Evaluation of the Wonder Initiative

Phase One report

2018-22

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CLOUD CHAMBER
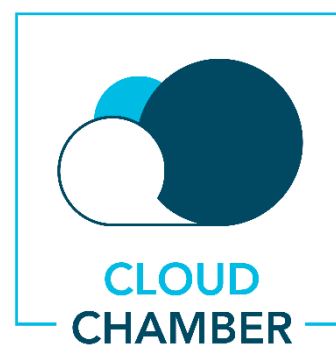
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1 Executive Summary

1.1 Introduction (Section 2)

The Wonder initiative was established by the Science and Technology Facilities Council (STFC) – part of UK Research and Innovation – in Autumn 2018. Wonder represents a concerted effort by STFC to increase the focus of science public engagement (PE) with communities who traditionally have had fewer opportunities to engage in science; and who feel science is 'not for them.' Specifically, the target for Wonder is defined as audiences from the 40% most socioeconomically deprived areas of the UK, particularly those aged 8-14 years old and their families and carers.

Wonder is described as an 'initiative' to differentiate it from a specific programme. STFC uses encouragement and promotion via its own activity and PE grant funding calls to direct PE effort towards Wonder audiences, but has not specifically ring fenced funding.

Cloud Chamber conducted an independent evaluation of Wonder between December 2018 and April 2022. The evaluation has ended, but the Wonder initiative is ongoing. The headings in this executive summary, which represent the report's main sections, each address one of the evaluation's key objectives.

1.2 Reaching Wonder audiences (Section 3)

The period of the evaluation was dominated by the Covid-19 pandemic, which significantly impacted reach. However, the reach with the 40% most socioeconomically deprived communities has remained high-- exceeding 40% of total STFC funded or delivered PE from the first year of the initiative. At this level, Wonder audience participation equates to the proportion of people living in Wonder communities across the UK and therefore represents a degree of equality of access with non-Wonder counterparts.

Absolute reach with Wonder audiences varied from year to year. 2019 – the first year of the initiative – saw an increase in Wonder reach volumes but in 2020 and 2021, it was lower than pre-Wonder (2018) levels. We expect 2021 figures to grow retrospectively as reporting continues. This has not adversely impacted on the Wonder proportion because the reach among non-Wonder audiences has also fallen. From the outset of the initiative STFC has been aware that a greater focus on Wonder audiences might result in reducing overall reach figures, and they have accepted this trade-off. Our interviews with people delivering PE projects have suggested that this has been the case in practice.

Reach among 8–14-year-olds across all STFC funded or delivered PE has followed an inconsistent pattern – annually representing between 5% and 13% of total reach – without any obvious trends.

1.3   Engaging and enthusing Wonder audiences (Section 4)

Preparation appears to be the key to successful Wonder engagement and avoiding making assumptions about the assets available to Wonder audiences: physical and intangible assets like transport, time, materials, and science capital . Wonder audiences are diverse, as are their needs and interests, so flexibility is required in   thinking through what that means for effective delivery.

In terms of content and approach, PE practitioners generally did not see their delivery as being markedly different to their usual ways of working. However, many PE practitioners we spoke with during the evaluation tended to have prior experience of working with Wonder audiences and were already committed to reaching under-served audiences.

Schools were a significant partner for many PE projects but many practitioners found engaging them – securing and retaining their interest and involvement – resource intensive. Furthermore, schools tended to be less flexible in terms of how activities could be tailored to specific audiences (because of curriculum requirements, fewer opportunities for co-design with pupils and other pressures).

Virtual or blended PE delivery as an approach increased significantly as a result of the pandemic and is likely to remain part of the PE landscape. Virtual delivery has financial and scale benefits but can make it harder to identify Wonder audiences who cannot be assumed to have the necessary resources (IT equipment, internet access) to engage to the same extent as their non-Wonder counterparts. Practitioners need to have the skills to make the most of digital opportunities to ensure they are engaging; it is still a relatively new operating space for many of them.

1.4   Making a difference to Wonder audiences (Section 5)

The evaluation evidence shows that audiences from more socioeconomically deprived backgrounds were much less likely to have been to an STFC event before and were also less likely to know someone in their family who was into, or who worked in, science. This suggests low levels of science capital among Wonder audiences which is consistent with previous research and the underpinning rationale for the initiative.

Once at a PE event, the evidence indicates that Wonder audiences felt broadly as welcome, inspired and involved as their non-Wonder counterparts. This suggests that the events themselves are tailored well to a range of audience backgrounds. Future intentions – to explore science further, to consider STEM careers and study, and to talk to others about their experience – were also similar across the two audience types, with Wonder audiences being slightly keener to share their experiences and consider future STEM studies and careers. Again, this points to events that are appropriate to their audiences, irrespective of background. It's an encouraging finding.

The only major difference in the outcome results was about the future impact of science, which Wonder audiences scored much lower than their non-Wonder counterparts. It is not clear why this should have been so different and deserves further investigation.

