careers and further and higher education.[11] Our finding that families from lower social grades have more limited cultural experiences would tend to support that conclusion. Their limited horizons led us to question the support schools provide and ask whether the focus of schools on exam results and league tables is serving students well. We found little explicit evidence of schools supporting longer-term destinations or outcomes.

3.4.2 Engaging the challenging to reach – principles and practice

The study sought to identify examples of approaches found to be effective in engaging challenging audiences. A series of principles emerged:

- experiences and content should be relevant to audiences' interests, experiences and backgrounds

- preliminary research should be conducted with difficult-to-reach audiences

- partnerships should be established with other organisations or groups already engaging with the target audience

- community outreach methods should be used

- experiences must be stimulating, interactive and engaging.

These principles underpin engagement with all audience types. However, none of the individuals or organisations consulted during the study considered that one single activity or approach in isolation was likely to be effective. It emerged from practice that the best means for securing sustained engagement involves a strategic approach that seeks to work with challenging audiences through a range of activities over a sustained period of time. Trialling new ideas alongside tried and tested approaches is important. As one respondent said, "engaging difficult-to-reach groups is challenging; it is time consuming and requires a lot of effort, which means that results might not be immediately evident". However, the experiences of many providers show that it is possible to engage challenging groups if the effort is made to meet them on their own terms – whether through outreach, virtually or via broadcast.

Audience-relevant content

Tailoring provision to the specific interests and backgrounds of the intended audience emerged as a key principle for engaging audiences across the sector. As well as helping to ensure that experiences are stimulating and enjoyable, tailoring to audiences' contexts and interests also increases the likelihood of repeat engagement and the development of ongoing relationships between audiences and providers.

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[11] Charlotte Carter-Wall and Graheme Whitfield. 2012. The Role of Aspirations, Attitudes and Behaviour in Closing the Educational Attainment Gap. Joseph Rowntree Foundation Round-up.

This was particularly the case for groups less likely to engage with existing provision, where cultural barriers may need to be addressed in service design and delivery. As one case study interviewee said, "the key is to start with their own interests and build around them," and many others considered that ensuring activities are relevant and meaningful was key to short- and long-term engagement. Broadcasters looked further afield for ideas on how to engage audiences. For example, in developing new content they considered current affairs and topicality, as well as audience research and their experience of what had worked well in the past, while striving for originality. Broadcasters try to build a deep understanding of which personalities audiences like, what they listen to and what they do. They try to engage through personalities that audiences relate to, so that programmes 'talk their language' and follow a format that audiences use. For example, "for the 24- to 35-year-olds, male, [programmes need to be] slightly wittier, slightly more irreverent...maybe bringing in comedians who have an amateur interest in certain science and technology" (TV broadcaster).

Examples of tailoring services to specific audience groups

One case study sought to develop services for specific audience groups that they found challenging to engage. The organisation has a specific 'developmental team' who identify 'audiences of special interest', which then underpin all their work, projects and exhibitions. One such group was people with disabilities. Using the social definition of disability, which identifies systemic barriers, negative attitudes and exclusion by society as the main contributory factors in disabling people, they aim to ensure all exhibitions are open and accessible to this group. One example of this was a recently curated exhibition about personal identity, which required an approach that incorporated disability issues. Working with an access consultant, they developed an approach that aimed to increase access for some while enriching the experience for everyone. This work included:

- an audit of the gallery for disabled users

- designing an accessible terminal, which proved hugely popular with the whole audience

- using experts to train the team and increase their confidence

- producing a stand about Changing Faces that included facial disfigurement and avoided normal/abnormal labelling

  using tactile objects, which were put on display for people to touch and proved popular all round, particularly with families with children with autism.

More generally, specific learning resources were developed for teachers and students (including pre- and post-visit materials, which can be used by those unable to attend the exhibition).

This approach aims to avoid 'ghettoising' certain groups and helps ensure that all exhibitions are as open and accessible as possible to all groups, whether teenagers, black and minority ethnic groups or those with disabilities. The museum does not want the inclusion of these groups to be about setting up separate exhibitions but wants to find a way to make them feel valued and listened to across all services.

The museum also found that deaf audiences were struggling to engage. To meet the needs of the deaf community, they now run deaf-led workshops and presentations as part of their weekend and holiday drop-in activities (which are very popular). Where the presenter is deaf and communicates directly through signing, these are accompanied by a voiceover. This has proved very effective for the general, as well as deaf, audience. The evaluation of this provision found that the deaf-led activities were perceived as more dynamic and interesting. Originally, they had used a non-deaf presenter with a signer translating alongside, but this was found to be more of a distraction than useful. The new approach has seen a rise in visitors from the deaf community.

A second case study provider worked with a British holiday company to establish a collaborative project targeted at families from lower socio-economic backgrounds. Following a pilot of another initiative: a fun and spooky science show was designed and delivered at the holiday venue. The show combined physics and entertainment to produce a science show that appealed to a family audience on holiday.

The show was developed jointly by staff from the museum and the entertainment staff at the holiday company. The show was performed by professional holiday entertainers after training from the museum. A website was created to link with the show, and the entertainers gave all children a sticker and encouraged them to check the website. In addition, an interactive workshop was held before the

show. The project ran from 2008 to 2010 and was considered on the basis of its evaluation to have been successful in providing disadvantaged groups with a positive science experience. The evaluation suggested that the science show activities encouraged families to talk about the activities immediately after the events and motivated them to follow up on things they had found interesting (e.g. looking up things in a book at home or mentioning to a teacher what they had learned).

Conducting research

To enable the tailoring of content and delivery and to ensure relevance, an understanding of audience preferences, needs and wider behaviours is required. While providers commonly drew on their own experience of 'what works with which audience', many considered that additional research was required to support engagement with challenging groups. Such research should start by identifying the barriers to accessing services, so these are considered when designing and developing provision.

A wide range of research activities was cited by respondents – from detailed research exercises (such as the large-scale surveying of potential users across a range of socio-economic and demographic groups) to more focused activities (such as group discussions with small groups of non-users). In several cases the act of researching challenging audiences was part of the engagement process itself, as illustrated in the examples below.

Examples of research to support engaging challenging audiences

One case study science centre is located in a densely populated urban area with a high concentration of British Bangladeshi children, high proportions of whom live in poor-quality housing. Before developing the content for the centre, substantial research was conducted with more than 8,000 local children to ascertain what content would be most engaging for them. A core aim of the centre is to make scientific research accessible to the local community, so this research was crucial to ensure that the centre achieves its mission. They explained:

> We wanted to ensure that the content was driven by young peoples' interest and knowledge. So we went out to speak to them to find out what they knew, and we developed our content from there. All the findings are written up in reports to ensure that the knowledge was bottled.
> (Case study interviewee)

An arts-based case study reported that a strand of their work involves creating a play around a scientific theme, developed by individual community members who do not usually engage in arts-based activities. This case study works intensively with members of the local community for one year before a production and undertakes in-depth research to establish the issues the community are interested in or concerned about, with a view to developing a production that represents these interests. Themes are identified by drawing together notes of conversations from people in the local community, and researchers actively go into the community and speak to people in different settings – from cafés in high streets to shopping centres and from door knocking to speaking to groups in community centres and through local organisations. This means that they can "authentically involve people from the community, and this gives the produced work a richness and complexity that reflects peoples' thoughts and feelings about a range of issues. We don't presume to know what people think and what they're interested in." (case study interviewee)

The actual research activity is part of the development process – as an interviewee explained: "the process is about community work and development. The show is the output but the process of working with people in the community is the most important element." They went on to explain that although this way of working is resource intensive, it is empowering as it can engage people who would not otherwise take part in similar initiatives.

A survey respondent highlighted that good practice with youth engagement should start with internal and external stakeholder consultation to assess levels of current work with informal groups and to gauge external perceptions of the appropriateness of any existing offer. It was highlighted that attending face-to-face meetings with group leaders and young people helped establish trust and dialogue, and secured longer-term partnerships. The museum also mentioned that it is important to give young people the choice of topic, object or specimen based on their interests, and also to give them guidance, support and challenges that would encourage and empower them to follow through their interest and develop further enquiries.

Partnerships with organisations or groups already engaging with challenging groups

Working in partnership with local community groups can help providers understand the needs of challenging audiences, develop approaches to engage them and contribute to the engagement process itself.

Respondents reported working with a range of groups and organisations, including schools, local authorities, community centres, community action groups, and voluntary sector and faith organisations. Partnerships varied in nature from ad hoc (to allow specific projects to be developed rapidly) to longer-term arrangements developed over months and years, some of which had become embedded within local communities. For broadcasters, partnerships could mean losing editorial control; however, those partnered with museums and similar organisations could link a programme and an exhibition in a way that would benefit both parties.

Several elements of successful partnership working were highlighted. First, there must be a willingness to work together and develop new ideas and strategies. Second, there must be a common goal or clearly identified benefits for all partners. Finally, the partnership should be open to new ideas and approaches and should maintain open dialogue even when a specific project is completed.

Working in partnership to engage teenagers in a community setting

Taking learning opportunities into community settings where teenagers socialise was an approach used by one of our science centre case studies. Their existing evaluation work found that they struggled to engage teenagers effectively. As a result, they drew upon their partnership with the local authority to find the best way to engage this group and found a local community centre that was a popular destination for people aged 12–18.

Working in partnership with the community centre, a drop-in science taster session was developed and delivered on a Saturday afternoon over the course of several months. The activity aimed to be fun and stimulating, and the drop-in sessions encouraged young people to take part, particularly as they took place in a venue where they felt safe and comfortable. The drop-in element, and holding repeat sessions over several weeks, was important as this allowed relationships and rapport to be developed with the young people, as well as encouraging wider participation as the activity looked enjoyable and fun.

In another case study the provider was also keen to interact with local teenagers. As they are based in an area with a high concentration of Muslim families, they engaged with local faith organisations to develop provision that overcame cultural barriers. A youth mentoring scheme connected people aged 14–18 with a STEM Ambassador for advice on school work, careers and further study. The scheme is considered a success, with more than 180 young people engaging to date. The links with the faith organisations, and the wider community, enabled the organisation to address cultural barriers and work with groups in a way that would not have been possible otherwise. For example, girls are allowed to attend sessions without their parents, which could only happen by gaining the trust of local families through constructive and culturally sensitive engagement.

Community outreach

Where specific audiences are unlikely to engage with traditional models of provision, new approaches may need to be developed to provide opportunities within local communities. As one provider described, this involved "going out to people and making the science fun and engaging to draw people to you. Don't dumb down the science" (survey respondent). This was considered important as "the only way to engage is to put the science where the people are, in shopping centres…and make it engaging and interactive" (survey respondent).

Respondents highlighted several challenges in undertaking community outreach, which can be resource intensive and will not always be successful. However, these challenges can be overcome through partnership working and initial research with local communities. Such outreach is considered to be "a well-established method of contacting groups who may otherwise not be interested in a museum due to social/cultural reasons" (survey respondent).

However, it can also provide benefits beyond attracting previously challenging audiences, such as helping embed an organisation within its community.

Examples of community outreach with challenging audiences

Several of the case study providers described undertaking community outreach work with the specific intention of engaging with groups they had found challenging to engage. They did so for a range of reasons, including increasing revenue, addressing unmet needs identified in their local communities and being as inclusive as possible in their service provision.

A principle that underpins the work of one case study is that the "key to high-quality community engagement is giving people a 'big hook' to participate, and critical to successful engagement is face-to-face and relational engagement". Although there needs to be an incentive for participants to engage, providers must also undertake deliberate outreach work that seeks to work with groups that would not traditionally engage with them. One interviewee described their outreach approach, which had successfully drawn challenging groups to their provision: "It's about pounding the pavements and getting out there and really speaking to people. We need to engage with them face-to-face and explain the community production…to answer questions, to deal with fears." (case study interviewee)

Working face-to-face and being based within communities was found to be most effective, as this allows partnerships to develop between local organisations working with challenging-to-engage groups and individuals. Consequently, provision can be tailored to the interests of local people. Face-to-face contact is considered most effective because people are bombarded with marketing materials and less likely to be attracted to something that does not immediately appeal to their interests. One interviewee explained that "by spending time in the physical community, we are able to identify opportunities to engage people in a way that we wouldn't be able to from an office. Going out into the community allows us to explain what we're doing, answer questions and dispel myths. It just lets us find places that we wouldn't be able to identify in any other way." (case study interviewee)

The use of community ambassadors, who are from local communities or challenging groups, can be an effective way of engaging with wider audiences. In one case study, ambassadors were employed on a part-time basis to promote interest in the provider's activities, as well as recruiting individuals for community-based and science-focused arts activities. This approach was successful owing to the ambassadors' links with existing local community networks. Ambassadors were recruited from a range of groups and successfully extended the reach of the organisation to include young people (18–25), older people (over 50) and residents of social housing.

Another case study also reported recruiting staff and volunteers from local communities, to help them better represent the audiences they are seeking to work with. The provider wanted to better engage with individuals from the black and minority ethnic community, and created links with local community groups and gatekeepers. A series of outreach and research activities informed provision for this group, including staff visits, consultations to explore barriers and cultural issues, and training for staff to accompany visitors to the museum. An ethnographic approach was followed to provide visitor-led, evidence-rich data to shape some new projects and activities. This resulted in, for example, one exhibition including a section on black astronauts in the space gallery and the development of a new exhibition on science and race, which led to visits and engagement with the intended target groups.

Creating stimulating, interactive and engaging experiences

Providers were keen to stress the importance of ensuring that all products and services are not only relevant to the audience (whether they are challenging or otherwise) but also stimulating, engaging and fun, particularly for younger age groups.

Examples of different approaches to providing stimulating experiences

One case study described how they deliberately seek to engage people in science through a range of stimulating cultural activities and do so by taking their science engagement work to places where 'learning' would not necessarily be expected. Although learning may often be a direct outcome of their work, their primary focus is on engaging people in science using art, music and play – their ultimate goal is to deliver unique experiences that work towards 'inspiring wonder' among their

audiences towards all things related to science.

This case study works in a diverse range of settings with the particular aim to deliver science engagement in environments where people would not normally expect to find the topic and to embed scientific principles in cultural and play activities. They have delivered a range of innovative science engagement activities at several music festivals – including the Secret Garden Party, Bestival, Green Man, Wilderness and Latitude – and as part of cultural and music events around London, including Lovebox, Secret Cinema, Distance and London Food. For example, as part of the London Food Festival they explored the science behind taste and flavour perception with inputs from sensory scientists and included hands-on activities such as blindfolded tests.

Another case study described how they had increased the number of female and black and minority ethnic visitors through the introduction of 'Lates'. These involve the museum staying open late for people aged over 18 on one evening a month and offering a range of dip-in social activities, including a disco, comedy, pub quiz, talks, and make-and-take activities. They have also recently introduced a teacher zone in the late programme, providing a chance for teachers to meet with members of the learning team and to try out new resources. So far more than 100 teachers have attended these sessions.

A final example is a provider who produces a comedy show aimed at the general public and held in a public theatre. The show includes stand-up routines from professional comedians, researchers and the show founder. Attendance at one event suggested that although most researchers attending had STEM backgrounds, others worked in the arts and one worked in the social sciences. Those with STEM backgrounds included a neuroscientist, a social mathematician, a timber scientist, a physicist and a pathologist. Five individuals attending the event discussed their experiences, each of which were attending for the first time and who had heard about it from friends or via a mailing list generated from previous visits to the venue, with one commenting that he chose to come because the ticket price seemed good value for an evening of comedy. All clearly enjoyed the event and would come again – most viewing it as a comedy night, although they all liked the idea of comedy and fun mixed in with a message.

In several cases it emerged that involving audience groups in the development of activities can help ensure their relevance and support the engagement process. The main examples of this identified in the study were associated with arts-related activities, where providers worked closely with the target community to develop ideas for events and participate in their delivery. Such approaches were not confined to the arts-based providers, and examples of jointly developed approaches were cited among other organisation types, where key factors for their success included establishing a degree of commitment to and 'ownership' of the new activity among the local community.

4 Impacts and evaluation

Key point summary

This section draws on the stakeholder interviews, provider survey, cases studies and a review of the 'grey literature' to explore current practice in evaluating informal science learning activities.

The section shows that:

- Considerable effort, and investment, is directed towards evaluation across the sector, although for the most part attention focuses on process issues and capturing immediate or short-term outcomes. The assessment of longer-term impacts is rare.

- Consequently, the evidence base for the longer-term impact of informal science learning in the UK is limited for several reasons, including restricted funding and the absence of widely accepted indicators or measures, although a stronger evidence base exists in the USA.

- A range of methods are used in providers' evaluation activities – most commonly including exit surveys, consultations with service users and participant observation. Evaluation work with non-user groups was less common, however.

- A range of barriers and challenges to evaluation were identified, including financial and other resource constraints (staff time and skills), the perceived limited availability of practicable methods – particularly for assessing longer-term impact – and cultural issues.

- The case studies provided examples of how these barriers can be negotiated, although identifying the long-term impacts of informal science learning remains a challenge. This represents a substantial task, and one that is unlikely to be within the remit or capability of a single provider in isolation.

4.1 Evaluating informal science learning

Before exploring current evaluation practice across the informal science learning sector, this section reports the findings from a brief review of the 'grey' literature. The review drew on reports and other materials from a variety of sources, some provided or recommended by organisations participating in the study and others known to be of relevance by the study team. In total more than 60 documents were reviewed, many of which are not in the public domain, although the majority of these could be made available to other practitioners by their owners. Coverage ranged from small, locally focused providers to organisations with regional and national interests.

The review found that evaluation was commonplace across the sector within the UK and was undertaken or commissioned by providers of all sizes and natures. Where the reports reviewed referred to the brief for the study, the methodologies followed generally seemed to be appropriate for the scale of funding available, although it seems that the scope of most evaluations is dictated more by budget than by the needs of the organisation and/or funder. Evaluation coverage commonly included delivery approaches, audience satisfaction and some attempt to identify the immediate or short-term impact of the service in question. Where impacts were reported, they most commonly referred to changes in participants' views on and attitudes towards science, and the likelihood of some form of response in terms of future engagement with STEM learning, considering a career in STEM or continued involvement in informal science learning.

However, we found that the assessment of medium to long-term impacts on participants' attitudes rarely included learning and behaviour for several reasons. First, while budgets seemed reasonable for the coverage of activity identified, they were rarely sufficient to allow for longer term follow-up, which is essential to identify sustained and meaningful impact. Second, methodologies to robustly assess impact are challenging to design, commission and

implement, with no common indicators or metrics currently available across the diversity of the sector. Consequently, the evidence base for the long-term impact of informal science learning in the UK is highly limited, although examples from US-based studies are provided in the Stanford/Oregon State report. However, in the UK it was not always clear what longer-term impacts were expected, or sought, by funders. This point will be returned to in our conclusions and recommendations, where we suggest a more strategic approach to evaluation as a whole.

In many cases evaluation studies were designed to be formative, with the aim of informing the development of new services or the improved delivery of existing services. However, there was little evidence from the literature review or the stakeholder interviews to suggest that learning from evaluation work is commonly shared across the sector to inform activities more widely. There are many reasons for this, including an unwillingness to share intelligence in a competitive market and limited preparedness to share any less positive findings. Moreover, the 'service specific' nature of evaluations means that without active attempts to synthesise learning across providers, the potential for evaluations to have wider influence will be limited. Similarly, although repositories such as the British Science Association 'Collective Memory' website can provide access to useful information, there was little evidence that they were commonly drawn upon to inform practice in the field.[12] This may be due to limited awareness of what materials are available, but it might also be due to the degree of specificity, which can make identifying appropriate learning difficult. While the stakeholder interviews found that evaluation findings were exchanged between some providers, these were often between single organisations or through networks of similar organisations.

Finally, it was clear that an appetite for – and, in many cases, a strong commitment to – evaluation existed across the informal science learning sector. The remainder of this section describes how this turns into activity, and explores the challenges and barriers faced in undertaking effective evaluation.

4.2   Current position – evaluation activity across the sector

The vast majority of providers responding to the survey (175, or 87 per cent) described undertaking some form of evaluation activity, with almost half (44 per cent) reporting evaluating all the informal science learning services they provide. Even among providers claiming not to evaluate their work, it emerged that many routinely collected data on the characteristics of service users and their experiences of the service, which was used in provision planning and review.

Broadcasters do not explicitly evaluate their programmes, although much quantitative survey research is commissioned to gauge audience numbers, profile the audience for specific programmes and, in some cases, measure the audience appreciation of specific programmes. The data are typically commercially sensitive and highly confidential, although viewing figures are often released.

4.2.1   The nature of evaluation activity

The nature of the evaluation work reported by the survey respondents was described by a series of predefined statements.