1.5 Building the capacity of public engagement (Section 6)

The Wonder initiative is successfully building capacity to support future Wonder public engagement. It has a good and understandable conceptual framework. It has strong backing from STFC's PE teams who have taken a lead and integrated Wonder thinking into their own PE delivery. Wonder is beginning to shape PE grant decisions and it has the potential to be something of an exemplar for other funders.

Knowledge about engaging with Wonder audiences is being shared, especially between grant projects. Overall, informal networking and conversations seem to be the preferred learning approach, especially for those PE practitioners who are new and/or do not work in larger institutions. This informal networking has generated new collaborations between practitioners.

While we have not evaluated project finance, feedback suggests that projects were appropriately resourced and project leads have more generally been very positive about the support they received from STFC. Their flexibility during the Covid-19 pandemic was especially welcome.

Monitoring data remains a challenge given the diversity of projects, settings, methods, deliverers, and audiences (exacerbated for this evaluation by Covid-19). The one new important characteristic for work with Wonder audiences is socioeconomic disadvantage as the proxy measure for underrepresentation. IMD is still probably the right measure, despite the difficulties of securing it from individual participants.

More generally, there may be potential for a more graduated approach to monitoring demands. Small, 'one-touch' projects will necessarily have less resource and opportunity to gather information, particularly on participant outcomes. Some PE practitioners may welcome the challenge of seeking evidence of longer-term impact, but it may require additional support.

The evaluation toolkit designed in the course of the evaluation provides guidance on how projects should measure deprivation and reduces the number of audience outcomes that need to be collected. Take-up during the evaluation was very limited because the creation of the toolkit had come too late in projects' development and delivery to alter monitoring processes. However, those who used the toolkit regarded it as a practical and understandable approach to data collection. It may be a good start in simplifying data collection for the Wonder in future, but it needs to be used by more projects – from the start of their delivery – to be certain about its practicality.

1.6 Modelling an audience-focused approach (Section 7)

Wonder projects have been able to demonstrate an ability to reflect the needs, interests and life experiences of their audiences. This has been driven primarily through open, constructive, well-balanced relationships with community partners. These take time to find and to develop – PE practitioners have to do the hard work in finding the right partners – and require flexibility, a willingness to listen to the needs of communities, and the ability to share power and control over events.

It emerged during the evaluation that there may be a skill set that is more successful in engaging Wonder audiences. Anecdotally, the difference seems to be in the approach, the mindset, and the motivation of practitioners more than the content of delivery. Wonder to date has tended to work with PE practitioners who were already engaging with or planning to engage with Wonder audiences before the initiative began. The longer term challenge for STFC is whether this focus on Wonder can be expanded beyond these 'early adopters', and STFC might consider whether providing training to enhance skills and competencies needed to work with Wonder audiences might increase the pool of Wonder practitioners. Emerging evidence from STFC's PE grants programmes would suggest that Wonder is being considered more frequently among a wider group of practitioners, but a lack of confidence and skill set might be a barrier for others working with Wonder audiences.

1.7 Recommendations

1.7.1 STFC

- Promote an assets and needs-based model for Wonder engagement, seeing PE as being responsive to communities' wishes and interests.

- Retain – but keep under review – the strategic principle that a reduction in overall reach volumes is an acceptable consequence of placing a stronger focus on engaging underrepresented (Wonder) audiences.

- Retain the current deprivation definition of Wonder (40% most deprived by IMD).

- Retain Wonder as an initiative rather than, for example, a ring-fenced grant programme.

- Explore the value of looking in more depth at Wonder communities for pockets of greatest need.

- Provide a platform to allow PE practitioners interested in Wonder to continue to share stories, collaborate and support one another; and broaden any platform to include STFC's own PE practitioners and encourage their participation.

- Support the development of PE practitioners' skills and knowledge in the areas of collaborative working; and virtual and blended delivery.

- Provide clarity in grant application and monitoring processes to ensure that grant holders understand clearly their obligations.

- Ensure that grant funding and support reflects the likely increased time and resources required to engage with Wonder communities.

- Reflect on the success of Wonder Match and consider whether there is scope and value in STFC being more proactive in facilitating links between PE practitioners and community organisations.

- Retain IMD as the key Wonder identifying characteristic, but consider wider promotion of a location-based IMD metric – beyond schools – where projects are working in and with communities.

- Consider graduating the monitoring requirements placed on grant holders to ensure they are proportionate to capacity and resource.

- Consider ways of sharing monitoring outputs back with projects to demonstrate how their information is used and the value of good data collection.

1.7.2 Public engagement practitioners

- Where possible, place under-represented audiences at the centre of public engagement.

- Adopt an assets and needs-based approach to working with Wonder communities: avoid focusing on deficits and disadvantages, understand the resources that they bring to the table and what they want to get out of an activity.

- Seek where possible to design and deliver projects with multiple touchpoints with Wonder audiences to generate more lasting impact and provide opportunities to understand how interventions affect audience outcomes over time.

- Approach monitoring and evaluation from the perspective of it as a potential benefit to learning and understanding rather than as a funder obligation.

- Develop and use informal networks to share knowledge and learning about engaging with Wonder audiences. There is a lot of experience already out there.