As Table 4.1 below shows, the most commonly reported type of evaluation by some way was 'formative evaluation', cited by 91 per cent of respondents and undertaken with the aim of informing the development of new or existing services. In comparison, summative evaluation studies were reported far less frequently (by 15 per cent of respondents, although this may be an underestimate given the reference to meeting the requirements of funders) and were most commonly mentioned by suppliers of STEM activities.

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[12] British Science Association Collective Memory website (collectivememory.britishscienceassociation.org/).

Table 4.1   What best describes your evaluation activity?

Statement	Responses	Percentage
Formative evaluation	160	91%
Summative evaluation	29	15%
Evaluate when required by funders	69	39%
Planned rolling evaluation programme in place	37	21%
Evaluate if concerns identified	32	18%
Evaluation undertaken on an ad hoc basis	24	14%

Source: Provider survey   Base 175, multiple responses allowed

This focus on formative evaluation was common across all the service providers, suggesting high levels of use of the resulting learning, as illustrated in the examples below.

The use of evaluation to inform service development

One museum described having an evaluation department, which is responsible for undertaking research and evaluation to support their wider services and activities, for more than 15 years. The department ensures that evaluation is built into services and exhibitions from the point of conception – an approach that extends beyond the planning stages to conducting formative and summative evaluations. A range of methods are used, including observations, follow-up interviews, analyses of dwell time, surveys, focus groups, feedback and exit questionnaires, tracking, accompanied visits and whole gallery observations.

A recent example of where evaluation informed a specific offer related to an exhibition developed for a disabled audience. The evaluation team worked with a team of disability consultants to assess the exhibits and provided feedback, as well as interviewing and tracking families visiting. This work informed future planning; for example, having objects for visitors to touch was very effective, and the evaluation team are currently looking at how this can be replicated more widely.

In another case study all new projects are piloted on a small scale and evaluated externally. If the evaluation suggests the activities are working well, they are scaled up and, in the following year, an internal evaluation is carried out. If significant changes are made as a result of the first evaluation, a second external evaluation may be commissioned. Considerable emphasis is placed on evaluation as a formative tool to help improve projects and activities. Evaluation is considered to work best when the outcomes they are seeking to evidence are realistic. As the provider explained: "the biggest challenge in evaluation is the unrealistic expectations of what activities can achieve. For example, a single intervention is unlikely to change the course of a person's life, and even if it is does the timescales over which we can do evaluation do not allow us to track this." Reputable and established evaluators are commissioned, and mixed quantitative and qualitative methods are used.

Finally, a small science centre case study reflected the approach of many smaller organisations in undertaking evaluation. With just a single member of staff to plan, deliver and evaluate much of the centre's learning activities and a budget that limits the use of external resources, the provider described how they are realistic about what they are able to evaluate and to what depth. Nevertheless, they try to evaluate 'all they do' on a sample basis. Their data collection focuses on visitor experience and satisfaction and perceptions of benefit at the end of the visit, rather than attempting to undertake any follow-up with individual or school visitors. Data collected through these feedback mechanisms are reviewed and used to adapt their provision – and in this case were particularly useful in supporting a Big Lottery funding bid.

Four in ten respondents (39 per cent) described how their evaluation activity was driven primarily by the requirements of their funders. This was mentioned particularly by STEM providers, science and discovery centres, and museums, and while it was acknowledged that funders legitimately required this information as a condition of contract, several saw it as an exercise in ensuring accountability rather than a means of learning about effective approaches.

Meeting the requirements of funders

One provider examined in a case study had taken part in an initiative to offer free entry to school children and had to evaluate the effect of this on admission as a condition of funding. While the funding award covered some of the cost of collecting monitoring data, the exercise represented a steep learning curve as the organisation had no prior experience in commissioning or designing evaluation research. They commented that they "didn't know where to start writing the invitation to tender" and were, for example, unsure of whether to publish the budget for the study. Although they were very happy with the final report, they felt that the information to support the commissioning of evaluation studies provided by the funder was very limited.

Nevertheless, the organisation found the evaluation beneficial. It provided them with a better understanding of the effects of their work on children and young people (e.g. it showed that a visit to the venue has more impact than an outreach visit to a school and helped the provider understand the different educational impacts that research has with children of different ages). The evaluation also had a positive effect on staff morale, by helping to illustrate the benefits resulting from their work. Unfortunately, the short-term nature of the funding meant the provider has not been able to continue collecting monitoring data, although their experience helped raise the profile of evaluation and they have recently appointed an evaluation manager to build evaluation into their work in the future.

In a second case study, a science centre reported finding that funders are increasingly asking for evidence of effectiveness in bids for funding, which require evaluation evidence to make a convincing case. While this experience was reported by several other providers in the stakeholder interviews and case studies, many providers described how the expectations of funders in regard to evaluation can vary considerably in terms of coverage and the specific data variables collected. This can present challenges in undertaking evaluation across organisations if funders require different data variables to be collected and can militate against the establishment of formalised approaches to data collection when their requirements differ significantly. As one small private sector STEM provider described in their stakeholder interview, this can lead to evaluation being undertaken solely to meet the requirement of funders, where it becomes an expensive means of ensuring accountability for funds invested and gives no opportunity for the funder or provider to learn from each other.

The final three statements in Table 4.1 explored the extent to which evaluation was planned across the year or undertaken on an ad hoc basis. The responses showed that:

■ one in five (21 per cent) have annual programmes of evaluation – reported most frequently by museums and zoos/aquaria

■ a similar proportion (18 per cent) evaluate in response to concerns identified with their services – suggesting either a degree of responsiveness or evaluating only when mission- or business-critical issues arose

■ one in seven (14 per cent) reported evaluating on an ad hoc basis.

4.2.2   Evaluation methods and approaches

The providers responding to the survey also described the data collection approaches they most commonly followed and whether these were delivered by internal staff, commissioned externally, or done through combination of both. The findings are shown in Table 4.2 below.

Table 4.2   Evaluation activity

Type of activity	Used	If used, conducted and commissioned:			
		Internally and externally	Externally	Internally	Not used
Surveys – service users	146 (98%)	39 (26%)	5 (3%)	102 (68%)	3 (2%)
Surveys – teacher users	142 (95%)	32 (21%)	9 (6%)	101 (68%)	7 (5%)
Surveys – staff	126 (85%)	12 (8%)	4 (3%)	110 (74%)	23 (15%)
Participant observation	118 (79%)	24 (16%)	12 (8%)	82 (55%)	31 (21%)
Visitor exit surveys	114 (77%)	27 (18%)	19 (13%)	68 (46%)	35 (23%)
Group discussions – users	113 (76%)	38 (26%)	13 (9%)	62 (42%)	36 (24%)
Analysis of visitor data	105 (70%)	26 (17%)	7 (5%)	72 (48%)	44 (30%)
Interactive feedback within exhibition space	71 (48%)	12 (8%)	7 (5%)	52 (35%)	78 (52%)
Group discussions – non-users	48 (32%)	14 (9%)	16 (11%)	18 (12%)	101 (68%)
Surveys – non-users	37 (25%)	9 (6%)	17 (11%)	11 (7%)	112 (75%)

Source: Provider survey   Base: 149

The collection of data from service users (individuals and/or teachers) was almost universally reported by 98 per cent and 95 per cent of respondents, respectively. In addition, more than eight in ten providers (85 per cent) described collecting data from consultations with their staff, with 79 per cent reporting the use of participant observation techniques.

The use of visitor exit surveys (77 per cent) and interactive consultations within exhibition spaces (48 per cent) were also reported, although their use was concentrated in providers delivering from fixed sites: science and discovery centres (96 per cent) and museums (88 per cent).

However, the collection of data from individuals or groups not using provider services was comparatively rare. Thirty-two per cent described using group discussions with non-users and 25 per cent followed other survey approaches. The collection of non-user data was most commonly reported by museums, almost half of which used group discussions and more than one-third of which used surveys of non-users.

In terms of delivering evaluations, the survey respondents most commonly reported using internal resources (and the skills and expertise of their staff) to collect data. While many reported using a combination of internal and externally commissioned capacity, the use of external resources was commonly focused on visitor exit surveys, group discussions with users and participant observation (by 13 per cent, 9 per cent and 8 per cent of respondents, respectively). However, external resources were also used to deliver surveys and group discussions with individuals not using the providers' services (by 11 per cent).

Evaluation methods

The study established that informal science learning providers use a range of methods and approaches in their evaluation work. The specific evaluation methods used are determined by a range of factors, most commonly by the budget and time available for their delivery and the nature and scale of the activity being evaluated.

Examples of the evaluation methods among the case study providers are summarised below.

■ **Provider 1** was required to evaluate their school services as a condition of funding awarded to work with hard-to-reach groups, which required the collection of specific data from schools participating. Although they always collect feedback data from schools, the funding allowed them to evaluate the impact of their school's education programme, and work directly with pupils, for the first time. An external evaluation expert was commissioned and worked closely with them to advise on methods, then conducted the evaluation. Quantitative and qualitative methods were

used. The quantitative work involved a large number of pupils completing pre- and post-visit questionnaires. The questionnaires included space for children to draw pictures, which were analysed to show whether their understanding of key concepts had improved before and after their visit. The evaluation showed the education sessions held impacted on pupil learning, and this had a positive effect on staff morale by illustrating their work was having an effect.

- **Provider 2** described how a culture of evaluation had been established and embedded within the organisation, so that all activities are now evaluated and all staff have a part to play. Different evaluation methods are used depending on the type of activity, for example:

  – Visitor feedback is collected through a visitor tracking system, operated by an external supplier who provides results to the centre on a weekly basis. Visitors are contacted one week after attendance by email to explore the impact of their work. While the self-selecting nature of respondents is recognised, the approach is considered to be the most cost-effective approach to collecting data on outcomes (the response rate is approximately 30 per cent). Originally funded as a pilot by the Scottish Executive, the survey is commissioned alongside another centre operating in the same area to ensure common data are collected.

  – Teachers participating in CPD provide feedback immediately after training (through questionnaires to give their views on training received) and are followed up several months later with questionnaires that explore the longer-term impacts of their work.

  – Their evaluation of science festivals includes collecting feedback forms from 5 per cent of the 10,000 individuals attending. Data provided include the age and area of residence of the individuals, how they heard of the event, agreement or disagreement with a series of outcome statements, and strengths and/or areas of improvement. The responses are fed into a database and analysed to inform the planning of subsequent events.

- **Provider 3** sees evaluation as core to their mission and role as a partner and funder, as well as supporting their ethos of continuous improvement and identifying what works. They use the Generic Learning Outcome framework as the basis for their evaluations, and although they have considered developing their own framework so all their activities use the same indicators and provide a programme-level evaluation, they have not had the time or resources to take this forward.[13] A mix of methods is used to reflect the nature of the activity in question, and evaluation is routinely commissioned alongside the delivery or commissioning of informal learning activities (with guidance being produced for partners or members evaluating funded projects). While there is no set evaluation budget, they typically allocate between 5 per cent and 10 per cent of project budgets for external evaluation. They are flexible in terms of the methods used and in balancing costs and methods. External evaluations are typically mixed-method studies that involve qualitative interviews, focus groups or questionnaires with users and delivery staff and, where relevant, teachers are included.

- **Provider 4** is a large, well-established and well-resourced museum with a comprehensive evaluation programme featuring formative and summative studies using a range of methods, including visitor observations, follow-up interviews, analyses of dwell time, surveys, focus groups, feedback and exit questionnaires, tracking, accompanied visits, and whole gallery observations. They also undertake in-depth evaluations of specific exhibitions, which involve qualitative interviews and tracking families. Monthly exit surveys routinely collect data for their key performance indicators, which include total audience numbers, audience demographics, reasons for attending and an example of life-enhancing outcomes (e.g. 'do you feel like you want to find out more?').

- **Provider 6** is a large and multifaceted botanic science and discovery centre with an annual programme of evaluation that collects a range of data on visitor characteristics, visitor experiences and the impacts resulting from the various educational activities offered. The centre is keen to identify whether the services they provide are leading to changes in behaviour and uses techniques developed for structured and unstructured learning to evaluate visitors' learning experiences. These include an approach that draws upon the Personal Meaning Mapping technique, which captures baselines for each visitor to measure conceptual development resulting from their experience. The centre also assesses its economic impact on the local area,

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[13] Generic Learning Outcomes (GLO) Framework – developed by the Museums and Libraries Authority, the GLO Framework features five categories of outcome: knowledge and understanding; skills; attitudes and values; enjoyment, inspiration and creativity; and activity, behaviour and progression. For more detail, see www.inspiringlearningforall.gov.uk/toolstemplates/genericlearning/.

which considers its function as a visitor centre as well as an education provider and catalyst for regeneration.

- **Provider 8** carries out internal evaluations of their services (pod shows, family workshops and interactive sessions); for example, through user satisfaction surveys. In some ways, evaluation focuses on the formative and focuses on involving people at the content development stage. The centre has found it more effective – and more cost-effective – to focus their limited staff and financial resources on developing good content that has a high impact, as opposed to investing in evaluating the impact of less well-developed content.

- In arts-based **Provider 9**, all activities are evaluated in some way, both formally and informally. Informal evaluation involves listening to users and adapting provision on an ongoing basis, while more formal evaluation is used with schools and involves collecting information around emotional and education indicators at the beginning, middle and end of a specific activity. Evaluation reports are produced in two formats – one is a front-facing, 'glossy' report for public consumption, and the second is a more detailed technical report for internal audiences. As single activities may be supported by a variety of funders, meeting their often different monitoring and evaluation requirements can be challenging within a limited evaluation budget.

The interviews with the major broadcast networks found that TV broadcasters use nationally representative surveys commissioned to major market research companies to measure audience size and profile. These large surveys allow analysis of relatively small subgroups and include both audiences and non-audiences. Smaller nationally representative surveys are commissioned to measure appreciation and impact. Press coverage of programmes is another measure of impact that is considered.

Broadcasters also commission research to inform the development of programmes, for example to ensure that their content is right for the target audience. This can take the form of direct contact with the audience, focus groups or other more interactive approaches where viewers rate programmes as they are viewed. Radio research tends to focus only on audience numbers and profile and does not usually explore reactions to individual programmes in the same depth.

Broadcasters also put on live events, and in-depth research is commissioned to explore the impact of an event and its legacy in terms of behavioural change. Some broadcasters also tracked website hits and routes to understand whether those who had seen the programme took their interest further, and if so how far they went.

4.3 Barriers and challenges to evaluation

As the survey responses illustrated, providers of informal science learning frequently deliver multiple services, using different delivery modes and serving very different audiences. While the extent of evaluation activity was not necessarily related to the number of activities provided, organisation size and available resources appeared to be more of a determining factor. While almost half of the respondents reported evaluating all of their services to some extent, it was recognised that the level, depth and coverage of the approaches reported would vary considerably.

Clearly, delivering this level of evaluation activity across a broad range of services with disparate audiences represents a challenge in itself. The initial stakeholder and practitioner interviews suggested that a range of factors influenced organisations' capabilities to evaluate – ranging from resourcing evaluation studies in the broadest sense to identifying appropriate methodologies. These findings were used to develop questions on barriers to evaluation for the provider survey.

4.3.1 Barriers and challenges reported

The survey asked providers to describe the barriers they faced in evaluating their services against a series of predefined statements (and to state whether these were major, minor or not barriers at all), before being asked to describe the single main barrier faced. Figure 4.1 below shows the statements and the responses received.

Figure 4.1   Barriers to evaluation
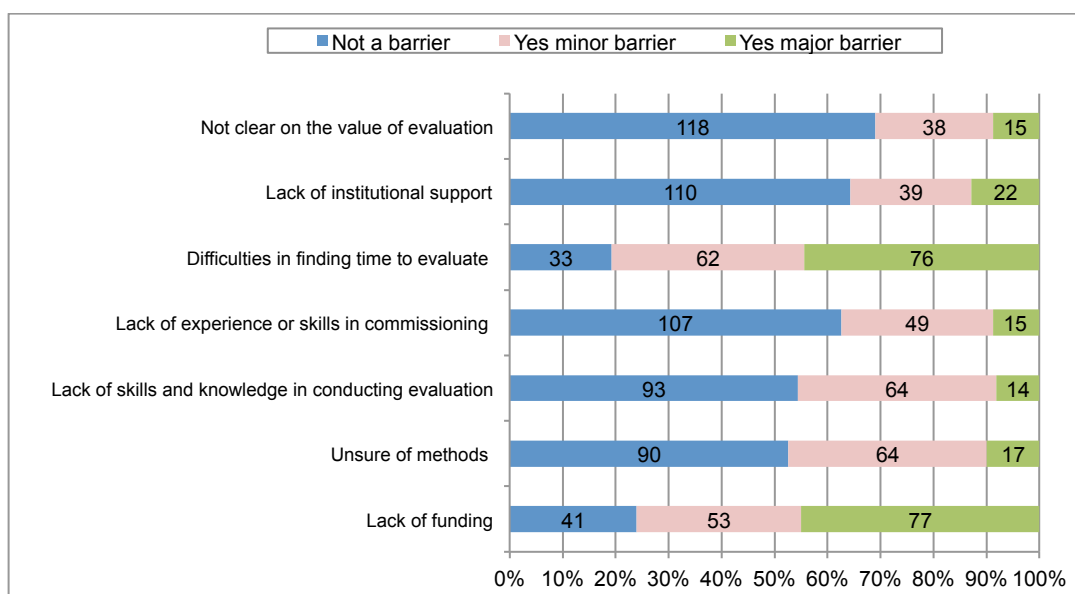
Source: Provider survey   Base: 171

The ability to resource evaluation studies was the most commonly reported barrier, where two interlinked issues were identified:

- **A lack of time to evaluate**. The most commonly cited barrier, reported by 80 per cent of respondents (and a major barrier for 44 per cent), relating to the availability of staff time to undertake or manage evaluation work.

- **A lack of funding to support internal or to commission external evaluation**. The second most commonly reported barrier (by 76 per cent of respondents) and the most commonly reported main barrier (by 45 per cent of respondents).

While it was apparent that balancing the 'cost' of evaluation with ongoing delivery commitments was a common issue, technical issues also emerged as barriers. These focused on:

- A lack of clarity on appropriate and practicable evaluation methods – cited as a challenge for almost half of the respondents (47 per cent), and a major barrier for one in ten (10 per cent). This challenge applied almost exclusively to methods to robustly assess impact that were practicable and could provide useful results in a reasonable timescale. In the stakeholder interviews some of the major broadcasters expressed an interest in evaluating longer-term impacts and described the difficulty of being able to do this.

- The availability of skills and experience in-house to conduct evaluation studies – reported by almost half of the respondents (46 per cent), and a major barrier for 8 per cent. Fewer reported a lack of staff skills to commission evaluation work (37 per cent and a major barrier for 9 per cent), perhaps due to the balance between internal and externally commissioned activities reported earlier.

Finally, and least commonly, was the influence of cultural issues and attitudes within the organisation:

- A lack of institutional support for evaluation was reported as a barrier by more than one-third (36 per cent) of organisations and as a major barrier by 13 per cent. In some cases this reflected perceptions of the relative prioritisation of evaluation against other investments.

- A lack of clarity on the value that evaluation can provide. Although this was the least commonly reported barrier, it was still cited by almost one-third (31 per cent) and listed as a major barrier by 9 per cent. Subsequent text responses showed that ensuring

investments in evaluation produced valuable outcomes was an important element in the prioritisation process.

4.3.2   Addressing the challenges – provider experiences

Many of the providers did, however, provide insights into how they had taken steps to address the evaluation challenges they faced.

Resourcing evaluation – staff time and funding

Staff time and resource issues were the most commonly reported barriers to evaluation and influenced whether, and to what extent, activities and services were evaluated. In some cases, where approaches to collect data from visitors and service users were in place, finding time to analyse and interpret the data was the main challenge.

Time pressures were most acutely felt among the smaller organisations. One described their main barrier as "having the time to develop evaluation techniques, complete evaluation when I am the one delivering the workshops, and time to analyse the evaluation data…I do what I can, when I can." (Survey respondent)

Other respondents referred to the scale of the task faced when evaluating across what can be multiple and varied services. As one science and discovery centre reported: "We have a small team who are primarily tasked with delivering many different programmes. Evaluation is something we believe in and try to do more of, but it is only recently that we have had an individual with oversight of our evaluation activity." (Survey respondent)

While many of the larger organisations had dedicated, specialist research and evaluation teams, in smaller organisations evaluation was one of many activities that competed alongside delivery requirements for available staff time.

The consultations with providers identified a series of attempts to mitigate resource-based barriers to evaluation activity. As described above, some had appointed individuals specifically to deal with research and evaluation – although this was most common in larger organisations. Even among these, there were examples where organisations were no longer able to afford a dedicated evaluation expert, and in others it was clear they had to prove their value given wider resource pressures. For example, as one science and discovery centre described:

> *We recently appointed an evaluation coordinator because as an organisation we're beginning to understand the benefits this role can bring, but it was at the expense of reducing our capacity to deliver. This will hopefully be short term as the increase in evaluation will bring future benefits, but it was a hard sell.*
> (Survey respondent)

Beyond appointing staff to undertake evaluation, the providers described either 'outsourcing' or commissioning external agents to evaluate their work. As described earlier, the use of external contractors alone was comparatively rare, and experiences of their use varied. In some cases providers were required to use external evaluators as a condition of contract, to avoid conflict of interest. This required internal staff to take more of a commissioning and/or management role, which they were not necessarily familiar with or comfortable with. In these cases several providers commented on the relationship between the expected level of investment in evaluation and the funding provided, and a few said the evaluation requirements seemed disproportionate to the scale of their awards. For some, the level of evaluation was, in effect, 'dictated' by the amount they were allowed or expected to spend – and for many, any improvement in the coverage and quality of evaluation would need to be matched by an increase in investment by the funder.

Others made reference to the costs associated with commissioning external evaluators. They were prohibitive for some, and others questioned whether they represented good value for money in the light of other priorities. Several described saving money on external evaluation – for example, by undertaking evaluation studies through "student projects" – although the quality of the resulting reports was considered variable and did not always

represent good value. Several larger providers described working with academic partners and others as members of consortia groups.

One additional approach, which was considered to be working effectively in several of the stakeholder and case study organisations, was the use of existing staff as internal evaluators. These were staff with existing responsibilities, which were enhanced to take on the role of evaluator. They received varying degrees of training to deliver their enhanced role, but in several cases they provided useful insights. Examples of this approach, reported by one small STEM provider and one large science and discovery centre, are provided below.

Using delivery staff to fill resource gaps

A large science and discovery centre described how staff with delivery responsibilities can also get involved in the evaluation of the products and services they deliver. Each receives training in basic evaluation principles from the in-house research and evaluation manager, and they work jointly to develop and agree the evaluation aims, objectives and methodology. After this, the role of delivery staff is primarily to collect data for analysis by the in-house team.

This model has been applied to several services and found to work effectively. Indeed, in addition to allowing the centre to deliver more than the 'specialist' team could do alone, other benefits include:

■ allowing research and evaluation staff to get closer to their delivery colleagues and better understand their services, audiences and evaluation needs

■ helping to demystify the practice of 'evaluation' and show how it can bring real benefits

■ helping to ensure that the methodologies and evaluation questions were firmly set in the context of the service in question and that the recommendations resulting were both practical and practicable.

A second, smaller provider described how their evaluation work was hampered by having few full-time staff and limited financial resources, which meant that unless required to do so by their funders evaluation work had previously been limited.

In response to these challenges, the organisation makes use of volunteers to undertake observation and to administer face-to-face surveys and, where possible, short interviews with participants. The data collected are then analysed by an independent evaluator, while the use of in-kind support from volunteers ensures data collection is undertaken at the lowest possible cost. In this way, the use of volunteers is essential and is heavily valued by the organisation.

> *"Volunteers are essential. When we're in the festival environment...you end up having no sleep, and you have to be really responsible, and there is a lot of to'ing and fro'ing on site. So as the event organiser you can't count how many people there are, and you can't keep an eye on who's leaving and who's engaged and who's bored, and you literally don't have time to talk to them after the event because you've got to get the next one going. So volunteers are brilliant at observing people, approaching people".*

The providers consulted frequently referred to evaluation having to compete against other investment priorities, and some believed that the comparative prioritisation was a reflection of the perceived importance of evaluation. Most, however, recognised the need to compromise, even if this meant following less rigorous approaches. As one STEM provider described: "To undertake 'formal' evaluation would require a significant commitment, and we just do not have the funds or the resources to do so. While we undertake simple evaluation with our own resources, doing it properly would take us away from our primary aim."

In this context it is not surprising that some of the consultees thought that a focus on formative evaluation, specifically to inform new product or service development, represented the best 'investment in evaluation'. However, there was a lack of appreciation of how evaluation could help them to better achieve their aims and would therefore be worth the investment.

Methodological issues

One issue raised by the majority of individuals consulted was the limited availability of methods and approaches considered appropriate for evaluating the impact of their activities. This apparent lack of confidence is an interesting juxtaposition to our conclusions from the literature review that generally appropriate methodologies are being used.

The issue of evaluation methodologies was commonly raised in three main respects: the availability of appropriate and practicable evaluation methodologies, the specific challenges posed by evaluating long-term impact, and practical difficulties associated with implementing evaluation research. Each is discussed below.

1   The availability of appropriate and practicable evaluation methodologies

Awareness of suitable evaluation methodologies varied considerably – from individuals who were expert in their fields and had an excellent understanding of the approaches available, to others for whom identifying suitable approaches was challenging. As one STEM provider described:

> *We lack a good set of tools to undertake evaluation – as do most people in our field. A handbook with a variety of suitable tools would be very helpful. (STEM provider)*

This challenge was highlighted despite the availability of numerous guides on effective evaluation approaches, published by organisations including the Association of Science and Discovery Centres, Research Councils UK, and the Wellcome Trust itself.

Challenges posed ranged from the generic to the specific – from 'knowing where to start' to robustly identifying specific influences on specific audiences. For example:

> *Our biggest challenge is being able to evaluate whether using our resources has led to long-term attitudinal change. (STEM provider)*

> *Our challenge is evaluating drop-in activities in open public spaces. It can be very hard to reach everyone with feedback mechanisms. (Science festival)*

> *Getting feedback/perspectives from the audiences we don't usually interact with, in order to find out what they think about the Society and why they are not interacting with us. (Learned society, but repeated by respondents across the sector)*

2   Availability of practicable methods for measuring long-term impact

Identifying practicable methods for measuring long-term impacts on audiences was a particular barrier, and those familiar with relevant methods were faced with the challenge of delivering them with restricted financial and other resources. Issues raised included:

- how to accurately measure the influence of informal science learning on student decision-making (subjects or careers)

- how to establish metrics that will accurately and equitably allow comparison between different STEM projects and their impacts.

Some consultees wondered whether a single or common methodology for assessing impact, in terms of what should be measured and how to measure it, could be developed for such a diverse sector. As one STEM provider stated:

> *We run two-hour sessions for up to 60 pupils at a time, including presentations and hands-on activities. The most common metric is pure numbers. Therefore, a 15-minute presentation to a secondary school will achieve a much higher audience than we are able to do over several days. But which has made the most lasting impact? (STEM provider)*

Others questioned whether the impact of informal science learning could be measured at all, in part citing the lack of existing methods and metrics as evidence of this.

Finally, many providers referred to the expectations for their services as unrealistic in some cases. They were concerned that the results of their evaluations could be seen as

disappointing, with any negative results being problematic for local collaborations and partnerships. As one learned society described:

> *The biggest challenge is unrealistic expectations of what activities can achieve. For example, a single intervention is unlikely to change the course of a person's life and even if it does, the timescales over which we can do evaluation do not allow us to track what someone ends up doing, 5–10 years after that intervention. The challenge, I think, is in getting everyone in the sector to evaluate against realistic aims/objectives and stop making claims that single interventions (however good they may be) are going to increase the number of people taking science degrees (or whatever).* (Learned society)

3   Issues with implementation

The final issue referred to the challenges of implementing evaluation approaches. Difficulties engaging schools and (to a lesser extent) individuals in the process were commonly reported.

The most common issue raised was poor response rates to hard copy or electronic questionnaires. Persistence emerged as the most common reaction, although some providers introduced new approaches to enhance response rates. One described introducing an approach that included providing feedback to each school on individual pupil effects. Even so, they still reported difficulties getting responses from teachers. A second provider described a reward system that incentivised schools to provide feedback, but despite this response rates remained low as teachers did not seem to appreciate the value of the exercise. It was clear from the examples above, and wider experiences reported in the provider fieldwork, that collecting data from schools was often problematic. While no definitive solutions were identified, it appeared that responses were likely to be greatest where an ongoing relationship existed between the provider and the school.

Some of the evaluation reports that we consider in the review of grey literature achieved both long-term involvement in evaluations and high response rates. This was often underpinned by the use of a financial incentive for schools; however, it may also be easier for a third-party evaluator to pursue responses as they do not have to maintain the same relationship as a provider. Just as it is not always necessary to undertake a formal evaluation, it is certainly not necessary to use an external evaluator, but in situations where response levels are crucial this may be a useful option.

One case study provider described a novel approach to collecting data from their adult audiences. For one particular show participants were given the opportunity to be space tourists and, after consulting with their 'travel agent', book a holiday to another planet. The travel agent described each of the planets they might want to visit, before revealing that the trip is simply far too expensive. As a means of gaining feedback for evaluation purposes, participants were offered the chance to send postcards to friends or relatives (or, in many cases, themselves) as if they were writing from a holiday on their selected planet. The postcards featured pictures of the universe from the Hubble telescope. Having written the postcards, participants deposited them in the post box provided, and the postcards were then reviewed before being sent on to the specified recipient. In many cases the postcards demonstrated what participants had learned during their experience, as they were able to describe different aspects of their chosen planets and their atmospheric conditions.

Other providers described the challenges of maintaining contact with users over time, either to establish relationships or to undertake longitudinal evaluation work. One commented:

> *Some of the key findings we would like to investigate take a decade or more to investigate, which is difficult and expensive to do.* (Museum)

This recognition, combined with often-reported low response rates to questionnaires, led several respondents to question the value of undertaking follow-up consultations, instead relying almost entirely on immediate post-event feedback that was collected while the audience members were still on the premises. All the providers were keen to ensure that evaluation work placed as little burden on participants as possible:

> *We would not wish any evaluation process to impede a visitor's engagement or enjoyment of an event or exhibition*. (STEM provider)

> *…the difficulty of getting enough non-self-selecting data without annoying the visitors too much.* (Science and discovery centre)

Cultural issues

In several cases providers questioned the value of evaluating their services at all. Although infrequent, such comments ranged from "my own personal belief is that evaluation is pretty much meaningless" (STEM provider) to referencing the position of evaluation within an organisation's hierarchy of priorities.

However, it was clear that the majority of organisations contributing to the study had a considerable appetite for evaluation, accompanied by a commitment to use the findings to improve service delivery and effectiveness. However, in most cases the findings of evaluation studies are rarely disseminated outside their organisation. This is partly because they are seen as being service specific but is also because providers tended to undervalue the quality of their evaluation work. We found several examples of this, caused at least in part by the absence of any benchmark against which to understand what constitutes good quality in informal science learning. Combined, these factors may have led to the presumption that little evaluation activity takes place across the sector.

Enabling a culture of evaluation

Creating a culture of evaluation throughout a science centre was very important to one of our case studies, where evaluation underpins everything that they do. All staff have a part to play in evaluating practice and impact. The director sees the best evaluation results as coming from within the team based at the science centre because "this helps us to improve the quality of what we are able to provide", as well as encouraging a culture of reflective practice. All staff are required to evaluate their own activities as part of the appraisal process, which sits alongside a range of organisational evaluation practices to monitor impact.

> *Evaluation for us is embedded within our culture and is important. That's why we don't like using external organisations, we like to do our own evaluation. When it's done internally then it's owned by the staff… Evaluation should be formative and transformative in later years. We need to work as a team to learn what is working well and what we need to change. Evaluation should not be persecution but persuasive.*
> (Interviewee)

Other factors also influence the organisation's evaluation practice, including the requirement of funders to provide information on impact. However, the most significant determinant comes from senior management, who set a tone and direction for evaluative practice that is shared with staff.

In another case study evaluation also underpins all activities, and the drive for robust evaluation comes from the top of the organisation "to ensure we know the impact of what we're doing and so we can improve our work in the future…there's no point doing something if people don't engage or haven't learnt anything from it" (interviewee). For this organisation, evaluation is crucial to its success and intrinsically linked to identifying whether they are achieving positive outcomes. They see evaluation as listening, and reflecting, with users, and commented that, "if we don't listen then we're not engaging, and if we're not engaging then we're not doing our job" (interviewee).

In addition, funders of informal science learning activities could, through their programmes, support the establishment of a culture that encourages the assessment of longer-term impacts. If a funder's programme includes explicit longer-term aims and objectives then a condition of funding might be that the provider has a strategy in place to provide evidence on whether the activity contributed to these aims and objectives. This might, for example, include a longer-term evaluation that continues beyond the completion of the funded delivery stage.

5 Conclusions and recommendations

This section provides our conclusions and recommendations, structured around the key outcomes set out in the study brief.

5.1 Scoping informal science learning and its links to formal science learning

The study has illustrated the breadth of services and activities taking place within the UK under the umbrella of informal science learning. These range from work with school audiences, both inside and outside of schools, to the production of television and video programming for mass audiences. The study focused on individuals aged up to 19, but it is clear that participation extends well beyond this group to include individuals of all ages.

The range of provision available in the UK is extensive, and while in-school provision and enrichment was the most commonly reported activity in the survey of providers, other formats – such as talks or debates, science festivals and fairs, and holiday and after-school provision – were also widely described. The sector also embraces the use of new media: gaming and podcasting emerged as mechanisms for both communicating with and engaging specific audiences.

The review of the organisational objectives of informal science learning providers showed that inspiring audiences to take an interest in science and influencing their attitudes towards it were key drivers across the sector. Stimulating audiences to consider further study or careers in STEM subjects were also mentioned frequently. Views on the extent to which providers sought to influence further study or career choices varied – some sought to directly support the achievement of the science curriculum, while for others this link was less direct and more about raising awareness of potential opportunities. This difference was reflected in the intended outcomes reported, which most commonly related to 'stimulating interest and engagement' with science and less frequently (as a main outcome at least) related to further study or career outcomes.

Consequently, a broad spectrum of provision can be identified, which extends from services closely linked to supporting formal provision (where the audiences are schools and pupils) to others that intend to inform, inspire and engage individuals with science more broadly (the audiences for which are members of the general public). This reflects the fact that the sector has developed opportunistically and grown organically, but means that no single theory of learning underpins activity across the sector and there is no single definition of informal science learning. When a series of parameters that can apply to informal science learning were explored with service providers, agreement was strongest for variables around active engagement and the availability of services to individuals of all ages and was less strong for parameters such as location (i.e. outside school), delivery agent (i.e. not a teacher) and supporting formal science learning.

Recommendation 1: Defining the informal science learning sector

To help funders to guide their investments in informal science learning activities in the future, we recommend that funders define the outcomes they are seeking to achieve rather than the delivery methods their providers should use. We suggest two groupings of activity, which reflect the ends of the spectrum between formal and informal learning:

- the first, where informal science learning services are directly and explicitly intended to contribute to the delivery of the formal science curriculum, and where outcomes should be set in terms of enhancing and enriching the curriculum and supporting achievement and progression for students

- the second, where informal science learning services aim to inspire, enthuse and engage individuals with science, and where outcomes include increasing awareness of, interest in, enthusiasm for and engagement with science among individuals of all ages but progression to qualifications is less relevant.

We believe this distinction would be helpful for funders in setting clear objectives for future informal science learning provision and the outcomes that can be expected, and would provide clarity on what services are trying to achieve rather than the delivery methods employed. However, we stress that investment in both 'curriculum-related' and 'inspirational' activities is equally valid: both have important parts to play in enhancing the scientific literacy of the UK population.

The study also explored the ways in which the informal science learning sector can, and currently does, link with more formal science learning. Some of the providers consulted were keen to highlight the distinction between the informal and the formal and thought supporting the latter should not be the main objective of informal learning. However, consultations across the sector, and the provider survey, found that provision to schools was commonly reported.

A variety of approaches to supporting more formal learning were identified in the study, and it was clear that many organisations involved in the informal sector have existing links with schools, colleges and others with interests in formal learning.

Recommendation 2: Linking informal and formal learning

Here our recommendations relate to how the links between informal and formal science learning can be enhanced for mutual benefit. It is important to note, however, that many teachers already use informal learning techniques with their pupils and take steps to ensure that the value of any interaction with the informal sector is maximised. However, the study also found that in some cases greater value could be added.

It is also important to remember that the decisions on whether to take advantage of informal science learning opportunities are taken by individual teachers and school leaders, and that significant efforts have already been made to improve accessibility of resources and activities (e.g. the STEM Directories and STEMNET).

Recommendation 2.1
When funding programmes designed to link with formal science learning, funders should be explicit regarding their objectives, participant groups, outcomes and the evidence required to show the outcomes have been achieved.

Recommendation 2.2
For informal science learning programmes that are intended to link with formal learning, funders should require the following issues to be addressed in proposals:

- The potential links with the school and college curriculum, to engage teachers, support planning and illustrate the contribution that informal learning can make.

- The role of materials for use in schools pre- and post-intervention, which can help teachers and pupils prepare for and build on informal learning activities. Many providers currently provide such materials but report that their use can be variable. Consequently, consideration should be given to how to maximise the use of such materials by schools.

- How the value of the different experiences that the informal sector can provide, and which cannot necessarily be offered in the classroom setting, can be most effectively demonstrated to teachers.

- How it can be made easier for schools to take advantage of informal science learning experiences – for example, by providing specific funding to address barriers such as transportation costs.

Not all activities will, or should, include these elements of 'good practice', but proposals should explain why they are or are not relevant to a particular activity.

Finally, services seeking to 'inspire and enthuse' audiences are also widely considered to contribute to individual decision making around continued study and potential careers in

science. However, beyond short-term 'intentional' effects there is little evidence in the UK outside the anecdotal for any longer-term and behaviour-influencing impacts. Our recommendations below include how this evidence gap can be addressed.

5.2   Evaluating the impact of informal science learning

The study found that providers of informal science learning services commonly evaluate the services they provide and that an appetite exists for learning about the effectiveness of provision to inform ongoing service development and improvement. Practices varied considerably across the sector, and while evaluation activities were broadly commensurate with budgets allocated to the services or activities, evidence of the medium- to long-term impacts of informal learning were highly limited. There are a range of reasons for this, including:

■   the nature of the activities and the resultant outcomes, which, by definition, can be difficult to capture

■   the variable availability of resources, both financial and in terms of staff skills, among individual providers to undertake the type of study that would allow longer-term outcomes to be identified

■   the awareness and availability of appropriate evaluation methods and approaches that can be practicably applied across a range of settings, services and delivery approaches.

While many evaluation reports were reviewed as part of the study, the evidence they presented suggested that at least short-term impacts in terms of raising interest in and engagement with science were commonly reported. However, the extent to which these effects were sustained, and resulted in behavioural change in terms of STEM study or careers uptake, remains largely unknown.

Recommendation 3: Evaluating informal science learning

Recommendation 3.1

Our principal recommendation, which is presented with reference to evaluation but has wider implications, is the establishment of a forum for leading funders of informal science learning provision. Convened and chaired by the Wellcome Trust, the aims of the forum should include:

■   stimulating discussion among the funders of informal science learning at a strategic level, with a view to providing a coordinating function where no such body currently exists

■   developing a strategic approach to supporting informal science learning to guide investment in a coordinated manner across the sector, with enhanced clarity on the aims, objectives and outcomes expected to result

■   acting as an advocate for the sector, to exert influence as a collective and communicate opportunities identified

■   establishing, as far as possible, common performance management and evaluation requirements, indicators and metrics across different funding streams and services

■   supporting cross-sectoral programmes of research to ensure the sector can build upon lessons from the field in the UK and internationally

■   enabling funders to account for their investments, where they face similar issues over prioritising investment in a period of wider austerity.

The forum may also consider whether providing funding for informal science learning on a longer-term basis would help support the wider assessment of impact over time. Other practical roles we recommend the forum also consider include:

■   offering clarity to providers on what is expected from them in terms of evaluating funded services and making them aware of the range of evaluation guidance currently

available across the sector

- providing briefings, and training where appropriate, on what is expected in terms of evaluation and potential approaches when it is a requirement of a funding award

- providing an environment and mechanisms where providers feel confident in sharing the lessons from their evaluation (and wider experiences) for the benefit of the sector.

Membership of this group should include key Government departments (e.g. the Departments for Education, Business Innovation and Skills, Communities and Local Government, Health, and Culture, Media and Sport), the Research Councils, learned societies and large corporate bodies with interests in science learning. The forum should also be able to draw upon the experience and expertise of stakeholders and providers operating in the informal sector to ensure decisions are made on a best-informed basis.

Recommendation 3.2
In addition to establishing common performance indicators and metrics across the sector, the funders' forum, in consultation with appropriate experts, should support a programme of evaluation research to provide an evidence base on the medium- to long-term impacts of informal learning in the UK.

The study found that most informal learning providers struggle to isolate their impact beyond short-term effects (i.e. changes in attitude and intentions to change behaviour at the end of service delivery). Attempts to explore longer-term impacts, for example to identify whether short-term intentions convert into actual change, are rare – not least as the scale and nature of the task requires investment beyond the reach of any single provider. We consider that providing robust and 'nationally credible' evidence of the benefits of informal science learning is a requirement for the sector looking forward, and a shared investment between funders offers the opportunity to do this.