- Continue to develop an understanding of the collaborative methods and processes that help to work in partnership with community organisations and audiences, especially those that are underrepresented.

- Develop or maintain strong online communication skills to ensure that virtual or blended delivery has the potential to be as engaging and impactful as face-to-face interaction.

2   Introduction

2.1   About Wonder

2.1.1   Creation and aims

Wonder was established by the Science and Technology Facilities Council (STFC), one of the bodies of UK Research and Innovation, in Autumn 2018. Already committed to funding and delivering public engagement (PE) activity with a focus on STFC-specific science[1] and facilities, Wonder represents a concerted effort by the organisation to reach and engage those communities who traditionally have had fewer opportunities to engage in science; and who feel science is 'not for them.'

Specifically, the Wonder initiative has the following aims:

- To significantly increase the proportion and absolute number of STFC's reach that is with audiences from socioeconomically deprived areas of the UK with engagements delivering relevant outcomes, including:

  - Feeling inspired by science and technology

  - Feeling welcome in a science and engineering environment

  - Valuing science and technology for its social, cultural and economic contribution to society

  - Considering choosing or continuing to study or work in STEM

- To establish a range of new initiatives co-created by PE delivery organisations and community organisations which, using current good practice to work with audiences from socioeconomically deprived areas of the UK, produce recommended approaches for how STFC and others can do this effectively into the future.

- To share and adopt good practice about working with the Wonder target audience, so that these approaches continue beyond the life of the initiative.

The Wonder target audience is defined as:

"Audiences, particularly those 8-14 years old and their families and carers, from the 40% most socioeconomically-deprived areas of the UK."

The 40% most socioeconomically deprived areas of the UK are those areas listed in the lowest four deciles of the Indices of Multiple Deprivation (IMD) for the respective parts of the UK.

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[1] For simplicity, we tend to refer to science throughout this report but we are often talking about STEM: science, technology, engineering and mathematics.

Wonder is described as an 'initiative' to differentiate it from a programme. It is not, for example, a specific grant call; its boundaries are deliberately less well-defined. Rather, it is an expression of STFC's ambition to widen PE reach, participation and impact through encouragement and promototion via its own PE activity and via grants.

2.1.2   The evidence case for Wonder

STFC's strategic commitment to Wonder is supported by good research evidence in two highly relevant thematic areas:

- The existence of groups and communities who are underrepresented in science study and careers. For example, a report by the Royal Society showed that people with better educated parents and people from middle-income families were most likely to enter the science workforce.[2]

- The key factors likely to influence young people from underrepresented backgrounds when considering science. For example, the ASPIRES research programme led by the Institute of Education at University College London[3] formulated the concept of science capital which seeks to characterise the science-related knowledge, skills, experiences and resources that a person develops over time which frame their relationship with science. The ASPIRES research found that young people (10-19) were significantly more likely to express science aspirations if they were from socio-economically advantaged families compared to their disadvantaged peers.[4]

This is the foundation of Wonder: a focus on under-represented communities using concepts such as science capital to explain, and hopefully overcome, those factors which might put children and young people off science. In practice, socio-economic disadvantage has become a proxy for science capital. Disadvantage is more easily identified in communties and tracked through monitoring than science capital itself would be (there are eight dimensions of science capital and full measurement is not practical for many PE activities and events).

The choice of an additional focus on 8-14 year olds reflects the importance of this time in a child's life on the formation of aspirations and attitudes towards science, further study and careers. Broadening this to include families and carers highlights their significance as positive influencers on children and young people. In science capital terms, families and

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[2] A picture of the UK scientific workforce: Diversity data analysis for the Royal Society (2014)

[3] https://www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/aspires-research

[4] https://discovery.ucl.ac.uk/id/eprint/10092041/15/Moote_9538%20UCL%20Aspires%202%20report%20full%20online%20version.pdf

carers are seen as having an important role in inspiring and encouraging (or dissuading) children and young people into science.

2.2 The evaluation

In December 2018 Cloud Chamber was commissioned to independently evaluate the STFC Wonder initiative, initially over a two and a half year period and later extended by a year due to the impact of Covid-19. The evaluation ended in April 2022 (the Wonder initiative itself continues). This final evaluation report covers the whole of the evaluation period.

Our primary role as evaluators has been to evaluate Wonder at a summative level (rather than at the level of each individual activity). This includes conducting research with key stakeholders such as grant holders, STFC staff and Wonder Steering Committee members; and synthesising qualitative and quantitative evidence from the level of individual projects.

Framed as questions, the objectives for the evaluation were as follows:

- In what ways is Wonder making a difference (in terms of outcomes) to its target audiences?

- To what extent has Wonder been successful in reaching greater proportions of Wonder audiences through its activities compared to pre-Wonder performance?

- What has been learned about how best to engage and enthuse Wonder audiences about STEM?

- To what extent has Wonder built the capacity of STFC and its partners to deliver public engagement with Wonder audiences in the future?

- To what extent has Wonder modelled an audience-focused approach to public engagement?

The evaluation was shaped by an evaluation plan, which was one of the first formal outputs from the assignment.