Recommendation 3.3
This recommendation relates to the development of a more coordinated and strategic approach to investment in evaluation studies across the sector. Any studies that aim to explore these long-term impacts will require significant investment, which again suggests a cross-sector and cross-funder approach. However, we believe that funders could use the resources they currently commit to evaluation in a more strategic manner – investing to develop an evidence base for different types of activity to give funders confidence in the efficacy of particular approaches. The current approach, where evaluation can form a condition of contract and which can confuse accountability with evaluation, should be reviewed to enable providers to demonstrate they have spent funding received effectively without the expense of formal evaluation activity. This would allow funding to be directed towards larger-scale evaluation studies, which could make a real contribution to the longer-term evidence base. The forum should work closely with experts in performance management and evaluation, and stakeholders in the sector, to draw on their collective expertise and knowledge to ensure the resulting studies are practicable and fit for purpose.

Recommendation 3.4
This recommendation focuses on the development of indicators that can be applied in the evaluation of informal science learning. As part of developing a more strategic and coordinated approach to evaluating and investing in services, the funders' forum should lead – again drawing upon appropriate expertise – on the development of a common set of indicators and measures that can be used in evaluating informal learning activities. Any indicators and measures proposed must capture the intended effects of investments and be practicable to implement, proportionate to the funding received and capable of being reported on.

There is a wide range of potential indicators that have already been developed by funders and others to capture many of the elements of informal science learning. These can be drawn upon to inform the indicator development process, and we suggest that a single list is drawn up to allow specific measures to be selected to fit funders' objectives and the activities in question. Below we provide an illustration of the potential indicators that could be applied, although we emphasise the importance of the final set being developed and owned by the forum in line with their wider remit of developing a more strategic approach to informal science learning in the UK.

Indicator	Measure	Data collection approach
Enjoyment of experience	Numbers that report enjoying the experience. What was liked most and least, and why. Interest in repeating the experience or aspects of it.	Collection of quantitative and qualitative data from participants during or after participation (e.g. through surveys, observations, interviews or focus groups).
Increased interest in science	Numbers that report being more interested in science after their experience. Factors that provoked an interest. Numbers that report an intention to find out more about the subject in question. Actual follow-on activity.	Collection of quantitative and qualitative data from participants during or after participation (e.g. through surveys, observations, interviews or focus groups).
Increased intent to study/continue to study STsubjects Actual take-up/continuation of study of STEM subjects	Numbers reporting intention to study STEM subjects at completion of intervention. Numbers evidencing take-up/continuation of study. Reasons for intentions and actual outcomes.	Collection of data from participants on completion. Follow-up surveys (e.g. six months after completion, after key transition points at ages 14,16 and18). Progression and management data from schools/colleges. Interviews, focus groups with participants.

The table above shows that data collection can combine data collected directly on completion of the service or activity and that collected through longitudinal or follow-up approaches, which will have different resource requirements and so should be applied appropriately.

In addition, baseline data should be collected to show change following the intervention. This may not be possible or practicable in certain circumstances, so the questions used to elicit the data may need to be specific on views before and after the service (although baselines can be estimated from initial 'show of hands' questioning and other techniques, which can be followed with audiences at the start of the intervention).

5.3   Engaging challenging-to-engage audiences

The study explored common audience groups across the sector, as well as the particular audiences that providers of informal science learning found challenging to engage. The suggestions from providers on challenging-to-engage groups supported the notion that financial deprivation was a key barrier to engagement, although this review also showed that the picture was complex and that a range of interlinked and wider social and cultural factors can deter involvement in activities. Level of education (both young person and parental) was an important factor here, as were ethnicity and limited aspirations (to a lesser extent), which in many cases combined to limit engagement.

Many different opinions on engaging challenging audiences, and approaches found effective in doing so, were described. Some providers reporting 'designing in' breadth of participation from the outset. For others the challenge was to attract new audiences for existing and new services, and the use of outreach approaches was common as a means of engaging more challenging groups and as a means of delivering services to them.

A series of approaches and principles were identified as underpinning efforts to engage audiences that providers found challenging. In many cases the lessons from these experiences resonated with good practice in engaging with audiences more widely. Approaches that actively engage the audience groups for which they were intended, that offer experiences clearly differentiated from standard school practice and/or that may be less explicitly linked to proscribed learning outcomes are also factors that were reported as attractive to all audiences, not solely the challenging to engage.

Our recommendations for engaging challenging audiences are provided below.

Recommendation 4: Understanding and engaging challenging audiences

Recommendation 4.1
Providers should consider the extent to which there may be groups within their respective communities who do not currently use their services but who could benefit from them. Acknowledging that engaging all members of their communities not using their services may require significant resources, providers should seek to:

- identify groups who are currently underserved by comparing data on their existing audiences to the demographics of their local communities

- undertake research with non-user and challenging-to-engage groups to identify why they do not attend, the type of activities that would be attractive to them, and the most appropriate means of promoting their services to facilitate engagement

- develop new provision or amend aspects of existing provision to address barriers to engagement

- review the effectiveness of the new approach followed, with a view to 'mainstreaming' any revised approach or service.

The funders' forum also has a part to play in delivering this recommendation, by considering and resourcing pilot approaches to researching and engaging with hard-to-reach groups based on effective practice elsewhere.

Recommendation 4.2
In developing new approaches to engage potentially challenging audiences, providers should consider the principles for reaching challenging-to-engage groups identified in the study and proactively apply them in planning service delivery by:

- ensuring that services and their content are relevant to audiences' interests, experiences, backgrounds and needs – as well as being stimulating, interactive, engaging and culturally attuned to the circumstances of their intended target audiences

- establishing partnerships with other organisations or groups already engaging with the target audience in question

- employing community outreach approaches with challenging audiences, with a view to raising awareness of opportunities, addressing actual and perceived barriers to access, and engaging to cultivate long-term relationships.

However, providers should consider whether it is realistic for them to serve all the potential users of their services or whether to simply prioritise resources towards specific audiences in their communities. Here preliminary research is important in identifying and prioritising target groups, as well as identifying their specific barriers and how they should be addressed.

Recommendation 4.3
Looking beyond challenging-to-engage groups, the Wellcome Trust, through the funders' forum, should support a programme of research to develop a more detailed understanding of demand and participation in informal science learning among different audiences. While this should draw on the experiences of different providers, improved knowledge of challenging-to-engage/underserved audiences would be a key element in promoting a more strategic approach to informal science learning provision nationally. This information could then be used to develop appropriate informal learning services locally and nationally.

Specific areas for additional research include:

- Undertaking a more comprehensive audit of informal science learning providers to understand in more detail the nature of their current audiences for different services offered, the audiences they currently find challenging to engage, and their experiences of approaches to engage challenging groups to provide a broader understanding of issues and good practice across the sector.

- Extending the Family Studies research undertaken as part of this study, using a qualitative research approach with tweens aged 12–16, and including fathers as well as mothers, to capture any differences in their views.

- Undertaking similar exploratory ethnographic work with children of primary school age (5–11), to explore the drivers and barriers to engagement as they are developing.

- Expanding the young people's element of the Wellcome Trust Monitor to include people aged 12–13, increase the sample size for the 12–18 group and cover additional topics such as how tweens access music and video, their use of social media, and sources of information on careers and subjects to study. Paired parent and child interviews should be included to explore how parental views and behaviour relate to their tweens' views and behaviour.

Recommendation 4.4
The Trust and other funders should consider setting expectations or soft targets for participation in funded activities by specific socio-demographic groups. This could be considered on a pilot basis, to include a programme that aims to stimulate providers to develop sustained links with their communities and share the learning from their experience with the sector more widely.

Annex 1 Study methodology

A1.1 Introduction

This Annex provides more detail about the data collection and analysis methods used in the study, which were developed in collaboration with the Stanford and Oregon State team and representatives of the Wellcome Trust.

The text below refers to the methods used in the production of the GHK report, highlighting where the approach was developed and data shared with the Stanford and Oregon State team. The Stanford and Oregon State report provides additional detail on the methods used in developing their report, including the main literature review.

The methodology followed in the production of the GHK report comprised the following elements:

- a programme of in-depth qualitative interviews with stakeholders and broadcasters with an interest in informal science learning

- an internet-based survey of informal science learning providers

- case studies with informal science learning providers

- a literature and data review, reviewing the 'grey literature' collected and analysing data from the Wellcome Trust Monitor and Public Attitudes to Science Survey

- the Family Studies research, comprising in-depth interviews with children and young people, supplemented by diary keeping and interviews with parents.

An initial task, and one that was reviewed at different points across the study, was to develop a typology of organisations involved in the provision of informal science learning in the UK. The typology was developed from an initial list provided by Stanford/Oregon State and was modified to reflect the structure of the sector in the UK. The typology developed is provided as Table 1 below.

Table 1   Typology of organisations with an interest in informal science learning

Organisation type	Organisation type
Aquaria	Physical games
Science museums	Science/engineering books, magazine publishers
General museums	Providers of STEM activities in school time
Science and discovery centres	Providers of after-school STEM activities
Educational film, television and radio producers	Community groups delivering activities
Documentary film, television and radio producers	Hobby clubs and societies
Entertainment film, television and radio producers	Sports clubs and societies
Libraries	Parks and nature centres
Websites	Theatre groups
Electronic games	Science fairs
CPD for teachers	Young scientist competitions
Science Learning Centres	Debates
Learned societies	Zoos
Schools (state and private)	

This typology was used initially in the stakeholder consultations, both to group the participants and to explore their understanding of the sector and the relationships between organisations operating within it. A modified version of the typology was then used in the provider survey to allow respondents to self-report their organisation type against a common list.

Each component in the study is described below.

A1.2 Stakeholder and broadcaster interviews

A programme of in-depth qualitative interviews was undertaken with 55 representatives of organisations with an interest or involvement in informal science learning, including representatives of broadcasters, new media producers and games developers. The sample of 60 organisations, with an additional 60 reserves, was developed from an existing stakeholder list compiled by the Wellcome Trust, and additional organisations were included from the study team's knowledge of the sector.

A total of 55 interviews were completed, with few organisations from the main sample being unable or unwilling to participate. The distribution of interviews by provider type is provided as Table 2 below.

Table 2   Stakeholder interviews by provider type

Organisation type	No. interviewed	Organisation type	No. interviewed
STEM activities	7	Learned societies	4
Aquarium/zoo	2	Libraries	2
Botanical garden	1	Museums	3
Broadcasting/gaming[14]	12	Publishers	2
Environmental education	2	Science and discovery centres	5
Science festivals	2	Schools	2
Film and theatre	3	Sports clubs	2
Government	3	Teacher support	3

The questions used in the stakeholder interviews were developed jointly by the GHK and Stanford/Oregon State teams and are provided as Appendix 1. Topics covered included:

- background on the organisation and its interest or involvement in informal science learning

- the organisations they work with and their respective roles

- the audiences they serve and audiences they find challenging to reach

- assessment policies and evaluation practices

- views on, and experience of, linking formal and informal science learning.

The stakeholder interviews also included an exercise to map the relationships between organisations and position the respondent on a grid comparing formality of venue and degree of free choice offered, for subsequent analysis by the Stanford/Oregon State team.

The data from the interviews were transcribed and analysed in detail by the Stanford/Oregon State team, with field notes and transcriptions also being used by the GHK team. The Stanford/Oregon State team used 51 of the 55 interviews in their analysis, excluding four interviews undertaken with funders.

A1.3 Survey of informal science learning providers

An internet-based survey was developed to collect the views of providers or supporters of informal science learning services. An online questionnaire was developed in collaboration with Stanford/Oregon State, a copy of which is provided as Appendix 2, and the resulting data was shared for subsequent analysis.

A sample of 366 organisations was developed for the survey from a variety of sources, including the STEM directories, the Wellcome Trust, ASDC and suggestions from the

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[14] The broadcaster group included national film, television and radio programme producers, providers of electronic media and online products, and games producers.

stakeholders interviewed. The survey was also promoted through Psci-Comm, GEM, Visitors Studies Group and Big Chat distribution lists, to maximise coverage and enable the broadest possible range of organisations to contribute. No attempt was made to restrict responses to one per organisation, as the intention was to collect views from the broadest possible range of respondents. It was also recognised that while the survey was never intended to be representative of the informal science learning sector as a whole, it aimed to feature a broad distribution of organisation types, sizes and activities.

The questionnaire could be completed in between 20 and 30 minutes and included questions on:

■ the respondent's organisation

■ the activities delivered

■ organisations collaborated with and the nature of any collaboration

■ audiences, plus groups found challenging to engage and steps taken to engage them

■ intended outcomes, evaluation practices and any challenges faced with evaluation

■ definitions of informal learning, and links between it and formal learning.

The questionnaire also asked whether the respondent would be willing to participate in further research, and this was used to identify potential case studies (see below).

A total of 168 completed responses were received to the survey, and an additional 28 were sufficiently complete to be included in the subsequent analysis. The number of responses by organisation type is shown in Table 3 below.

Table 3   Survey responses by organisation type

Organisation type	Number	Respondents
Supply of STEM enhancement/enrichment activities – main business	44	22%
Museum	27	14%
Science and discovery centres	26	13%
Supply of STEM enhancement and enrichment activities – not main	25	13%
Not-for-profit education organisation not otherwise specified	13	7%
University	11	6%
Learned society	10	5%
Electronic media producer (e.g. websites, games, videos)	6	3%
Charity and Social Enterprise	6	3%
School	6	3%
Zoo/Aquarium	5	3%
Broadcasters, film, TV and other media producers	4	2%
Science festivals	4	2%
Research Council/Funder	2	1%
Other (one sole trader STEM provider and one learned society)	2	1%
Research Institute	1	1%
Park, nature centre or field centre	1	1%
Theatre group	1	1%
Society for Professional Development	1	1%
Planetarium	1	1%

Organisation type	Number	Respondents
Grand total	**196**	**100%**

The responses were analysed using Microsoft Excel, and certain fields were also analysed using SPSS. In addition, the open text responses were coded and analysed using NVivo. The analysis explored responses by organisation type, size and services offered, as well as other variables to explore topics such as challenging-to-engage audiences and evaluation practice.

A1.4   Provider case studies

After completion of the provider survey, respondents who indicated they would be prepared to take part in additional research were reviewed and a 'first list' of ten, with ten reserves, was developed.

Potential case studies were selected on the basis of their survey returns, particularly where they suggested they may be of interest in terms of their evaluation practice and experience of engaging challenging audiences. The sample also sought to include providers of different sizes and from different organisational types.

The distribution of the final ten case studies by organisation type is shown in Table 4 below.

Table 4   Provider case studies by organisation type

Organisation type	Number
Science and discovery centres	3
Museums	2
STEM provider	1
Zoo	1
Learned society	1
Arts/theatre group	1
University	1

The case studies comprised:

■   Visits to each provider and interviews with provider staff, partners and participants where possible. The coverage of each case study varying depending on their individual circumstances.

■   The review of documentation provided and the production of individual summary reports.

The case studies built on the individual survey responses to explore:

■   their experiences of working with challenging-to-reach groups – the approaches they had found to be effective and any outstanding challenges

■   their evaluation practices – from planning to implementing evaluation strategies, and the barriers and enablers experienced

■   the links between formal and informal science learning from their perspectives – including practical examples and experiences.

The analysis of the case study findings was set in the context of the wider experiences of other organisations of their type, although owing to their limited number were treated as illustrative of practice on the ground.

A1.5   Literature and data review

Following the stakeholder interviews and subsequent case study fieldwork, and in recognition of the part played by non-academic reports in the development of informal science learning in the UK, a range of 'grey literature' was reviewed.

A range of documents were considered, including Government-sponsored reports, Parliamentary Inquiries, evaluation reports commissioned by sponsors or organisers of STEM activities and academic publications. Some of the documents were identified or provided by stakeholder participants, and others were known to members of our team.

The documents were reviewed in a qualitative fashion to draw out issues relating to the evaluation of informal science learning activities (and science and society activities more widely). While some of the documents are publicly available, many were provided to the review team to inform our thinking but are not openly available.

A1.6   Family Studies research

The Family Studies research featured a programme of in-depth and wide-ranging interviews with 12 tweens aged 11–16, supplemented by diary keeping to record out-of-school activities over a two-week period (one week of which was a school holiday, and one week of which was a school week). For 11 of the young people the holiday week covered was the February 2012 half term, but in one case fieldwork was delayed and the holiday week covered was one week of the Easter break in April 2012.

Short discussions were also held with one parent in each case. The father was only involved in one, which was held jointly with the mother. In the two to three weeks after the interview each young person conducted short peer-to-peer interviews with two friends; unfortunately, two of these (from the same respondent) were never returned. These 20 interviews were analysed alongside the in-home interviews with the 12 participants. This served to boost the sample of tweens, but the interests and activities undertaken were very similar to those of the main participants, as might be expected of relatively close friends.

The focus of all the interviews was on how time out of school was spent and what drives interests and activities. The interview was guided by the content of the individual diary and a topic guide but, as with all qualitative research of this type, not all issues were raised in all the interviews. For example, we did not systematically collect information on pocket money and while we know that two tweens attended the same school (e.g. some of the lower social grade group in Manchester), this was not always fully recorded.

Background information on participants was collected at the time of recruitment to ensure that the required sample profile was achieved, and this focused on school year, social grade and the position of the child in the family (i.e. oldest or only child, or younger child). This background information was not collected from the peer-to-peer interviewees as the young interviewees could not be expected to ask what can be difficult and very personal questions. We have assumed that the peers were similar in age and social grade to the primary respondent.

Interviewing took place in two areas in Greater London and two areas in Greater Manchester. These areas were selected as major cities with a range of entertainment available and with public transport systems that would allow tweens to travel to science centres and/or science museums without an adult. The intention was to remove the barrier of accessibility to informal science learning activities (i.e. respondents could not claim that they did not take part in specific activities or visit specific types of venues because they were physically inaccessible).

The Market Research Society Code of Conduct, which also guides much of the social research conducted in the UK, requires parental permission for children and tweens aged under 16 to take part in this type of research. We therefore recruited via parents and this, plus the requirement that the young person be reasonably articulate, has probably skewed the sample towards 'mainstream' culture – but we must emphasise that this research was very exploratory.

For the purposes of analysis, the tweens who took part in the Family Studies were divided into two groups: those from social grades A, B and C1 where at least one of the parents had a degree or equivalent, and those from social grades C1, C2, D and E, where neither of the parents had a degree. The sample profile is provided as Table 5 below.

Table 5: Sample profile

School year	Social grade A/B/C1 and at least 1 parent to have at least an undergraduate degree level qualification	Social grade C1/C2/D and neither parent to have degree level qualifications or above
7	Oldest or only child (Manchester)	Younger child (Manchester)
7	Younger child (London)	Oldest or only child (London)
9	Oldest or only child (Manchester)	Younger child (Manchester)
9	Younger child (London)	Oldest or only child (London)
11	Oldest or only child (Manchester)	Younger child (Manchester)
11	Younger child (London)	Oldest or only child (London)

In addition:

■ all those in Manchester lived within half an hour travelling time of the Museum of Science and Industry

■ all those in London lived within one hour travelling time of the Science Museum

■ none were home-schooled

■ we included white, black, Asian and mixed-race families, although not on a large enough scale to analyse by ethnic group.

This ethnographic and in-depth interview data was supplemented with quantitative survey data from the Wellcome Trust Monitor (2008) and the Public Attitudes to Science Survey (PASS) (2011).

Appendix 1

Stakeholder interview checklist

Your Organisation and What You Do

1.1   What do you see as the main goals of your organisation; do different parts of your organisation have different objectives?

1.2   What are the main services/activities that you provide/support?

1.3   Please describe the key activities that you undertake/support to interest, inform, engage, entertain or educate people about science and technology.

1.4   What are the specific audiences for these activities? *IF MULTIPLE AUDIENCES*: Are there key audiences, and why do you consider some more important than others?

1.5   What, if anything, are you trying to achieve? *PROBE*: changes in attitude, an increase in knowledge, increased motivation, to entertain, etc

1.6   Is there any underlying philosophy, educational theory or other set of values that drive or guide what you do? *IF YES*: What are they? *IF NO: STRAIGHT TO NEXT QUESTION*

1.7   What other factors and agents drive what you do, and your decision making processes? *EXPLORE BEYOND FUNDING*

1.8   How do you decide on the specific activities you undertake/support – is there a base of evidence or a theory that underpins these decisions?

1.9   Where do you get your ideas about what to do from? *PROBE HERE WHETHER MAINLY FROM OTHER PEOPLE IN THE FIELD, IN HOUSE, FROM READING, ATTENDING CONFERENCES, WEBSITES, AUDIENCE RESEARCH/FEEDBACK, PEOPLE BRINGING IDEAS, ETC. EXPLORE FULLY WITH RESPONDENT.*

NOTE FOR INTERVIEWERS: ALTERNATIVE SECTION FOR FUNDERS/GOVT. ETC.

1.1   What do you see as the main goals of your organisation; do different parts of your organisation have different objectives?

1.1   What are the main services/activities that you support?

1.2   Please describe the key activities that you support to interest, inform, engage, entertain or educate children, young people and families.

1.3   What are the specific audiences for these activities? *IF MULTIPLE AUDIENCES*: Are there key audiences, and why do you consider some more important than others?

1.4   What, if anything, are you trying to achieve? *PROBE*: changes in attitude, an increase in knowledge, increased motivation, to entertain, etc

1.5   Is there any underlying philosophy, educational theory, policies or other set of values that drive or guide what you do? *IF YES*: What are they? *IF NO: STRAIGHT TO NEXT QUESTION*

1.6   What other factors and agents drive what you do, and your decision making processes? *EXPLORE BEYOND FUNDING*

1.7   Do you set the agenda for the activities you support or act in a responsive mode [*NOTE FOR INTERVIEWERS: THE ANSWER MAY WELL BE BOTH*]

1.8   When acting in a responsive mode, how do you decide on the specific activities you support? *PROBE HERE FOR WHETHER THERE IS A BASE OF EVIDENCE OR A THEORY UNDERPINS DECISIONS?*

1.9   When you set the agenda, how do you decide on the areas or activities to support?
PROBE HERE FOR WHETHER THERE IS A BASE OF EVIDENCE OR A THEORY WHICH UNDERPINS DECISIONS?

Who do you Work With?

2.1   Which, if any, other organisations/institutions do you work with to provide your services/activities? What are each organisation's respective roles?

2.2   Why do you work with these organisations?

2.3   What do they bring to your provision/what added value do they offer?

2.4   How did your partnerships with these other organisations come about?

2.5   Do you consider these relationships to have been successful? Why is that?

Audiences

NOTE FOR INTERVIEWERS: USE THIS SECTION FOR PROVIDERS AND FUNDERS/GOVT. ETC. BUT REMEMBER FUNDERS/GOVT WILL NOT, GENERALLY, BE RUNNING ACTIVITIES THEMSELVES SO AMEND WORDING ACCORDINGLY.

3.1   Earlier you mentioned the sorts of audiences you serve/target/work with. **Which audiences or sub-sets of audiences do you think you serve well**? Why do you say that?

3.2   Do you find that the same people come back time and time again? How do you know this? Why do you think they come back? *PROBE FOR HARD EVIDENCE*

NOTE FOR INTERVIEWERS: IN GENERAL IT IS BEST NOT TO APOLOGISE ABOUT A QUESTION, IT IS BETTER JUST TO LAUNCH IN MATTER OF FACTLY

3.3   **Are there audiences or sub-sets of audiences that you don't think you serve very well**? Can you give me an example of an audience you don't think you serve very well?

3.4   What would you like to achieve with these audiences? E.g. increase their knowledge, influence their choice of career, subject choices, interests, views on a topic, attitudes, get them to use your facilities more frequently, etc?

3.5   **Are there any audiences or sub-sets of audiences that you find hard to reach**? Have you tried to reach these audiences? Would you like to reach these audiences?   Why are they hard for you to reach PROBE ON: age, gender, location, socio-economics, interests.

IF SOCIO-ECONOMICALLY DISADVANTAGED AUDIENCES NOT MENTIONED ABOVE, PROBE: Specifically, what steps do you/your providers take to involve children, young people and families from socially and financially disadvantaged backgrounds in the services you provide/support?

Assessment of Activities

NOTE FOR INTERVIEWERS: USE THIS SECTION FOR PROVIDERS AND FUNDERS/GOVT. ETC, BUT REMEMBER THAT THEY WILL NOT, GENERALLY, BE RUNNING ACTIVITIES THEMSELVES SO AMEND WORDING ACCORDINGLY.

4.1   Can you give me one example of something you have done for any audience that you believe was really good?

- Which audience was it for?

- What was good about it?

- How do you judge that it worked well?

- Why do you think that this worked well?

- Is this part of a series of experiences aimed at this group/these groups?

PROBE FOR HARD EVIDENCE AND REFER BACK TO INTENDED ACHIEVEMENTS DESCRIBED IN QUESTIONS IN SECTION 1.1

4.2 Have you ever done something that you thought had not worked well? What was it? Who was it targeted at? What were you hoping it would achieve? Why didn't it work as expected? *PROBE FOR HARD EVIDENCE*. What did you learn from this experience?

Assessment Policy

5.1 We have been talking about assessing activities, what is your organisation's policy on evaluation? Do you always evaluate your activities? *IF NOT*: How do you decide which to evaluate and which not to evaluate?

5.2 How do you go about your evaluations? *PROBE FOR IN-HOUSE, COMMISSIONED, METHODS USED AND RATIONALE BEHIND DECISIONS.*

5.3 Does this give you the sort of information you want/need in order to plan future activities? Why/Why not?

5.4 Does this provide you the sort of information you want/need to influence policy makers and funders? Why/Why not?

FOR COMMISSIONERS/FUNDERS:

5.1 What information do you require from providers about the activities they spend your funding on?

5.2 Are the providers you support able to provide this information? – briefly summarise the approaches they follow.

5.3 What are the challenges you face in assessing impacts?

5.4 How have you/your providers sought to address these challenges?

5.5 From your perspective, what represents good practice in identifying the impacts of the types of activities you commission/fund?

Mapping Linkages

6.1 Are there other organisations who provide similar services to yourselves? What's similar about them (target audience, nature of activity, content, location)?

Mapping Exercise

6.2 Please look at this set of cards and the following types of organizations. I would like you to place the card(s) with your organisation in the middle, to see how you see yourself in relation to others. With your organization at the middle, can you add any others that you think are important in supporting the work you do or who do related types of work – placing those most important to you closest to the centre, those less important furthest away. If there are any cards you do not think are relevant, just place them to one side. As you do this please explain why you have chosen to place each organisation where you have.

There are also some blank cards for you to write on to add groups that are not on our list. *ASK INTERVIEWEES IF THERE ARE ANY ORGANISATIONS MISSING – IF SO WRITE ON BLANK CARDS AND PLACE APPROPRIATELY*

TAKE PHOTO OF MAP

ONCE THE EXERCISE IS FINISHED, GO THROUGH THE CARDS THAT WERE EXCLUDED AND ASK WHY EACH WAS EXCLUDED

List:

- Aquaria
- Science museums
- General museums
- Science centres
- Educational film/Television/Radio producers
- Documentary films/Television/Radio producers
- Entertainment films/Television/Radio producers

- Libraries
- Websites
- Electronic games
- Physical games
- Science/engineering books and magazines publishers
- Parks/nature centres etc
- Providers of afterschool STEM activities
- Community groups delivering activities
- Hobby clubs/societies
- Sports clubs/societies
- Providers of STEM activities in school time
- Theatre groups
- Science fairs
- Young Scientist competitions
- CPD for teachers
- Science learning centres
- Zoos
- Learned societies/scientific societies
- Schools (state and private)
- Debates

6.3 Of all these groups we've spoken about, which do you think do a really good job? Why do you say that? What evidence/information are your views based on?

Informal and Formal Learning

7.1 Do you see your organisation as an educational provider? *IF YES*: What distinguishes the experience you provide from those provided by others? How, if at all, is this different from what schools provide/do? *IF NO*: What do you see yourself as?

SHOW MAP OF COMPULSORY TO VOLUNTARY ACTIVITY AGAINST FORMAL TO INFORMAL VENUE AND ASK RESPONDENT TO PLACE THEMSELVES ON THE MAP. THEY MAY WANT TO PUT THEIR DIFFERENT ACTIVITIES IN DIFFERENT PLACES.

7.2 Why have you put your activities in these spaces? *PROBE FULLY*

7.3 How do you see what you do as contributing towards learning, if at all?

TAKE PHOTO OF MAP

7.4 Have you heard of the term 'informal learning'? What do you understand it to mean?

7.5 What do you see as the main differences between formal and informal learning?

7.6 What do you see as the strengths and weaknesses of informal learning?

7.7 What do you see as the strengths and weaknesses of formal learning?

7.8 In your view, how can informal learning best contribute to formal learning outcomes? Can you give me an example of when this has worked particularly well?

7.9 How can formal learning best contribute to informal learning outcomes? Can you give me an example of when this has worked particularly well?

And Finally

15.1 In your view, what represents good practice in the area in which you work?

8.3 Are there additional points you would like to raise?

Thank and close.

Appendix 2

Internet survey of providers

Section One: About Your Organisation

In this section we would like to find out about your organisation.

1. **Please complete the box below.**

Organisation	
Your Job Title	

2. **Please briefly describe your organisation's aims and objectives in engaging the public with science, technology, engineering and mathematics (STEM)** *(Free text)*

3. **Which of the following best describes your organisation? (please tick one box only)**

Organisation Type	Please Tick
Organisation/individual whose **main business** is the supply of STEM enhancement and enrichment activities	
Organisation/individual supplying STEM enhancement and enrichment activities, but **not our main business**	
Community group/Hobby club/Sports club	
Electronic media producer – e.g., websites, games, videos	
Broadcasters – film, TV and other media producers	
Learned society	
Library	
Park, Nature centre or Field centre	
Publisher of printed books and magazines	
School	
Museum	
Science and discovery centres	
Science Festivals	
Theatre group	
University	
Zoo/Aquarium	
Private/for profit education organisation not otherwise specified	
Not for profit education organisation not otherwise specified	
Other – please describe	

4. **Please describe the legal status of your organisation by ticking the appropriate box below:**

Organisation Type	Please tick one option
Charitable Trust	
Not for profit organisation	

Private limited company	
Public limited company	
Sole trader/self-employed	
Other – please describe	

5. **Please state the number of people who work in your organisation.**

Number full-time	
Number part-time	
Number permanent full time equivalent	
Number fixed term/temporary full time equivalent	

6. **On what scale does your organisation operate? Please tick the box below as appropriate.**

Scale	Please tick as appropriate
Local	
Regional	
National	
International	

Section Two: Activities

This section explores the services and activities that your organisation provides, and the organisations you collaborate with.

7. **Which of the following STEM experiences, services or programmes does your organisation provide? Please indicate below up to 3 services which you see as your main service areas and others which you see as secondary services. If you would like to change your selection, please click the 'clear selection' button below and re-enter**

Service/Activity	Main	Secondary
In-school provision/enrichment		
Holiday/summer school programmes/activities		
Holiday/summer school programmes/activities		
Formal or informal talks or debates – e.g. lectures, science cafes		
Community outreach programmes		
Collections and other resources (books, kits, artefacts)		
Fixed exhibitions or displays		
Travelling exhibitions or displays		
Print Publishing (e.g. books, magazines, articles, etc.)		
Video and/or audio production e.g. films for broadcast/websites		
Electronic games, podcasts and other electronic media		
Performances (e.g. theatre, music, etc.)		

School Curriculum Development		
Science/engineering fair(s)		
Science/engineering festival(s)		
Continuing professional development for teachers (CPD)		
Other – please describe		

8. **Please tell us about how you deliver your services by selecting the appropriate options below.**

Does your organisation:	Yes	No
Operate from a fixed base/centre?		
Have science outreach programmes?		
Have an online presence?		
Deliver programmes or science experiences online?		

9. **How often, if at all, do you collaborate with each of the organisations listed below?**

Organisation Type	Please Tick Only One Option for Each Sector			
	Never	Rarely	Occasionally	Often
Organisation/individual whose **main business** is the supply of STEM enhancement and enrichment activities				
Organisation/individual supplying STEM enhancement and enrichment activities, but **not our main business**				
Community group/Hobby club/Sports club				
Electronic media producer – e.g., websites, games, videos				
Broadcasters – film, TV and other media producers				
Learned society				
Library				
Park, Nature centre or Field centre				
Publisher of printed books and magazines				
School				
Museum				
Science and discovery centres				
Science Festivals				
Theatre group				
University				

Zoo/Aquarium				
Private/for profit education organisation not otherwise specified				
Not for profit education organisation not otherwise specified				
Other, please state				

10. Please describe how you work with the following types of organisation, by completing the box below. Please tick each of the options that apply to each organisation type.

NB – the respondents were presented with a list of organisation types which only includes those reported as 'Often' collaborate with from QUESTION 9.

Organisation Type	Please Tick All That Apply for Each Organisation Type								
	Develop resources/projects together	We use their resources (people and physical resources)	They use our resources (people and physical resources)	They provide financial support	We provide financial support	They provide expertise we do not have	We provide expertise they do not have	They provide access to new/different audiences for us	We provide access to new/ different audiences for them
Organisation/individual whose **main business** is the supply of STEM enhancement and enrichment activities									
Organisation/individual supplying STEM enhancement and enrichment activities, but **not our main business**									
Community group/Hobby club/Sports club									
Electronic media producer – e.g., websites, games, videos									
Broadcasters – film, TV and other media producers									
Learned society									
Library									
Park, Nature centre or Field centre									
Publisher of printed books and magazines									

School										
Museum										
Science and discovery centres										
Science Festivals										
Theatre group										
University										
Zoo/Aquarium										
Private/for profit education organisation not otherwise specified										
Not for profit education organisation not otherwise specified										
Other, please state										

11. **Please tell us which organisation types, in your opinion, contribute most and which contribute least to science learning for people aged 19 years and below in the UK. Please select up to three organisation types which you consider contribute the MOST to science learning in the UK, and up to three which contribute LEAST. If you would like to change your selection, please click the 'clear selection' button below and re-enter**

Organisation Type	Contribute Most (Tick 3 organisations)	Contribute Least (Tick 3 organisations)
Organisation/individual whose **main business** is the supply of STEM enhancement and enrichment activities		
Organisation/individual supplying STEM enhancement and enrichment activities, but **not our main business**		
Community group/Hobby club/Sports club		
Electronic media producer – e.g., websites, games, videos		
Broadcasters – film, TV and other media producers		
Learned society		
Library		
Park, Nature centre or Field centre		
Publisher of printed books and magazines		
School		
Museum		
Science and discovery centres		

Science Festivals		
Theatre group		
University		
Zoo/Aquarium		
Private/for profit education organisation not otherwise specified		
Not for profit education organisation not otherwise specified		
Other – please state		

Section 3: Your Audiences

This section explores the audiences you deliver services to, and your experience of engaging with different groups.

12. **For each of your main services, please indicate whether the audience types listed represent your main or secondary audiences, or are not an audience you work with. Please click on the different service types below to select your main and secondary audiences for each.**

NB – the respondents were presented with the options below for each organisation they selected as 'contributing most' in Question 11. For example if selected 'In-School provision/enrichment' as contribute most this would be the first option.

OPTION 1 FROM Q11. (i.e. In-School provision/enrichment').			
Service/Activity	**Main Audience**	**Secondary Audiences**	**Not an Audience**
Children aged under 5			
Children aged 5-11			
Young people aged 12 to 16			
Young people aged 16-19			
Families			
Adults aged over 19 years			
Schools – Primary			
Schools – Secondary			
Other – please describe			
OPTION 2 FROM Q11.			
Service/Activity	**Main Audience**	**Secondary Audiences**	**Not an Audience**
Children aged under 5			
Children aged 5-11			
Young people aged 12 to 16			
Young people aged 16-19			

Families			
Adults aged over 19 years			
Schools – Primary			
Schools – Secondary			
Other – please describe			

OPTION 3 FROM Q11.

Service/Activity	Main Audience	Secondary Audiences	Not an Audience
Children aged under 5			
Children aged 5-11			
Young people aged 12 to 16			
Young people aged 16-19			
Families			
Adults aged over 19 years			
Schools – Primary			
Schools – Secondary			
Other – please describe			

The above was repeated for the main service areas reported in Question 7

13. **Looking across all the services you provide, please select any audience types which you have found challenging to reach.**

   The first row provides an example of how to complete this question. If you have found all children aged up to 11 challenging to reach, select the box below the column entitled All. If, however, you only find young people from minority ethnic groups in that age group challenging to reach, select the minority ethnic groups column, as shown below.

	Overall	Male	Female	From disadvantaged areas / with low incomes	With low levels of education /lower achieving groups	From minority ethnic groups	With physical or learning disabilities
Children aged up to 11 (example)	√					√	
Children aged up to 11							
Young people 12-19							
Adults – 19 yrs plus							
Primary school groups							
Secondary school groups							

14. **Of the groups listed above, which do you find the most difficult to engage and why? Please describe below.**

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15. Please describe what you consider to be good practice in reaching and engaging audiences in science and technology that you have found hard to reach. What are the key elements of effective approaches, and please list any organisations that you feel do this particularly well?

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Section 4: Benefits and Outcomes

In this section we explore the benefits of your work in terms of the outcomes that result from it for your audiences, and how, if at all, you assess whether these benefits have been achieved.

16. Please state the outcomes that you are achieving for your audiences. In each case please tick which you consider to be the main outcomes and which are more secondary outcomes.

Outcome	Main Outcomes	Secondary Outcomes
Make science enjoyable and interesting for audiences		
Raising awareness of STEM issues and the importance of science		
Changing participants' attitudes to science		
Inspiring a general interest in and engagement with science		
Informing audiences about science/helping increase understanding		
Inspiring participants to find out more about science		
Encouraging participants to study STEM subjects		
Encouraging participants to consider STEM careers		
Encouraging further learning in non-science subjects		
Preparing participants for future STEM education or careers		
Preparing participants for non-science careers		
Other, please state		

17. Does your organisation undertake any sort of evaluation or assessment of its science engagement work?

Yes	If yes, go to Q18
No	If no, go to Q20

18. Which of the following statements best describe your organisation's use of evaluation, using either internal resources or external support? Please tick the boxes below.

Statement	Best Describes
We evaluate every service/programme we deliver	
We have a planned programme of evaluation which focuses on different services/programmes each year	
We evaluate new services/programmes on a formative basis as part of their development process	
We evaluate services/programmes where concerns have been raised (e.g. reduced take-up, in response to complaints, etc)	
We evaluate services/programmes when required to by funders as a condition of contract	
We evaluate some services/programmes from time to time but on a fairly ad hoc basis	
Most of our evaluation work is undertaken on a summative basis (i.e. when services are completed)	

19. **Please describe all the approaches you use in evaluating your activities, by ticking the relevant boxes below and indicating whether they are commissioned externally, undertaken internally or not used.**

Evaluation Approach	Commissioned externally	Conducted internally	Not used
Group discussions with service users			
Group discussions with individuals who do not use services			
Visitor exit surveys			
Surveys/feedback from service users			
Surveys/feedback from individuals who do not use your services			
Surveys/feedback from teachers using services			
Surveys/feedback from your staff			
Participant observation			
Interactive feedback within exhibition space			
Analysis of visitor data			
Peer review of services (i.e. by scientists, other activity providers, etc.)			
Other (please state)			

20. **Does your organisation face any barriers or challenges in evaluating your work? If so, please describe below what you consider to be the single biggest challenge you face.**

21. **Does your organisation face any other challenges in undertaking evaluation activity? Please complete the box below to show which of the stated barriers have applied to your organisation.**

	Yes – a major barrier	Yes – a minor barrier	Not a barrier
Lack of funding available to support evaluation			
Unsure of which methods are appropriate/practicable			
Lack of staff skills and knowledge in conducting evaluation activity			
Lack of experience and skills in commissioning and managing evaluation activity			
Difficulties finding time to evaluate			
Lack of institutional/organisational support for conducting evaluation			
Not clear of the value of evaluation work for the money we spend on it			

Section 5: Informal Science Learning

This section explores your awareness and understanding of the term 'informal science learning', and the ways in which it might complement and support more formal learning activities and outcomes.

22. **Had you ever come across the term informal science learning before being involved in this survey?**

	Please tick
Yes	
No	
Not sure	

23. **How would you define informal science learning? Please provide your definition below.**

24. **Which of the following statements do you consider should always, can or should never apply to informal science learning activities?**

Statement – Informal science learning…	Should Always Apply	Can Apply	Should Never Apply
Involves activities that are different from day-by-day formal learning			
Aims to bring about changes in attitudes to science			
Aims to bring about change through emotional engagement			
Actively engages the learner			
Has outcomes that are less prescribed than			

formal learning			
Happens as a result of free choice by the learner			
Typically involves learning with a group of the learner's choosing			
Involves an agent other than the regular teacher			
Takes place in a setting outside the school classroom			
Starts outside the formal curriculum.			
Is available to people of all ages			
Supports the achievement of formal education qualifications in science			
Supports the efforts of other science learning organisations			

25. In your view, do any of the services you provide constitute 'informal science learning'?

	Please tick
Yes	
No	

26. How does informal science learning relate to formal science learning? Please show in the box below the extent to which you agree or disagree with the following statements.   `

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree	Unsure
The main purpose of **informal** science learning is to reinforce formal science learning					
The main purpose of **formal** science learning is to reinforce informal science learning					
Informal science learning allows individuals to progress at their own pace					
Informal learning has inherent value of its own					
Informal learning can stimulate an interest in formal learning					
Informal learning enables people to follow their interests					

27. Does your organisation directly support formal science learning? If so please summarise below.

Section 6: Your Contact Details

28. If you would be prepared to take further part in this study, or be contacted again by the study team to discuss your work, please provide your contact details below.