2.3 Fieldwork

Over the course of the evaluation we have completed a range of evaluation activities including:

- Attendance at bi-annual Wonder Steering Groups

- Facilitation of monthly online Wonder project drop-ins since August 2020

- Interviews with project grant holders throughout (14 in the final research phase)

- Interviews with STFC PE practitioners[5] and strategic project deliverers (see below)

- Design of, and support for, an outcomes toolkit for Wonder projects

- Analysis of grant holder and STFC data (reach and outcomes) covering activity from 2018 to 2021

- Ongoing communication with STFC through regular catch-up calls and meetings

An interim report was completed in 2021. Any relevant findings from that have been included in this final report.

2.4   Projects

Wonder encapsulates a wide range of projects delivered by various organisations in many different settings. For clarity, we set out below descriptions of the main project types by deliverer. Note that, throughout this evaluation, we use the term 'project lead' as a universal descriptor for any PE practitioner delivering a Wonder project, irrespective of their host institution. All quotes in the quote boxes come from project leads unless otherwise specified.

2.4.1   STFC PE activity

The STFC PE programme has three main strands:

- PE Grant projects

- National Strategic projects

- STFC National Laboratories PE (NLPE) programme

2.4.2   Grant projects

Over the course of the evaluation, 32 grant projects were identified to us as Wonder projects, representing around half of all STFC PE projects with a start date of 2018 through to 2020. Of these Wonder projects, about two-thirds engaged to a greater or lesser extent in the evaluation. Due to the timing of funding rounds and the ending of some projects during the course of the evaluation, it is difficult to be more precise.

Grant projects included projects funded by STFC through four different awards:

- Spark: up to £15,000 for new PE activities (23 awards)

- Nucleus: up to £125,000 for new PE activities (4 awards)

- Legacy: up to £62,500 to continue to improve and existing PE project (1 award)

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[5] In this report, we use 'PE practitioner' as an umbrella term to describe deliverers of STEM public engagement activities. This includes, for example, PE professionals working in Higher Education, academics, relevant STFC staff, and consultants/freelancers

- o   Leadership Fellowships: up to £200,000 for prolonged, higher profile PE promotion and delivery (4 awards)

The balance of these awards is important for the context of the evaluation. Spark awards represented more than two-thirds of all Wonder projects. Their capacity to engage with the evaluation and conduct independent monitoring and evaluation was likely limited by the resource they had available. Nonetheless, some of the Spark award-holders were among the most active and involved participants in our evaluation.

Throughout this evaluation, we use specific project examples to demonstrate both the range of activity and to bring some of our findings to life.

2.4.3   National Strategic projects

We describe two projects as 'strategic' in this evaluation. They are both larger in scale than most other STFC Wonder grants, and they are subject to their own evaluations:

- o   Explore Your Universe 4 (EYU4): the fourth phase of a strategic science programme led by the Association for Science and Discovery Centres (ASDC) and delivered through its national network of science centres. Designed as a programme of events to engage and inspire school-age children and families, EYU4 more specifically set out to adopt a more audience-led approach to science PE using participatory methods and engaging families through multiple engagements. EYU4 began in 2019 and ended in 2022, with additional dissemination activities supported through to Spring 2023. We have seen an early version of the programme's independent evaluation.

- o   Reading Sparks: led by The Reading Agency, Reading Sparks seeks to use reading for pleasure as a way of engaging children and families in science. It is delivered through libraries and focuses on areas of socio-economic deprivation. The mechanisms of delivery include reading bags (books and science activities to take home on loan), in-library family activities and in-depth participatory work with young people. The project began in 2021 and initial phases end in late 2022. Cloud Chamber are the evaluators for this project and we have drawn on our own evaluation evidence to date for the Wonder evaluation (with the consent of The Reading Agency).

2.4.4   National Laboratories PE programme

The three main National Laboratory Public Engagement (NLPE) sites are:

- o   Royal Observatory Edinburgh (ROE)

- o   Daresbury Laboratory (DL), Cheshire

- o   Rutherford Appleton Laboratory (RAL), Oxfordshire

These sites deliver both ongoing PE programmes and short-term projects, mainly for local audiences and also some for nationwide audiences. The teams have sought to introduce

a Wonder approach to project work and to programme work (where Wonder priorities are balanced with other considerations).

2.5 Factors impacting on the evaluation

There have been a number of factors which have had an impact on the evaluation, the most significant of which we mention here so that readers are aware of the potential limitations to the evidence base and our findings.

2.5.1 Wonder as an initiative

Because Wonder is an initiative, PE activities were not definitively ruled in or ruled out of consideration for inclusion in the evaluation. Identification of Wonder-relevant projects depends on one defining characteristic: the extent to which an activity is aiming to reach Wonder audiences. This was encouraged through grant calls, and in some cases was already a defining part of project bids and ambitions. How much a Wonder project sought to be involved in the evaluation or 'Wonder-related' activities (like the regular monthly online drop-ins) was left up to project leads. This means that the total population of Wonder projects and Wonder activity is not as tightly defined from an evaluation perspective compared, for example, to an evaluation of a very specific grants programme with clearly defined boundaries.