Name	
Email	
Telephone	

Annex 2 Family studies

1. Introduction

This section provides background on the study to provide context, the study objectives and the methodology followed.

A2.1 Background

This work was commissioned as part of a larger study into informal learning with a focus on science. The aims of that study were:

- to try to define and scope informal science learning in the UK

- to explore the theoretical base of informal learning and the types of change it can bring about in people's understanding, behaviour and attitudes to science

- to explore how informal science learning links to formal science education

- to explore how to reach 'deprived learners'

- to begin to identify indicators and measures that might be used by the informal learning sector to judge the quality of provision.

The majority of the study looked at informal learning from the provider or supplier side, exploring how providers – from one-person businesses to major museums – engage audiences and which audiences providers find hard to reach. Information about the scope and nature of evaluation by practitioners in the field was also collected and reviewed.

A2.2 Objectives

This element of the project was designed to address how informal learning reaches out or could reach out to 'deprived learners' by looking at informal learning from the perspective of the audiences or consumers. We defined 'deprived learners' as groups who tend to engage less with education and who tend to leave compulsory education with lower levels of qualifications. However, some providers defined 'deprived learners' as groups that they believe engaged less with science and therefore defined 'deprived learners' as, for example, girls and older people.

In this part of the study our focus was on those aged 11–16, and we use the term 'tweens' to refer to this age group throughout this report. The term 'young people' is commonly used to refer to those aged 16–24, who are attitudinally and behaviourally quite different from tweens. Young people have a greater degree of independence compared to tweens: they often live away from home, are able to drive and have some degree of financial independence.

The main purposes of this element of the project were to:

- identify the drivers and barriers to families and tweens engaging in informal learning in their leisure time, with a particular but not exclusive focus on informal science learning

- map the extent and nature of informal learning experiences that occur during leisure time

- identify reactions to informal learning experiences that occur during leisure time

- explore how engagement in informal learning during leisure time affects tweens' attitudes to formal education, with a particular but not exclusive focus on science education.

In the design of this element of the study we intended to contrast those who engage with informal education with those who engage less, to draw out recommendations on approaches that might help providers engage with harder-to-reach audiences. However, it is important to remember that we did not include groups such as the long-term unemployed or families on very low incomes. Our intention was to focus on the 'mainstream' and to compare those from groups that tend to do fairly well academically and economically (those from the higher social grades) with those from groups that tend to do less well academically and economically (those from the lower social grades) and to draw out lessons for informal science providers. It was not our intention to explore how to reach out to the most deprived;

we believe that such work would need a different approach and we anticipate that such a study could follow, drawing on what has been learned from this study.

A2.3   Methodology

This chapter is based on several sources. We conducted in-depth and wide-ranging interviews with 12 tweens aged 11–16. This was supplemented by a diary of out-of-school activities over a two-week period, one week of which was a school holiday week and one week of which was a school week. For 11 of the young people the holiday week covered was the February 2012 half term, but in one case fieldwork was delayed and the holiday week covered in the diary was one week of the Easter break, which was in April in 2012.

Short discussions were also held with one parent. The father was only involved in one case, and this was jointly with the mother. In the two to three weeks after the interview, each young person conducted short peer-to-peer interviews with two friends; unfortunately, two of these (from the same respondent) were never returned. These 20 interviews were analysed alongside the in-home interviews with the 12 participants. This served to boost the sample of tweens, but the interests and activities shown were very similar to those of the main participants, as might be expected of relatively close friends.

The focus of all the interviews was on how time out of school was spent and what drives interests and activities. The interview was guided by the content of the individual diary and a topic guide but, as with all qualitative research of this type, not all issues were raised in all the interviews. For example, we did not systematically collect information on pocket money, or school attended.

Background information on participants was collected at the time of recruitment to ensure that the required sample profile was achieved, and this focused on school year, social grade and position of child in the family (i.e. oldest or only child, or younger child). This background data was not collected from the peer-to-peer interviewees as the young interviewees could not be expected to ask what can be difficult personal questions. We have assumed that the peers were similar in age and social grade to the primary respondent.

Interviewing took place in two areas in Greater London and two areas in Greater Manchester. These areas were selected as major cities with a range of entertainment available and public transport systems that would allow tweens to travel to science centres and or science museums without an adult. The intention was to remove the barrier of accessibility to informal science learning activities (i.e. respondents could not claim that they did not take part in specific activities or visit specific types of venues because they were physically inaccessible).

The Market Research Society Code of Conduct, which also guides much of the social research conducted in the UK, requires parental permission for children and tweens aged under 16 to take part in this type of research. We therefore recruited via parents and this, plus the requirement that the young person be reasonably articulate, has probably skewed the sample towards 'mainstream' culture, but we must emphasise that this research was very exploratory.

In general, relationships with parents were good, and this is almost certainly a function of the way in which the tweens were recruited.

For the purposes of analysis, the tweens who took part in the Family Studies were divided into two groups: those from social grades A, B and C1 where at least one of the parents had a degree or equivalent, and those from social grades C1, C2, D, E, where neither of the parents had a degree. Throughout this section we use the conventional terms of 'higher social grades' to refer to the former group and 'lower social grades' to refer to the latter group.[15]

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[15] Social grade definitions: A = higher managerial, administrative or professional (4 per cent of UK population); B = intermediate managerial, administrative or professional (22 per cent of UK population); C1 = supervisory or clerical and junior managerial, administrative or professional (29 per cent of UK population); C2 = skilled manual workers (21 per cent of UK population); D = semi and unskilled manual workers (16 per cent of UK population); E = casual or lowest grade workers, pensioners and others

Table 1: Sample profile

School year	Social grade A/B/C1 and at least 1 parent to have at least an undergraduate degree level qualification	Social grade C1/C2/D and neither parent to have degree level qualifications or above
7	Oldest or only child (Manchester)	Younger child (Manchester)
7	Younger child (London)	Oldest or only child (London)
9	Oldest or only child (Manchester)	Younger child (Manchester)
9	Younger child (London)	Oldest or only child (London)
11	Oldest or only child (Manchester)	Younger child (Manchester)
11	Younger child (London)	Oldest or only child (London)

In addition:

■ all those in Manchester lived within half an hour travelling time of the Museum of Science and Industry

■ all those in London lived within one hour travelling time of the Science Museum

■ none was home-schooled

■ we included white, black, Asian and mixed-race families, although not on a large enough scale to analyse by ethnic group.

This ethnographic and in-depth interview data was supplemented with quantitative survey data from the Wellcome Trust Monitor (2008) and the Public Attitudes to Science Survey (PASS) (2011). We refer to the findings from these datasets as the Wellcome Trust Monitor or PASS, as appropriate.

The Wellcome Trust Monitor included interviews with 259 people aged 14–16. For this report the responses to specific questions were analysed by age, gender and parents' highest level of education. Social grade was not collected. It should be noted that base sizes are relatively small, especially for respondents with parents whose highest level of education was A level (45) and Higher Education (HE) qualifications (64). All other base sizes are above 80.

PASS is a nationally representative survey commissioned by the Department for Business, Innovation and Skills. We use only the findings from the 2011 wave, but there have been three earlier waves, in 2000 (funded jointly with the Wellcome Trust), 2005 and 2008. The 2011 survey interviewed 2103 adults aged 16 and over about their behaviour, attitudes and knowledge regarding various aspects of science and UK science governance. The data have been analysed primarily by social grade for this report.

We refer to the findings from this dataset as the Family Studies.

A2.4   This report

This report begins by describing engagement in a range of activities based on ethnographic research with 12 tweens and their parents. This data is enhanced by data from two nationally representative surveys, the 2011 Public Attitudes to Science Survey (PASS) and the Wellcome Trust Monitor (2008), to give wider context to the findings.

The report goes on to consider the drivers and barriers to engagement in informal learning and young people's aspiration, before making some recommendations to support providers of informal science learning to engage with young people and our thoughts on further research on the subject.

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who depend on the welfare state for their income (8 per cent of UK population). Pensioners with occupational pensions are classified according to their last occupation. The percentages are sourced from the National Readership Survey (NRS) 2010 (www.nrs.co.uk/lifestyle.html). Due to the sampling method and sample size, NRS is taken as a definitive source of population data between censuses by the market research industry. In addition, about 2 per cent of the population is upper class (the nobility, super rich, etc.) and excluded from this classification. The total comes to more than 100 per cent as a result of rounding.

2   Activities

A2.5   Introduction

This section is largely descriptive. It looks at each of the activities recorded in the two-week diaries with tweens and other activities that were specifically probed but might not have occurred during the diary period. Data from the Wellcome Trust Monitor and PASS are used to provide an understanding of the prevalence of the activity. The Wellcome Trust Monitor allows us to compare more robustly between tweens from homes where parents were better educated and those where they were less well educated. However, the small sample size means that differences between subgroups are indicative rather than statistically significant. The PASS data enable comparison between the higher and lower social grades and provide some information on the context of the visit. Much more detailed information on the proportions of the age group with access to different media viewing devices and internet usage (including viewing and use of social media) can be found in Ofcom reports, which we have occasionally referenced to provide context.

A2.6   Activities in the home

Watching TV

The diaries reveal that watching TV was a daily activity and therefore a critical influence and source of information. Watching TV fills time and was turned to when tweens felt they had nothing else to do. It requires little effort (physically or intellectually) and provides relaxing downtime. It was seen to be informative/educational by tweens and their parents, although some parents would have preferred that their child did not watch specific programmes that they classed as 'rubbish'. However, none of the parents who took part in the Family Studies restricted the time spent watching TV or the programmes watched. Some of the tweens had a TV in their bedroom; only one boy described TV as 'boring'.

The diaries and the discussions found that TV generally played a bigger role in the lives of the tweens from lower social grades than in the lives of those from the higher social grades, but viewing for all increased during the holidays.

Humour and being able to relate to characters in the drama were the two most important drivers in the choice of viewing, leading tweens to watch programmes such as *The Simpsons*, *Two and a Half Men* and *Waterloo Road*.[16,17,18] *Eastenders* was the most popular soap, especially among those from lower social grades.[19] Where they were watched, soaps were watched as a family activity.

This is a time of transition from childhood to adulthood, and the diaries show that choice of programmes depends on age and gender. For example, one Year 7 boy still watched some children's TV, while one Year 11 girl enjoyed *Desperate Housewives*.[20] Boys tended to watch programmes such as *Family Guy* and *QI* and liked factual and investigative programmes and documentaries, such as *Crimewatch*.[21,22,23] The boys were also more interested than the girls in watching programmes that related to science and explicit learning, such as *The Gadget Show*.[24] Girls tended to prefer programmes such as *The Only Way is Essex*.[25]

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[16] *The Simpsons* is a US animated sitcom.

[17] *Two and a Half Men* is an American television sitcom about two brothers who live together. One is very successful in his career writing jingles, the other is unsuccessful. The unsuccessful brother moved in to live with his successful brother bringing his son with him.

[18] *Waterloo Road* is a TV series focusing on the lives of teachers and students in a British secondary school.

[19] *Eastenders* is a British soap opera based in the East End of London.

[20] *Desperate Housewives* is a US TV series about a group of women who live in the same suburban street.

[21] *Family Guy* is a US animated sitcom about a dysfunctional family in the USA.

[22] *QI* is a BBC quiz show based on unexpected facts.

[23] *Crimewatch* is a BBC programme that appeals to the public for help solving crimes.

[24] *The Gadget Show* is a British Channel 5 consumer programme that tests new technological gadgets.

[25] *The Only Way is Essex* is an ITV reality TV show about a group of young people in Essex, UK.

Genres that have the ability to provide scientific education were thought to be documentaries, medical dramas, crime shows and quiz shows. Programmes that were referenced by the tweens in this context were *Brainiacs*, *Top Gear*, *The Gadget Show*, *Planet Earth*, *One Born Every Minute*, *Holby City* and *QI*.[26,27,28,29,30] Scientists and broadcasters mentioned in relation to scientific programming were Stephen Hawkins, David Attenborough and Brian Cox.

On average, Wellcome Trust Monitor respondents said they watched 13.8 hours of TV per week. This was lower among those whose parents had HE qualifications; this group reported watching 10.5 hours per week. Boys said that they watched more TV than girls: 15 hours per week compared with 13 hours, respectively. Viewing increased with age: respondents aged 14 and 15 said they watched about 13 hours of TV a week, and respondents aged 16 said they watched 15 hours. The diaries from the Family Studies confirm the social grade difference and that watching TV takes up around 13 hours per week, although some of this time is spent doing other activities at the same time (e.g. talking and texting).

The Wellcome Trust Monitor also found that 60 per cent of respondents in this age group said they watched programmes about animals and wildlife at least once a month. Half (51 per cent) reportedly watched programmes about new inventions and technology at least once a month, but in line with the findings of the Family Studies this was considerably higher among boys (70 per cent) than girls (31 per cent).

Programmes about medical advances were less popular, and only 29 per cent reported watching at least once a month. Older respondents were more likely to watch these types of programmes: 37 per cent of 16-year-olds said that they watched at least monthly compared with around a quarter of 14- and 15-year-olds. Those whose parents had HE qualifications also seemed more interested in these programmes, with 38 per cent saying that they watched at least once a month compared with only 25 per cent of those whose parents' highest level of qualification was below A-level education.

The least popular overtly educational programmes were about space. Only 24 per cent watched programmes about stars and planets at least once a month, although boys were more likely to watch than girls (31 per cent and 16 per cent respectively). However, fieldwork took place in the first quarter of 2008, before the popular astronomy-based programmes presented by Brian Cox aired.

Watching DVDs

The tweens who took part in the Family Studies regularly watched films on DVDs; the films mentioned included *The Inbetweeners*, *Harry Potter* and *Twilight*.[31] Watching a DVD was a communal activity in some families and was seen by parents as an opportunity for family time. It was also a social activity with friends.

Specific DVDs made it into three of the tweens' personal inventories as being among their favourite items, suggesting that this format was still fairly popular.

Online activities

All the households had broadband internet access via a WiFi connection.

The tweens who took part in the Family Studies primarily went online for two reasons: to play games or to complete homework. In some instances school homework exercises were accessed online, but in other cases it was used to find information to complete homework

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[26] *Brainiacs* is a British Sky TV programme that conducts experiments to find out whether common conceptions are true.

[27] *Top Gear* is a BBC TV programme that tests and reviews new cars and features extreme driving.

[28] *Planet Earth* is a BBC natural history documentary.

[29] *One Born Every Minute* is a British documentary that follows a maternity ward.

[30] *Holby City* is a medical drama set in a hospital.

[31] DVDs were referenced as physical objects.

assignments. The BBC Bytesize website was used for help with GCSE revision.[32] Other online activities were viewing YouTube and some use of Facebook and Twitter.

Ofcom data reported in April 2011 showed that 90 per cent of households that included a person aged 12–15 had internet access and 35 per cent of people aged 12–15 had smartphones (and could, therefore, access the internet via their devices).[33] Nevertheless, the data also showed that 88 per cent of respondents aged 12–15 accessed the internet via a PC or laptop compared with 23 per cent using a mobile phone for access. Moreover, the findings of the Family Studies and the Wellcome Trust Monitor suggest that smartphone ownership is likely to be skewed towards those from the higher social grades.

Gaming

Gaming, either online or on a games console, was very popular. It was more popular among boys than girls but was by no means exclusively a male activity. Boys tended to like 'violent' or 'war' games, such as *Call of Duty* and *Assassin's Creed*, while girls played games such as *The Sims* and *Just Dance*.[34,35,36,37] For some boys gaming was a time filler in the way that TV was for others.

Those boys who had experience of playing online tended to express a preference for playing online or against other people on a console rather than against their previous performances. Online playing reportedly allows friends to play together when at their own homes but also allows them to play with unknown opponents. This interaction was said to make the experience more challenging and fun. The strategic thinking element was attractive to some and they did not want games to be too easy. None appeared to extend the games in any way by writing scripts, but some did have email contact with online players.

None of the girls mentioned playing online.

Some homework exercises (mathematics was mentioned specifically) were in the form of online games.

Parents tended to monitor and try to restrict gaming, whether online or on a console. They were concerned that it took up too much time and displaced other activities such as sport, family time and possibly homework. None expressed concern about playing online and the potential for 'meeting' unknown players. Neither did parents mention being concerned about particular games or types of games, for example violent games.

Three quarters (76 per cent) of the Wellcome Trust Monitor respondents reported playing computer games at least once a month. This figure was considerably higher among boys (92 per cent) than girls (59 per cent), and was lower among those whose parents had a HE qualification (67 per cent) than those whose parents were less well educated (77 per cent of those whose parents' highest qualifications were below A level and 87 per cent of those whose parents highest qualification was A level).

Stream or download video clips/movies

Streaming through YouTube was a social activity: friends watched clips together and sent links to one another. Mainly music videos and funny clips were streamed. Some tweens used their mobiles to access YouTube.

Only one of the tweens mentioned streaming films but highlighted the disadvantages of doing so, including the low picture quality. Streaming TV programmes and films was not mentioned.

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[32] The BBC Bytesize website is an online BBC site that supports revision for UK school examinations.

[33] Ofcom, Children's Media Literacy, April 2010.

[34] *Call of Duty* is a series of interactive war games that can be played on a variety of devices.

[35] *Assassin's Creed* is a series of interactive war games that can be played on a variety of devices.

[36] *The Sims* is a computer game that allows the player to design, build and furnish houses and act out receiving visitors.

[37] *Just Dance* is a music video game.

Only one young person in the Family Studies mentioned downloading, which they did to watch a TV series on an iPod.

Social networking

By 'social networking', we mean Facebook, Twitter and other such sites, email, texting, Skype, and so on. With the exception of texting, the tweens who took part in the Family Studies used social networking passively rather than actively, and in general usage was lower than might be expected. It must be remembered that the 11–16 age group will have friendship groups built around school and clubs that they regularly attend. They therefore do not need social media to keep in touch with a geographically dispersed friendship network, especially as those who took part in this research were urban based. They were also limited in their access to online tools by parental limits and access to computers, which may be shared between family members, hence their use and technical knowledge was different from that of the 'young people' (16–24) group.

Facebook was used by almost all of the tweens in the Family Studies. There was variation in levels of use; some preferred to look at the posts of friends and famous people rather than contribute themselves. Others posted photos of themselves and their friends. Facebook tended to be more popular with girls than with boys. The chat function was used as a means of communication with friends. There was little interest in interacting with celebrities on Facebook.

Only three of the tweens interviewed had Twitter accounts, and these were used to 'follow' celebrities, mostly footballers and musicians. This was not a way tweens communicated with their friends, and they did not tweet more generally.

Skype

There was limited awareness of Skype, and only one of the tweens used it; this was to keep in touch with an older brother who was away at university.

Speaking on the phone

Speaking on the phone was not a major activity among the tweens who took part in the Family Studies, although girls did it more than boys.

Texting

Parents were generally keen on their child having a mobile phone so that they were in constant two-way contact. They felt this enabled them to know the whereabouts of their child at all times and saw it as a way of ensuring safety.

All the tweens had mobile phones and these were mainly used for texting. Several had BlackBerries but other makes were not recorded. For those who with BlackBerries, BlackBerry Messenger was the communication tool of choice because it was free.[38] For some Year 7s, texting helped them to maintain contact with friends from primary school whom they no longer saw regularly.

Email

Email was hardly mentioned. It was used a little, but texting was preferred.

Music

Listening to music was rarely recorded in the diary, which is surprising, but it may be that music was a background activity. However, the tweens who took part in the Family Studies said that they listened to music on iPods or mobile phones or over YouTube; radio was mentioned less. There was no mention of illegal downloading, but we can assume that they used iTunes and other legal downloading because of the devices used.

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[38] BlackBerry Messenger (BBM) is an Internet-based instant messenger application included on BlackBerry devices that allows free messaging between BlackBerry users.

As a group, those who took part in the Family Studies had eclectic tastes in music. Most, especially the girls, preferred mainstream pop music and a few of the boys liked rap. They reported liking rap because of the lyrics, and two of the boys thought that the rhyming was very clever.

There was a very strong north–south and class divide when it came to learning a musical instrument. None of the tweens in the north or in the lower social grades were learning to play an instrument, although one was considering doing so. In the south all three of the tweens from the higher social grades were learning instruments and played to quite high standards. The instruments played were the trumpet, violin, clarinet and ukulele. None of these tweens were part of pop or rock bands, but one was part of a quartet.

Family encouragement was an important factor in the decision to learn a musical instrument, and influence often came from the mother. Leaning a musical instrument involved taking private lessons, so the ability and willingness to pay was also a factor in the decision. Despite this, school was an important influence with tweens sometimes playing their instrument at school as well as out of school.

Reading

As a group the tweens who took part in the Family Studies read fiction and non-fiction books. Not all read non-fiction but those who did tended to read fiction as well, while those who read fiction did not necessarily read non-fiction.

Some reported that reading as a leisure activity had been squeezed out by homework, but it may also have been squeezed out by other activities. Several reported that they had no time for reading nowadays or that they were too tired to read in the evenings after school and homework, although they had read for pleasure much more when younger. Less taxing activities such as TV, or more fun activities such as gaming, filled spare time.

There may also be an issue regarding the availability of suitable books. The subject and genre of the book were important, but there was also some interest in a book because of the writer or the circumstances in which the book was written. One of the older girls also said that she felt that she was between children's books and adult books and that it was difficult to find books to read.

The Wellcome Trust Monitor reports that 45 per cent of those aged 14–16 read novels or fiction books with scientific storylines at least once a year. This figure is considerably higher among respondents whose parents have HE qualifications, with 62 per cent reading scientific fiction, compared to only 35 per cent of those whose parents' highest level of qualification was below A level.

Non-fiction seemed to be at least as popular as fiction for those who took part in the Family Studies. Boys in particular enjoyed reading books with lots of 'facts'. Books that were 'funny' were also popular, and this included some styles of factual books, such as the Horrible Science and Horrible Histories books. Tweens, boys especially, were explicit that they enjoyed 'learning while being entertained'.

Just under half (47 per cent) of the Wellcome Trust Monitor respondents aged 14–16 said that they consulted factual books for scientific information at least once a year. This could be in the context of leisure or to support school work; the questionnaire does not differentiate. Differences can be seen between the youngest and oldest respondents (55 per cent and 39 per cent, respectively), boys and girls (51 per cent and 43 per cent), and the level of parental education. Those whose parents had the lowest level of education were less likely that those with parents whose highest level of qualification was A level or a HE qualification to consult books (44 per cent versus 53 per cent versus 55 per cent, respectively).

Few tweens who took part in the Family Studies recognised the term 'electronic book'. Once explained, one reported occasionally using their parent's Kindle and another had books downloaded to an iPad to read when travelling. Ebooks seem to be adult technology, as several parents reported owning one, although this information was not collected systematically.

The tweens did not express much interest in comics: although one or two mentioned them in passing, none recorded reading comics in their diary. Only a few of the tweens read magazines. The magazines read were special interest magazines linked to their hobbies, for example, BMX and rock music.

Cooking

About half of the tweens who took part in the Family Studies had an interest in cooking, and baking was one of the most popular subgenres.[39] Another couple cooked but were not very enthusiastic. Most were taking only a few tentative steps with a limited repertoire and ambitions. Some reflected that cooking offers the opportunity to be experimental and creative and that it is rewarding to both see and eat the results. Some saw it as a skill that will be useful, if not essential, in the future. Parents supported the interest and in some cases actively encouraged even the less enthusiastic to do some cooking as preparation for adult life and/or as a contribution to family life. In some households it was seen as a shared interest that facilitated parent and child spending time together.

Arts and crafts

Questions about arts and crafts received polarised responses. This seems to be something that those who have natural talent enjoy and others dislike because they find it too difficult.

Puzzles and board games

Puzzles and board games seem to be for younger children. Only the two Year 7 tweens played these sorts of games, although one Year 11 boy from Manchester bought puzzles off the internet. Board games and similar were not recorded in the diary or much mentioned in the discussion. Monopoly was the exception, and this was seen as a whole-family activity and was usually played with adults.

Gardening

This was not a regular activity for any of the tweens who took part in the Family Studies. Only one young person showed a personal interest, and she had her own vegetable patch in the garden. Generally gardening was done to help parents or grandparents.

Pets

The majority of the tweens who took part in the Family Studies did not have a pet in the household. Those who did tended to leave pet care to their parents, with the exception of one girl who wanted to work in the police service with animals. Generally, tweens were more interested in playing with pets than exercising or otherwise caring for them. Dogs were the most popular pet, but there was also a hamster and goldfish.

News

The tweens who took part in the Family Studies were not very interested in news, but interest tends to grow with age.

Almost three-quarters (73 per cent) of Wellcome Trust Monitor respondents reported watching news on TV at least once a week and a quarter said that they watched it every day. This figure was lower for 14-year-olds (13 per cent) and higher for respondents whose parents had HE qualifications (38 per cent).

The Wellcome Trust Monitor found that just over half (52 per cent) of people aged 14–16 listened to radio news programmes at least once a month. Girls were much more likely to regularly listen to radio news programmes (at least once a week) than boys (52 per cent and 33 per cent, respectively). Weekly listening was also higher among those whose parents' highest level of qualification was A level (44 per cent) or HE (48 per cent) than among those whose parents' highest level of qualification was lower than this (35 per cent).

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[39] It should be noted that over the previous year or so there has been a considerable amount of TV time devoted to baking.

These tweens rarely read newspapers and when they did, they looked at those brought into the home by their parents. This was only mentioned as something that was done occasionally with attention focused on areas of interest and links to hobbies and interests (e.g. the sports and fashion pages). Typically they were not engaged by UK or world news, so interesting headlines were crucial in stimulating the initial interest of tweens.

The Wellcome Trust Monitor found that 28 per cent of tweens read a daily newspaper at least three times a week. This was higher among boys (34 per cent) than girls (22 per cent). Of those who read newspapers, the most commonly read were the *Sun* (34 per cent) followed by the *Daily Mail* (18 per cent).

A2.7 Activities outside of the home

Exercise and sport

The tweens who took part in the Family Studies and their families generally believed that physical exercise was a good and necessary part of daily life, and the majority were keen on exercise and sport. Some of the tweens exercised at home, but primarily exercising was an activity that took place outside of the home and was linked to improving fitness and thereby improving sporting performance.

Swimming was the most common individual sport, although trampolining was popular, while skateboarding was enjoyed by two of the Manchester boys. Other individual sports mentioned were gymnastics, horse-riding, bowling, athletics, BMX and jogging.

There was huge variation among the tweens interviewed with regards to their levels of interaction and involvement in sports clubs, and the type of sports played. The team sports most commonly played by the boys were football and rugby, while girls played netball and, to a lesser extent, football. Other team sports mentioned included lacrosse, cheerleading, hardball and dance.

Drivers to involvement in sports clubs were friends, friends of parents and previous experience of the sport from primary school. Interest in membership of sports clubs primarily stemmed from the young person; however, proximity to facilities and parental involvement and encouragement were important factors in taking up a sport. Tweens often relied on their parents for transport and financial support to pay for club membership and kit. Tweens from the higher social grades were more likely to be members of sports clubs than those from the lower social grades.

Those who belonged to sports teams valued membership very highly. They regarded it as 'fun', but they also clearly identified the benefits of keeping fit and active, as well as finding the social aspect of being with friends important. Those most involved with sports clubs engaged with the challenge, competition and attainment aspects, and those who had won awards and medals were proud to show them. However, science competitions were not viewed as 'competitive' in the same way.

Barriers to involvement in sports clubs were more significant for the lower social grades and were to some extent finance related. Other barriers were the time commitment and concerns over bullying.

Those at the younger end of the age spectrum were more willing to try different sports (and, indeed, hobbies more generally) and the range of sports played by each individual decreased with age, in some cases to focus on one sport but mainly to make time for school work, especially as GCSEs approached.

The tweens in the Family Studies all lived in urban areas and they had little or no experience of 'outdoor pursuits'; only four had taken part in any such activities and many were unaware of the term. The most common of these activities were camping, kayaking, sailing and skiing, and they tended to be pursued by the higher social grades. These were either family activities or an opportunity to spend time alone with one parent.

With respect to watching sport, this was most commonly done on TV rather than at live sporting events. The sports watched were closely linked to those played. Those who played

a less popular sport (lacrosse, for example) watched less sport on TV because their sport did not feature. However, those who did not play much sport still watched it on TV.

PASS found that adults aged 16 and over tended to go to sporting events with friends (43 per cent). In the 16–24 age group this rose to 90 per cent, and none went with family, although a few (9 per cent) went with their partner and friends or with just their partner.

Theme parks

Theme parks were very popular with the tweens who took part in the Family Studies, especially those from the lower social grades. The thrill of the high rides was commonly referenced, and for some a day at a theme park was their ideal 'day out with friends'.

PASS 2011 shows that around a quarter of respondents had visited a theme park in the 12 months before their interview and this rose to around a third in each of the following age groups: 16-24 (36 per cent), 25-34 (32 per cent) and 35-44 (38 per cent). Fewer of those in social grades D and E had been to a theme park, probably because of access issues related to cost and transport. Theme park visits tended to be a family activity, with 45 per cent of respondents to PASS saying they went in a family group. About a quarter (23 per cent) went with a group of friends and this rises to 75 per cent among respondents aged 16–24.

Shopping

Going shopping was seen as a leisure activity and was done with friends or, in the case of girls, sometimes with their mother. It was as much a social activity as an activity specifically to make purchases. The higher social grade tweens went to relatively up-market shopping centres and areas of town. While going shopping was a fairly regular activity, it was seen as a special occasion and money was spent carefully. Tweens did not have their own source of income; only one had a part-time job (delivering newspapers).

Going shopping was more popular among the girls than the boys who took part in the Family Studies. However, there was evidence that from around the age of 14, the boys started to develop more of an interest in fashion, wanting to select their clothes. Boys also developed an interest in buying items related to hobbies, such as cameras and bicycle accessories. Girls primarily bought clothes and accessories, such as jewellery and hair accessories.

Cinema

Going to the cinema was seen as a social event and many went with family, although it was also somewhere to go with friends. The tweens who took part in the Family Studies enjoyed going to the cinema, although one thought that it was pointless and a waste of money.

One of the tweens remarked that watching a film can be educational and used the example of *The Social Network* teaching viewers about Facebook. Other recently watched films included *Battleships*, *Jack and Jill* and *Journey 2*.

Libraries

Libraries were used by some of the tweens in the Family Studies, but the libraries referenced were mainly school libraries that are used as a place to do homework. Generally, going to the library was viewed negatively, especially among boys, who tended to find it 'boring'. Indeed, one tween thought that the library had become obsolete because he had access to a collection of books at home and to the internet. However, two of the tweens viewed going to the library as a social activity; one went with friends and another went with his father and sister.

PASS shows that half of the respondents (49 per cent) said they had been to a library in the 12 months before interview. This rose to 67 per cent of those in social grades A and B and fell to 34 of those in social grades D and E. This activity tends to be one parent taking their child or children (44 per cent).

Art galleries

There was variation in the levels of interest in attending art galleries among the tweens who took part in the Family Studies. Views were heavily dependent on individual preferences. Those who had an interest in art and drawing were more interested in visiting galleries than those who did not, but this did not always hold true and visiting art galleries was often regarded as 'boring'.

The Wellcome Trust Monitor shows that just over a quarter (27 per cent) of the respondents aged 14–16 had visited an art gallery in the last year. Girls were more likely to have done so than boys (32 per cent and 23 per cent, respectively), and older respondents were more likely to have visited than younger ones – 32 per cent of respondents aged 15 and 16 had been to a gallery compared with 19 per cent of respondents aged 14.

PASS found that just under a third of respondents (31 per cent) had been to an art gallery in the 12 months before interview and that this peaked at 40 per cent of those aged 55–64. This is an activity that appeals to older people, and they tend to go with their partner (43 per cent) or with friends (32 per cent), not with family. It is also an activity that appealed much more to the higher social grades: half of those in social grades A and B had been in the 12 months before interview compared with only 14 per cent of those in social grades D and E.

Museums

Almost all of the tweens who took part in the Family Studies had been to either the Science Museum in London or the Museum of Science and Industry in Manchester when they were at primary school. Some of those in Manchester had also been to the London Science Museum. However, these visits were perceived as tourist outings and family days out rather than as educational trips. Trips to museums, like family days out more broadly, had declined now that the tweens were older. Some of the tweens had only vague memories of these visits and had to be prompted by their parents. Parents tended to think that teenagers were too old for these museums and others like them and that they were targeted at families with younger children.

Like their parents, the tweens believed that these museums and their hands-on activities were aimed at younger (primary school aged) children. Despite this, the tweens were generally positive about science museums and hands-on activities were frequently mentioned as being interesting and enjoyable. There was a preference for museums with interactives because tweens recognised that this increased engagement, fun and the likelihood of remembering any new knowledge. This was particularly true for boys. Some tweens were interested in how science affects everyday life. Nevertheless, museums have to overcome a 'boring' image.

Other museums that had been visited included the Imperial War Museum, the National Maritime Museum, the V&A, the Museum of Childhood in London, Eureka in Halifax, the Horniman Museum and Gardens, Manchester Museum, Manchester Transport Museum, and the Body Worlds exhibition (which was in Manchester in 2008).

The Wellcome Trust Monitor found that science museums were the second most commonly visited attraction of those listed (after zoos), with 27 per cent having been in the last year – this figure is slightly lower for 16-year-olds (21 per cent). If respondents' parents had HE qualifications, tweens were considerably more likely to have visited a science museum (36 per cent) than those with parents whose highest level of education was A level or below (22 per cent and 24 per cent, respectively).

PASS found that 22 per cent of respondents had been to a science museum in the 12 months before interview. As with many other activities outside the home, visits were far more common among those from social grades A and B (33 per cent) than those from social grades D and E (9 per cent). While around a quarter (27 per cent) of these went to a science museum with their partner, similar proportions went as a family group (28 per cent) or as a lone parent with children (23 per cent). Those who went only with their partner tended to be older and from social grades A and B.

PASS found that slightly more respondents had been to a non-science museum (27 per cent) than to a science museum (22 per cent) in the 12 months before interview. The middle-aged (45–64) and those from social grades A and B (37 per cent) were more likely than other age and social grade groups to have visited; only 13 per cent of those from social grades D and E had visited in the 12 months before interview.

Science centres

The concept of a science centre caused confusion for most of the tweens who took part in the Family Studies. They were generally unfamiliar with the term, including the two who had visited the same science centre. A few of the tweens showed some interest in visiting a science centre once the concept was explained.

Expectations are a major barrier to visiting many venues, but once there tweens tend to enjoy themselves. For example, one tween had visited the NASA Space Centre in Florida while on holiday. The visit was a parental decision and she did not expect to enjoy it, but she was pleasantly surprised by the experience and was fascinated by the shuttle take-off.

Twelve per cent of Wellcome Trust Monitor respondents aged 14–16 said they had been to a science centre in the 12 months before interview. This activity was more common for respondents aged 14 (19 per cent) than for those aged 15 and 16 (10 per cent and 7 per cent, respectively) and respondents whose parents had HE qualifications (19 per cent). PASS found that 11 per cent of respondents had been to a science and discovery centre in the 12 months before interview. While a fifth (18 per cent) of PASS respondents had been to a science and discovery centre with just their partner, this was primarily a family activity with 42 per cent saying that they went in a family group and a further 26 per cent saying that they went alone with children.

Science festivals

The tweens who took part in the Family Studies had no understanding of a science festival and when probed they were largely unable to identify what it would involve. Once the concept was explained, they tended to think that this might appeal when they were older, but it would have to involve interactive elements.

The Wellcome Trust Monitor found that only 2 per cent of the age group had attended a science festival in the 12 months before interview. PASS found that 3 per cent of respondents had been to a science festival in the 12 months before interview, but this rose to 8 per cent of those in the A and B social grades.

Science talks and debates

Only one Year 9 boy who took part in the Family Studies had been to a science lecture outside of classroom activities.

The Wellcome Trust Monitor does not ask specifically about attending talks and debates, but PASS found that 12 per cent of respondents had been to a talk or lecture on a scientific topic in the 12 months before interview, rising to 21 per cent of respondents aged 16–24. These were mainly from the higher social grades, with 22 per cent of those in the A and B social grades and 13 per cent of C1s saying that they had attended such a talk but only 6 per cent of social grade D and 5 per cent of social grade E saying they had done so. Seven per cent had been to a debate or public meeting on a science subject in the 12 months before interview, but this rose to 13 per cent of those from social grades A and B.

Zoos and aquaria

There was a very significant difference in the experiences of visiting zoos and aquaria between the tweens who took part in the Family Studies in London and Manchester. Almost all of those living in Manchester had been to a zoo or an aquarium; Chester Zoo was a particular destination of choice, and the Blue Planet Aquarium in Wigan was also popular. In London, however, there was little interest in visiting this type of venue and only two had visited. London Zoo was visited by one as part of a primary school trip and the experience was described as 'boring'. There was a preference for venues where there could be

interaction with the animals and where direct physical contact was allowed. Aquaria were not thought to be somewhere to spend free time.

However, the Wellcome Trust Monitor found that zoos were the most commonly visited attraction of those listed: just under a third (29 per cent) of respondents aged 14–16 had visited one in the 12 months before the interview. This was less common among 16-year-olds: only 18 per cent had been in the 12 months before the interview.

PASS only asks about zoos (not aquaria) and found that a quarter of respondents had visited in the previous 12 months. However, while 27 per cent of those in the north-west had visited a zoo in the time period, only 18 per cent of those in London had done so, reflecting the difference found in the Family Studies. Compared with many other activities this was more evenly balanced by social grade, with 29 per cent of those in social grade A and B and 21 per cent of those in social grade D and E having visited. Again, this tended to be a family activity. Forty-five per cent had been in a family group, and a further 22 per cent had been as the only adult with children.

Parks/nature centres

None of the Family Studies tweens had ever been to a nature park or centre, but the Wellcome Trust Monitor shows that just under one in five (18 per cent) of respondents aged 14–16 had visited a nature reserve in the 12 months before interview. This figure was higher for 14-year-olds (25 per cent) and those whose parents' highest level of qualification was A-level (24 per cent) or higher education (30 per cent).

Urban parks, however, were quite popular with those who took part in the Family Studies as a place to meet friends and talk.

Young scientist competitions

None of the tweens who took part in the Family Studies had competed in science competitions, although there was an awareness of their existence. The fear of failure was a barrier to entering such competitions for some who thought that they would not win. However, one girl had no interest in scientific competitions, as in comparison with sport she did not view them as competitive. This raises questions about the motivations for taking part in competitions. Is it about testing oneself against an absolute rather than winning?

Theatre/musicals

Four of the tweens who took part in the Family Studies had been to the theatre or to see a musical, and musicals were preferred over plays. However, this was mainly a social activity, and the driver was usually a family outing or mother-and-daughter trip, not a specific desire on the part of the young person to see the show. The show was generally chosen by a parent. Some of the higher social grade parents viewed the theatre as something in which their children should be interested.

PASS found that 40 per cent of respondents had been to the theatre in the 12 months before interview. Again, this was skewed towards those in the A and B social grades (53 per cent had been in the previous 12 months compared with 22 per cent of D and Es) and those aged 45–74. PASS also found that this is an activity that adults do with their partner (45 per cent) or with friends (33 per cent), rather than with children (16 per cent).

Religious groups

On the whole this was not something that was a regular activity for the tweens who took part in the Family Studies. Only one was actively involved in religious activities, which played an important part in her life, although this was more cultural than religious. She was actively involved in the Jewish community and was training to lead a summer camp for younger children.

Sixteen per cent of Wellcome Trust Monitor respondents aged 14–16 said that they attend religious services or meetings at least once a month. This seems to decline as respondents age – 19 per cent of 14-year-olds, compared with 13 per cent of 16-year-olds, reported

attendance at this level. Parents' level of education also seems to have an effect on attendance – 20 per cent of those whose parents had HE qualifications attended at least once a month, compared with only 10 per cent of those whose parents' highest level of qualification was below A level.

After-school clubs

There was a north–south divide on this issue. While all six of the London tweens attended different schools, four of them attended an after-school club, which was often linked to their favourite subject (e.g. art, drama, Spanish and science). One of the Year 11 girls attended a weekly senior club that had guest lectures on topics such as jobs, law, politics and gap years. Science clubs were more generally linked with primary school. None of the young people who took part in the Family Studies in Manchester attended non-sport after-school clubs, although they attended five different schools (two attended the same school). This might be because after-school clubs were less available than in London, because parents have shorter journeys to work and do not need the facility to provide childcare or because the clubs were less popular with students.

Sixteen per cent of Wellcome Trust Monitor respondents in the 14-16 age group had attended a science club in the last year. Those whose parents had HE-level qualifications were more likely to have done so (23 per cent) than those whose parents' highest level of qualification was A level (13 per cent) or below A level (14 per cent).

PASS 2011 found that a fifth of respondents said that their school had a science and engineering club. This rose to 38 per cent in the group aged 16–24 and a quarter of those in social grades A, B and C1. When asked whether they attended, 43 per cent said they had done so, with half of those in social grades A and B saying that they attended and 37 per cent of those in social grades D and E saying so. There was not a noticeable regional skew.