2.5.2 Variety of activities

It is something of a challenge to draw conclusions from what is a highly varied evidence base of PE activities. This is particularly the case for the grant projects, which are diverse in a number of different ways, for example:

- Audiences: projects have included open access/public events; and specific events for selected groups or organisations (e.g. schools and home schoolers). Some have been more targeted at particular age groups, while others have engaged families and communities more generally.

- Delivery approaches: face-to-face, online and blended approaches.

- Engagement mechanisms: projects have engaged audiences in science with a wide range of mechanisms including an inflatable planetarium; rap music; a board game; art; poetry; science experiments; and 'meet a scientist' events.

2.5.3 Covid-19

The Covid-19 pandemic had a major impact on Wonder activity, both in terms of event volumes and delivery approach. Event numbers fell and delivery increasingly switched online. As an example, Figure 1 shows the number of events delivered annually by NLPE. From over 350 events in 2018 (the year before Wonder began) and 2019, the number fell by a third with the arrival of the pandemic in 2020 and remained at similar levels in 2021. Online delivery was not present at all in 2018 and 2019 – NLPE activity is traditionally focused on in-person engagement at STFC facilities or in local communities. In 2020 71%

of events were delivered online, rising to 95% in 2021. We know anecdotally that the picture was very similar among grant projects.

Figure 1: NLPE events by year and main delivery mechanism (2018: baseline)
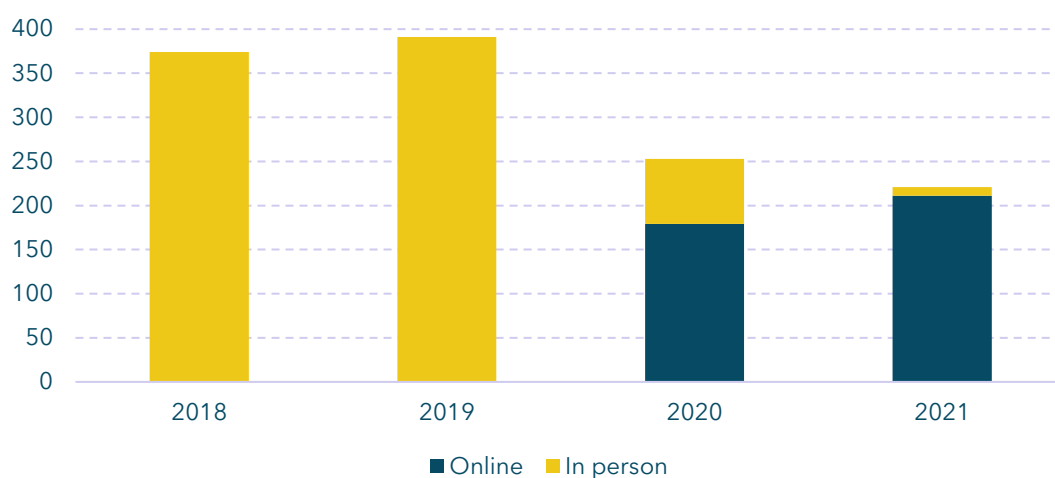
Source: NLPE data

For the evaluation, there have been several implications arising from this:

o   Our intended face-to-face research had to switch to online interviews and informal group conversations.

o   Quantitative data for Wonder demonstrates some big swings in the numbers, especially between 2019 and 2020, which we attribute primarily to the pandemic (see Section 3).

o   Project delivery was significantly affected in a variety of ways: some had to change their approach completely, learning new technology skills along the way; others had to delay, reschedule and sometimes abandon events; and some host organisations had to deal with wider problems, such as severe financial difficulties, staff on furlough, and redundancies.

2.5.4   Data quality and consistency

We have had to work with a number of issues related to data quality and consistency and have taken a pragmatic approach to their analysis throughout. Some of these issues are highlighted through the report, and in Appendix 1 in more detail, but we summarise here those that are particularly worth bearing in mind as readers consider the findings of this evaluation:

o   Socio-economic deprivation is often based on the IMD profile of a school. This may not always reflect the socio-economic impact of its catchment area, and therefore its pupils. It is, however, a readily available metric and we judge it to be a reasonable proxy for deprivation and disadvantage in the absence of a better option.

- NLPE, grant-holders, and strategic projects all gather data in different ways, to different degrees and often use different research questions to secure participant feedback. We have collectively attempted to improve the consistency and volume of monitoring data during the evaluation, particularly among grant-holders, but it remains a challenge.

- Grant projects report their metrics annually to STFC via a monitoring spreadsheet and ResearchFish[6]. Spot tests of this data demonstrate inconsistencies between the two, and over time, so we have had to make judgements about which to use on a case-by-case basis. See Appendix 1 for more details on the analytical approach.

- Outcomes data from grant projects in particular is rather limited in scope and volume. This may reflect practical difficulties in gathering outcomes data (e.g. participator engagement), limited project resources, or other factors.

2.6   Acknowledgements

We are extremely grateful to all those involved in Wonder who contributed to this evaluation. For many, the Covid-19 pandemic was an incredibly difficult period both professionally and personally. Their willingness to remain engaged in the evaluation and committed to inspiring people about science throughout has been a wonder in and of itself.