Youth clubs and organisations

For a few of the tweens who took part in the Family Studies, attending a youth club was something they had done in the past, although it seems that tweens grow out of these clubs. There comes a point at which they feel they no longer gain any benefit from attending, and they begin to find them boring and consuming time they would rather spend on other activities.

Visiting family

Visiting grandparents and spending time with cousins was quite common for those who took part in the Family Studies. For some of the only children, cousins were surrogate siblings, but continued contact as they grew older depended on common interests. For some families grandparents had a childcare function, especially in the holidays.

Relationships with siblings

There was variation in levels of interaction and time spent playing with siblings depending on the age of the siblings and the age gap. Some spent time with siblings, especially older siblings who had a certain cachet.

A2.8 Conclusions

The activities undertaken by the tweens in the study can be categorised into active and passive. Active activities tended to revolve around sport, music (playing an instrument), shopping and being with friends. Passive activities tended to revolve around TV, DVDs and the cinema. The group as a whole engaged in a wide range of activities, but individually tweens seem to have a limited range of activities. Boys tended to spend more time playing computer games and other solitary in-home activities, whereas girls tended to take part in a wider variety of out-of-home activities, often with friends.

Whole family days out were rare, and there were two main reasons for this. Partly this was because of the cost, especially for the lower social grades. However, parents and their

children tended to think that teenagers were too old for family days out. This was most common in families where our selected young person was an only or younger child, but even where the selected child was the oldest, family days out tended to have been phased out. In some families the parent's working hours precluded many family days out (or even time at home together), although this can have the effect of maintaining whole family trips. While money does not seem to have been a particular limiter, financial constraints did impact on the nature and frequency of family days out.

Parents made some references to their own childhood experiences, but they did not seem to be trying to relive their lives through their children.

3 Drivers and barriers to engagement

This section draws out key messages around the drivers and barriers to tweens' engagement in out-of-school activities and the influence of family, friends and school on their interests and choices.

A2.9 Drivers and introducers

Interest in an activity is a key driver of engagement. However, it is difficult to understand what triggers interest in some individuals but not in others. Work by Hidi and Renninger (2006) proposed four phases in the development of interest:

■ triggered situational interest

■ maintained situational interest

■ emerging individual interest

■ well-developed individual interest.[40]

Without going in to too much detail about this theory, it does help us to understand how tweens become engaged with specific activities. In general terms, and as relevant to this study, triggered situational interest is sparked by something that is surprising or relevant to the individual and is generally supported by the environment, in this case family and friends. The maintained situational interest stage follows this and involves focused attention on, or persistence in, the activity by the young person and is generally also supported by the external environment; again, family and friends in this case. Emerging individual interest follows, where positive feelings about the activity and the use of stored knowledge and personal values mean that the individual begins to seek out engagement with the activity. Well-developed individual interest continues the feelings stimulated at the previous stage.

We can see this process at work in the way that the tweens develop interest and participation in out-of-school activities where their environment, expressed through personal contacts, was important in introducing tweens to activities and especially in sustaining interest and commitment. Family friends and the context for the activities have helped to build positive feelings, knowledge and values that support 'emerging individual interest'.

The activities of adult friends of the family, teachers from primary school and friends from primary school (and their parents) were the key drivers for tweens to take up activities, especially sports and dancing. The influence of parents seems to be less, apart from their role as gatekeepers to other adults and in their choice of primary school, in particular, given its role in providing access to the early influences that seem to set interests and behaviour in later life. The influence of younger siblings is negligible, but the influence of older siblings is oddly perverse: younger siblings tend to look for activities that have not been taken up by older siblings. Younger siblings tried to find activities that were unique to them and perhaps enabled them to spend time alone with one parent. This results in them tending to reject the interests of older siblings.

In some cases parents participated in an activity with their child (e.g. swimming, shopping or going to the cinema). Often only one parent participated at this level; for example, fathers tended to go swimming with their child, while mothers and daughters went shopping or to the theatre together. This type of activity tended to be phased out over the years, and the oldest tweens were more focused on spending time with friends.

Tweens were asked with whom, if anyone, they would like to converse, and this could be 'anyone dead or alive'. Three categories of choice arose, and again we can see the importance of people within their own sphere:

■ deceased friends and family members

■ world leaders, most popularly Barak Obama, Ghandi and Nelson Mandela

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[40] Hidi S and Renninger KA. The four-phase model of interest development. Educational Psychologist 2006;41(2):111–27.

- sportspeople (boys especially selected sportsmen).

The first category was identified because the tween felt that they had missed something, usually an opportunity to know a person. This supports past work on role models that found that the most effective role models were those that were known personally because these were seen as attainable.[41] The second two categories related to tweens' ambitions. The driver for the conversation was to understand how the selected individual had achieved their position. For example, boys were interested in the training programmes of sportsmen.

Fun was an important driver. Activities must above all be 'fun'. However, tweens found it very difficult to define 'fun'. They did not necessarily mean funny, although in some cases entertainment was funny; they meant enjoyable, which could be challenging, but often meant 'easy'. Hence TV, music, films, and so on were the time-filling activities of choice.

Related to this is the drive to visit museums. Trips to science museums, as with all museums, were seen as family days out that happened to be educational. Science museums were more popular than some other categories of museum because of their interactive nature, which appeals to children and tweens.

Some tweens like to take part in competitions, so an element of competition was a driver to take part in some activities. However, some were afraid of failure and therefore preferred to compete as part of a team, rather than individually. The definition of 'competition' needs further exploration with tweens because a science competition is not necessarily seen in the same light as a sporting competition.

Tweens tended to like to undertake activities with their friends, and another key driver for participation was the opportunity to meet with friends. This was especially true for those towards the older end of the age range.

Tweens also tended to enjoy being physically active, and this was another driver. Sport was enjoyed by most respondents and this is also reflected in the list of favourite lessons, in which PE, doing experiments in science and art all featured because they do not involve sitting still, writing and listening.

While learning was not a conscious driver of the activities tweens chose to undertake outside of school, some boys like to collect 'facts' and this was a motivator to watch TV programmes such as *QI* and to read non-fiction books. If these facts can be wrapped up in 'fun', as some felt was done in *QI* and some non-fiction books, such as Horrible Histories, this was very attractive. Some wanted to show off their new-found 'facts' to their friends, while others were the subject of bullying for knowing more than others in their class.

This enjoyment of learning was also reflected in the enjoyment some of the higher social grade class tweens gained from attending talks from experts. However, these talks were enjoyed because the issues they covered were interesting and allowed discussion. They were not regarded as explicitly educational.

This interest in debate has led some tweens to enjoy religious education in school, despite a lack of commitment to any religion. This is because religious education as taught in many schools was not the study of the content of religions; rather, it was an opportunity to learn, think about and discuss moral issues that were part of the lives of tweens or that they see on the news or hear adults discussing. This interest in debate chimes with the How Science Works curriculum, which seeks to help pupils develop critical and creative thinking skills to become effective problem-solvers, as well as communicating the results of their work effectively to different audiences. It also resonates with the findings of the CILIP Working Group that children and young people want to contribute ideas.[42]

Parents can drive their children's interests to a certain extent, but they were not always successful in engaging their tween in an activity. Apart from household chores, the tweens did not report being asked or forced to do things they did not want or like to do. Attempts to

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[41] Royal Society. 2004. Taking a Leading Role.

[42] Chartered Institute of Library and Information Professionals (CILIP) Working Group on library provision for children and young people. 2002. Start with the Child. ISBN: 0 9543792 2 5

interest tweens in new activities tended to be focused on social rather than educational issues. For example, one mother tried unsuccessfully to get her son to join a youth club that her friend's child attended because she was concerned that the activities he enjoyed were solitary.

A2.10   Barriers to activities

The main barrier to taking up an activity was personal interest and a tendency to assume that something would be boring.

Parents could be a barrier to tweens' activities because they provided money and transport to enable tweens to take part.

Family finances were not an explicit constraint on activities for any of the tweens in this study.[43] Nevertheless, new interests were scrutinised by parents before financial commitments were made. For example, one parent insisted the child went on a one-day event to try a new activity before they bought kit. (The child did not like the activity and this saved in the region of £100.) Based on what they know about their child and his or her existing preferences, parents made judgements about the likelihood of their child enjoying and therefore continuing with any proposed new activity. This assessment was generally based on the child's current interests and abilities, as activities that were enjoyed were far more likely to be maintained. This is one reason why parents tended not to push their children to take up activities or visit specific places. Nevertheless, those from the lower social grades were generally involved in fewer activities and these parents were more cautious about paying for their children to try new activities. This was especially true in Manchester.

Parents were concerned about their children's safety, and several (especially those from the lower social grades) explicitly preferred their children to stay at home rather than go out because they were worried they might come to harm. Indeed, a couple had been attacked in their neighbourhood. The most common reference parents made to when they were young related to personal safety.

Tweens living in London had more freedom than those in Manchester, and those from the higher social grades had more freedom than those in the lower social grades. This was partly because the better public transport infrastructure in London enabled tweens to travel around on their own more easily. Parents in the higher social grades in London explicitly recognised the benefits of living in London in terms of the activities available, to a greater extent than those from the lower social grades in London.

All parents tried to put limits on the time spent on computer games and online generally. Boys were the main players of computer games and therefore suffered the most restrictions in this regard. Often there was a weekday ban or time limit to ensure that homework was completed.

The low level of online use may be surprising. However, it is vital not to confuse this group of tweens with the 16–24 age group. Tweens are dependent on their parents and cannot yet drive or even ride a low-power motorbike. They live at home, do not have their own income (apart from pocket money) and do not tend to have friends who live very far away (especially as our sample was urban based). They are dependent on parents for access to WiFi, computers, tablets, TV, mobile phones, iPods, ebooks and other relatively expensive pieces of electronic equipment and the services that come with them. Even relatively wealthy parents restricted access either by limiting time or because equipment was shared. Moreover, while they text friends, tweens tended to see most of their friends most days at school or weekly at clubs or other events; hence, they had little need of social media such as Facebook as a communication tool.

Moreover, we found that tweens were not as technically expert as might be expected. As part of this project, tweens were asked to interview two friends and to submit the information. This information could be provided in writing on paper through the post, by email or in the

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[43] It should be remembered that we did not include very poor families, and with the exception of one lone parent family in London where the mother was a registered carer for her mother, all the households had at least one person in work.

form of a video or audio recording via Dropbox. Only two of the tweens chose not to use paper and post. These were both from the higher social grades and living in London.

Homework was not a major barrier to informal learning activities, although it may be a barrier to the types of activities tweens want to do for the remainder of their time and reduce their desire to spend free time explicitly 'learning'. While tweens said that homework squeezed out other activities (particularly reading) as they grew older, they did not feel that homework was too onerous – even those in Year 11, although those in Year 7 expected the volume of homework to increase. Some tweens were allowed to do their homework at school during the lunch break or after school in the library.[44]

Aspirations might be thought to be a driver of engagement; however, we found evidence of a lack of aspirations or limited aspirations, which may be constraining engagement with science and other out-of-school activities. Questions asking about activities for a 'perfect day' at home or a day out were designed to explore interests but also revealed aspirations and horizons. For the most part tweens listed activities that were already part of the individual's repertoire. Many wanted to visit Alton Towers or Thorpe Park, including those who had been before and those who had not. None suggested venturing outside their known environment, although perhaps a day was too short a time period and a longer holiday would have been a better gauge of aspirations.

Career aspirations were not always explored, but where the topic arose we found that most had not yet thought seriously about what they would do on leaving full-time education. Parents felt that this was not unusual, given their age, and believed that their child was too young to have a realistic idea of what they wanted to do after finishing their education. A few tweens had a sense of vocation, mainly for medical and animal-related occupations.

In some cases, aspirations seem to be limited by parents, both consciously and subconsciously. For example, one Year 9 girl from a lower social grade aspired to a medical career, but the mother tempered her desire to be a doctor with comments such as 'or perhaps a nurse' several times during the discussion. This may have been more realistic, and the interview was not designed to judge ability to achieve aspirations. In another case a Year 11 boy, also from a lower social grade, regarded his parents' life as desirable and saw no reason to aspire higher.

A recent Joseph Rowntree Foundation Round-up paper concluded that tweens and their parents from poorer backgrounds do not generally have lower aspirations than their peers in the higher social grades; the barrier to social mobility is in the ability of these parents to support their children with knowledge about careers and further and higher education.[45] Our finding that families from lower social grades have narrower cultural experiences would tend to support this conclusion. Their limited horizons led us to question the support schools provide and whether the degree to which schools focus on exam results and league tables is serving students well. We found little evidence of schools supporting longer-term destinations or outcomes.

Parents tended to want their children to be happy, and for some this was more important than academic achievement, even among the higher social grades. However, we spoke almost exclusively to mothers; fathers may have other ambitions for their children.

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[44] English education policy allows tweens who may not have the facilities at home to do homework at school. Some schools offer this to all tweens.

[45] Charlotte Carter-Wall and Graheme Whitfield. 2012. The Role of Aspirations, Attitudes and Behaviour in Closing the Educational Attainment Gap. Joseph Rowntree Foundation Round-up.

4.   Conclusions and recommendations

This study was designed to be exploratory and the sample is very small, although we have used the findings from the Wellcome Trust Monitor and PASS to verify our findings where possible. Moreover, our findings are fairly consistent across the sample and we therefore feel they are reliable for mainstream tweens, although the recruitment method is likely to have skewed the sample against those with more alternative or fringe lifestyles.

We did not find a culture of self-education with tweens using their spare time to support their school work or learn about other topics. Neither did we find that parents supported an educational focus to their children's free time. Indeed, parents (or at least mothers) were concerned that tweens had some 'downtime' as they believed that they were under pressure at school and needed time to relax and explore their own interests. Any learning was serendipitous – for example, if a TV programme was educational in some way or if they improved in a sport. This did not differ by gender, age or social grade. However, the findings from PASS in particular highlight the social grade differences in participation in a whole range of events, and the Family Studies findings suggest that the barrier is not entirely financial.

Tweens set out to have fun and socialise with friends in their free time and not to do anything that they did not want to do, especially if they believed it to be either taxing or boring. While sporting activities were popular and some attended lectures, relatively passive, less taxing activities – primarily TV, gaming and, probably, music (although this was not explicitly recorded on a large scale) – consumed a lot of their leisure time. Any learning is incidental and unintended. Not only do they not see learning as something they want to do in their free time, they do not recognise when they are learning.

Our most important recommendation for those who wish to attract the 11–16 age group to activities is to focus the activity and the marketing on tweens themselves rather than on their parents. This is not a family audience; the family audience has children aged under 11. By the time tweens entered secondary school aged 11, they had already established personal leisure time preferences. Parents respect this and do not generally try to engage their children in activities they believe will not interest them. Indeed, parents were generally supportive of their choices, perhaps because they had screened out those of which they disapproved earlier in the child's life. Where parents were a barrier to an activity this tended to be passive rather than active, in that they did not actively ban an activity but rather discouraged it by refusing to pay. Moreover, by the age of 12 or 13 tweens are able to travel on their own using public transport, and as they grow older they increasingly spend their leisure time with their friends and not family members.

To reach this secondary school age group, moving entirely online is not an appropriate strategy. While 90 per cent of households that include a person aged 12–15 have internet access, our study found that internet access was limited by access to equipment. Laptops might be shared with other household members, parental attitudes limit computer use and tweens cannot access the internet during school time. Moreover, action needs to be taken to drive traffic to websites. Websites are primarily accessed through searching for information for school work. This group is, for the most part, too young to be looking for information on university courses or careers.

Tweens use YouTube, but from their interests we can assume that when browsing they would focus on comedy, films and entertainment, only accessing science and technology for more specific purposes.

From this we recommend that the focus must be on content that will engage the age group. It must be entertaining or 'fun', which incorporates being funny but also encompasses activities that tweens can do with their friends and that are challenging, discursive, physically active, easy, relaxing and interactive without being perceived as for younger children. If this list sounds contradictory, this is because activities need to engage a range of tweens with different interests and energy levels, and because individual tweens will engage with different activities in different modes depending on their mood and whether it is a school day, a weekend or a holiday period.

A2.11 Recommendations

Recommendation 1

Activities must be targeted at tweens themselves, not at their parents or families. The objective must be to engage the tweens so that they engage their parents and friends. This means that active activities should:

- be physically active

- be team-based and thereby competitive

- be relevant to the life experiences of tweens

- enable the expression of individual views and opinions

- be fun focused.

The tweens liked to be competitive but some lacked the confidence to compete alone and preferred to be part of a team. However, the option for tweens to take part without a ready-made team should be offered.

With respect to competitions, lessons should be learned from TV programmes such as *Masterchef* and *Time Team* and from the world of sport, where knowledge, expertise and skills are not enough to stimulate excitement; time limits are imposed to provoke a sense of thrill.

Recommendation 2

Passive activities should be:

- film, video or TV-based

- computer game-based

- relevant to the life experiences of tweens

- story-based.

Boys are attracted by comic and war themes.

Recommendation 3

The interest in theme parks and thrilling rides could be harnessed to develop rides that have a biological or other scientific context or content, or designing rides could be a kit for schools or science and engineering clubs.

Recommendation 4

Debates about issues that affect tweens and young people will appeal to tweens, especially if they are led by known personalities.

Recommendation 5

Thought should be given to linking with existing personalities who already have a profile with the age group, perhaps through YouTube, TV, music or sport.

Recommendation 6

Tweens will access activities directly and through their peer group, parents, other relatives and school. Marketing of activities to tweens should, therefore:

- clearly convey that the activity will:

  - be physically active

  - be team-based and competitive

  - enable the expression of individual views

  - be relevant to them and their life experiences and situation.

- ensure that tweens understand that they can join a group on arrival or come with one or more friends as a team or part of a team

- be colourful and relevant, including tweens themselves and people with whom they identify

- use YouTube and other online sources but not focus on Facebook and similar social networking sites, including Twitter

- include online sources, which must be suitable for viewing on smartphones

- reassure parents that the venue, and travel to and from it, is safe.

Recommendation 7

The development and marketing activity should draw on the experience and research of the commercial sector in engaging tweens. Some of this is publicly available, while some might be accessed through partnerships with commercial organisations.

Recommendation 8

Best practice would be to be clear and precise about the primary target audience and to research individual activities and marketing material with this audience before launch. This might be conceptualised as research and development, formative evaluation or engaging the target audience in the development of the project (or at least representatives of the audience).

Some of the conclusions from Start with the Child, which focuses on the future of library services of children and young people, are also relevant to engaging tweens in informal science learning. These are the need for:

- a safe and welcoming environment

- impressive and interactive displays, activities and exhibitions

- venues that are more like shops, which tweens want to visit and 'hang out' at

- recognition of their culture and activities that are relevant to their interests and self-image

- opportunities to participate and be involved in the planning and delivery of services, to provide feedback and have their ideas listened to and acted upon

- staff who have the time and skills to assist and support tweens in making best use of the service

- resources targeted to meet particular needs and changes in the nature of mainstream services where necessary to foster and achieve inclusiveness

- services that are marketed to tweens and their parents

- work to promote the benefits of activities with a range of partners, especially to reach hard-to-reach groups and individuals.

A2.12 Further research

Several issues should be followed up in further research. The three most important are:

- expanding the current study using qualitative research with tweens aged 12–16

- similar exploratory ethnographic work with children aged 5–11 (primary school age)

- expanding the young people's element of the Wellcome Trust Monitor.

Expanding the current study

This research could be expanded to include a wider range of young people. For example, the Channel 4/Crowd DNA typology of young people identifies five 'tribes' – Aspirant Mainstream, Mainstream, Urban, Alternative and Leading Edge – and several sub-tribes, and

this information could be used to ensure recruitment from a wider range of young people. It is freely available providing credit is given.

We suggest that future research of this nature should also include discussions with fathers as they may have different views to mothers.

Similar research with primary school children

This study has found that by age 11 or 12, tweens have already established leisure time pursuits. We therefore suggest that a similar study to this be conducted with children aged 5–11, so drivers and barriers to engagement can be explored as they are developing.

Expand the Wellcome Trust Monitor

We also recommend that the Wellcome Trust Monitor be extended to:

- include the 12–13 age group
- increase the sample size for the 12–18 age group
- cover some of the issues raised here, such as how tweens access video and music content
- pair parent–child interviews so that it is possible to look at how parent views and behaviour relate to their tweens' behaviour and views.

Topics that should be included in the questionnaire to help understand the lifestyles and attitudes of tweens include:

- ownership of devices
- access to devices
- use of social media
- pocket money
- membership of clubs
- sports played
- instruments played and/or band membership
- preferred music genre
- sources of information on careers and subjects to study.

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Wellcome Trust
Gibbs Building
215 Euston Road
London NW1 2BE, UK
T +44 (0)20 7611 8888
F +44 (0)20 7611 8545
E contact@wellcome.ac.uk
www.wellcome.ac.uk