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[6] Researchfish is a commercial online system that collects details of research outcomes for a range of funders with the intention of supporting the tracking of research impact

3   Reaching Wonder audiences

Key findings

- The Wonder audience has exceeded 40% of total reach from the first year of the initiative. At this level, Wonder audience participation equates to the proportion of people living in Wonder communities across the UK.

- Total reach – Wonder and non-Wonder, separately and together – has fallen since 2018. Overall volumes are now approximately two-thirds of their pre-initiative size. The reasons for this are not clear, although Covid-19 is likely to have been a major factor.

- Reach among 8–14-year-olds has followed an inconsistent pattern and we cannot detect any obvious trends.

3.1   Introduction

In this section we consider to what extent the Wonder initiative has been successful in reaching greater volumes and proportions of Wonder audiences through its activities. We draw on monitoring data from both grant-funded projects and NLPE activity.

3.1.1   A note on the data

We have analysed monitoring data from both the grant-funded projects and NLPE activity over the past four years (2018-2021). Where the data allows it, the year 2018 is used as a pre-Wonder baseline against which subsequent performance can be measured, although the inititive started towards the end of the calendar year, and therefore not be a truly accurate baseline.

The analysis of this data has been complex and we set out more detail about our approach in Appendix 1. We note here the following points that should be borne in mind when drawing conclusions from the analysis:

- The data is highly dependent on the individual circumstances of particular projects. A small number of projects reporting extremely large reach numbers have been excluded from the analysis as they would unfairly skew the results. Even then, it is a dataset that can be influenced – one way or the other – by a relatively small number of projects.

- The data can be inconsistent. For example, ResearchFish can be updated at any point, allowing for the retrospective addition of information. The ways in which individuals interpret and use ResearchFish can also vary considerably.

- As a proxy for the deprivation element of the Wonder definition, we rely heavily on school postcode data, which is not perfect but is the metric that has been

agreed with STFC for the Wonder initiative. A school's postcode refers only to its site and not its catchment area.

- 2020 and 2021 were heavily affected by Covid-19 which makes drawing trends over the four year data period problematic. This is particularly relevant given the upheaval the pandemic caused for schools and the volume of PE delivery that involves schools.

- Reach among 8-14 year-olds is reported for all young people in this age group, not just those from target IMD postcodes. This is due to challenges applying IMD estimates to a specific age group (see Appendix 1 for more details)

We comment on the lessons for collecting reach data later in this report.

3.2   Total reach

Wonder reach has to be contextualised first in terms of the overall reach of STFC PE activity, both Wonder and non-Wonder. Figure 2 sets out the headline figures for the last four years (all ages). While the trend in overall numbers has been downward, year-on-year, for both grant project and NLPE activity, we would make the following observations:

- The large drop from 2019 to 2020 is likely to be caused primarily by the pandemic and its impact on educational activity and society more generally.

- NLPE activity in 2020 and 2021 seems to have been more affected by the pandemic than the grant projects. This is probably due to the importance of the Labs' physical assets (observatory, particle accelerator, etc.) making it harder to replicate events online.

- We assess that the 2021 figure for grant projects (354k) is an underestimate as projects often continue to report reach figures well after the required submission date. Based on the trends from previous years' data, we would conservatively estimate that the reach for 2021 will increase by around 10% in the coming months, ultimately bringing it in slightly above the 2020 reach figure.

- It is possible that we are seeing a 'Wonder effect', where a focus on what might be described as harder to reach groups results in lower engagement volumes. We comment on this later in the section.

Figure 2: Reach – all categories by volume (000s)

	2018 (baseline)	2019	2020	2021
Grant projects	558	432	382	354
NLPE	37	31	21	22
Total	595	463	403	377

Source: ResearchFish and NLPE data; numbers may not add precisely due to rounding

It is worth noting here that grant projects have consistently delivered the bulk of the numbers – between 93% and 95% of the total annually – reflecting the scale of investment

by STFC in grant-delivered activity. So any proportionate shift in their reach with audiences (total audience and sub-sets, such as Wonder) will have a more dramatic impact on the overall picture than for a similar proportion for the work of NLPE.

3.3 Wonder audience reach

Figure 3 provides the total Wonder audience reach (all ages). After a rise in the numbers of people from Wonder audiences reached in 2019, the figures fell back in 2020 and 2021. As with total reach, we think that this is most likely due to Covid, and that the 2021 figure will increase as more projects submit their figures for the year. Nevertheless, the Wonder audience reach figures have been more robust in 2021 compared to overall reach: they have stayed at 2020 volumes while overall reach fell by 6% over the same period.

Figure 3: Reach – Wonder (40% most deprived areas) by volume (000s)

	2018 (baseline)	2019	2020	2021
Grant projects	178	225	168	167
NLPE	9	8	5	6
Total	**188**	**233**	**173**	**173**

Source: Project monitoring spreadsheets and NLPE data

The Wonder proportion of total audience has exceeded baseline (2018) levels in each of the following three years (Figure 4). The overall Wonder audience proportion has been above 40% for 2019, 2020 and 2021 – this is the point at which the Wonder audience becomes over-represented within PE activity compared to the population as a whole and should be regarded as a very positive achievement. In some places, this increase in the Wonder proportion has been more about a reduction in the overall audience rather than an absolute increase in the Wonder audience numbers (e.g. for National Labs in 2020), but the effect is the same.

Figure 4: Reach – Wonder (40% most deprived areas) as a proportion of total reach

	2018 (baseline)	2019	2020	2021
Grant projects	32%	52%	44%	47%
NLPE	25%	26%	23%	27%
Total	**32%**	**50%**	**43%**	**46%**

Source: Project monitoring spreadsheets and NLPE data

3.3.1 A 'Wonder effect' on reach?

From the outset of the initiative, STFC has been aware that a greater focus on Wonder audiences (and, more generally, on deprived and harder to reach audiences) might risk reducing overall reach figures, and they have accepted this trade-off. PE practitioners have suggested that this has been the case in practice.

The argument is that it takes more effort to engage these new audiences, while the outturn in terms of numbers engaged might also be lower than for other groups (for example, highly motivated science students from a school with a wealthy catchment area). Assuming all other factors remain the same (e.g. resources devoted to STEM PE do not change), we might expect to see higher proportions of Wonder audiences engaged, but against lower overall reach volumes.

We have already commented in this section about the year-on-year fall in overall reach figures. Figure 5 shows how Wonder and non-Wonder audience volumes have changed over time. The chart shows a dramatic drop in non-Wonder audience volumes from 2018 to 2019, but after that both audiences remain reasonably similar and there is no year-on-year trend that might suggest the assumptions above are correct. Covid-19 inevitably is a confounding factor which makes drawing conclusions difficult for the years 2020 and 2021.

What of the first year (2018-19) drop in non-Wonder audience reach? We are unable to determine a reason for this, but we think it doubtful that the Wonder initiative caused such a sudden and dramatic behaviour change in a single year. It may be that the drop is related to wider cycles in grant-related activity (e.g. the end of a grant phase).

We should note that this analysis is purely about reach. It is not a comment on the value or importance of reaching and engaging Wonder audiences.

Figure 5: Reach volumes: Wonder and non-Wonder audiences
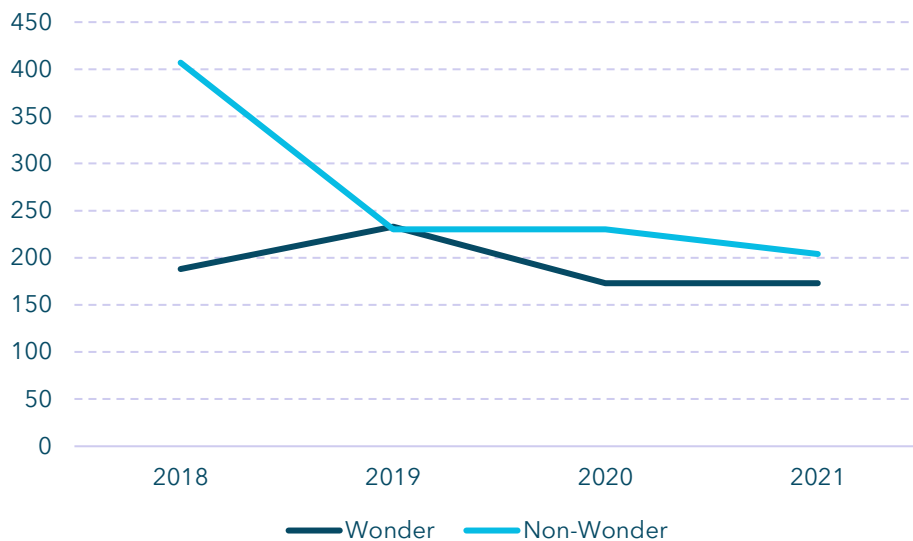
Source: Project monitoring spreadsheets and NLPE data

3.4   Reach among 8-14 year-olds

Reach among 8-14 year-olds is another important focus within the Wonder definition. Our analysis presents the findings for all 8-14 year-olds as we were not able to isolate 8-14 year-olds from within the deprivation-defined Wonder group with any accuracy.

The data on 8-14 year-olds shows a rather inconsistent pattern from year to year (Figure 6). For grant projects, one or two projects have effected a large annual swing. For

example, one project in 2019 delivered around half of the total 53k. Without that project, figures in 2019 would have been very similar to 2018. For NLPE activity, numbers have been steady for three of the four years, the drop in 2020 likely being connected to Covid-related issues. A review of our other evidence suggests no other obvious reason for the decline.

Figure 6: Reach – 8-14 year-olds by volume (000s)

	2018 (baseline)	2019	2020	2021
Grant projects	23	53	17	35
NLPE	9	9	5	9
Total	**32**	**61**	**22**	**44**

Source: ResearchFish and NLPE data

By proportion, NLPE activity is more focused on the 8-14 year-old audience than grant projects, as Figure 7 illustrates. The proportion remained broadly steady from 2018 to 2020 and then increased quite considerably in 2021. It is not clear from the evidence whether there were any particular reasons for this, but as an example of potential factors it may be that NLPE found it easier to target this age group during the pandemic. The proportions for grant projects have been lower than for NLPE activity in each year and appear to have followed a two-year cycle of lows (4%) and highs (12%) but as mentioned previously, we consider that some specific projects have been the cause of the swing rather than representing a broader trend.

Figure 7: Reach – 8-14 year-olds as a proportion of total reach

|	2018 (baseline)	2019	2020	2021
Grant projects	4%	12%	4%	10%
NLPE	25%	29%	24%	39%
Total	**5%**	**13%**	**5%**	**12%**

Source: ResearchFish and NLPE data

3.4.1   Shifting reach within age groups?

We explored whether the grant projects had shifted their focus away from older children and young people, potentially as a result of the influence of the Wonder initiative which prioritises 8-14-year-olds. In their ResearchFish returns, projects categorise their reach among children and young people under three school age groups: upper primary, lower secondary, and upper secondary. The first two of these broadly equate to Wonder's 8-14 definition.

The proportions for all three of these groups are shown in Figure 8. We have not been able to identify a discernible trend across the period under evaluation.

Figure 8: Reach by proportion across three age groups of children and young people (grants)
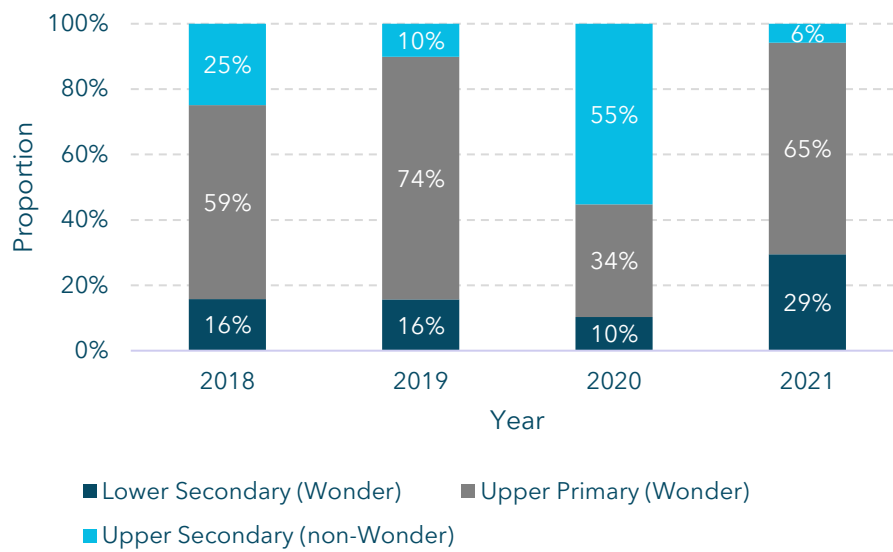
Source: ResearchFish

Reaching Wonder audiences – Reading Sparks

Reading Sparks is a national strategic project seeking to use reading for pleasure as a way of engaging children and families in science (see Section 2).

Gathering information about the volume of project activity and the characteristics of participants was crucial to understanding whether the project was succeeding in reaching Wonder audiences.

At the time of writing, the project had been delivering its Science and Reading Bags to children and families for around ten months. During that period, 392 bags had been distributed and information gathered about 309 participating families (79%). The proportion of users from Wonder communities (defined by household IMD) was 67%, representing a very strong focus on reaching families in socioeconomically deprived areas.

Age data was available for 218 children taking part. There was a spread of ages ranging from 4 to 15 years old, but the majority (69%) were of Wonder age, i.e. 8-14 years old.

4　Engaging and enthusing Wonder audiences

> **Key findings**
>
> - Schools were a significant partner for many PE projects but many practitioners found engaging them very resource intensive.
>
> - Effective Wonder audience engagement requires careful preparation: addressing practical obstacles to participation; recognising that audiences might be more diverse in terms of education and other factors.
>
> - During events, PE practitioners need to remain flexible and adaptable. Creative approaches work well, as do opportunities to meet scientists and show they are like everyone else.
>
> - Substantial digital PE delivery arrived in response to Covid-19 and is likely to remain part of the PE landscape. It has benefits and disadvantages for Wonder audiences.

4.1　Introduction

In this section we explore what has been learned about how best to engage and enthuse Wonder audiences about science.

We break this down into two broad areas:

- Reaching and engaging schools, which was a particular challenge highlighted in our interviews. Project deliverers regarded this as an often important first step in the engagement process and one that took a lot of time and effort.

- Engaging Wonder audiences themselves. Much of the feedback from project deliverers in this area has tended to focus on good preparation in advance of activities and events.

The evidence used in this section comes primarily from interviews with PE practitioners and project deliverers.

4.2　Reaching and engaging schools

A large amount of Wonder activity has been focused on reaching and engaging schools. The majority of feedback we received from grant projects focused on the challenges related to schools and the ways they can be addressed.

4.2.1 Challenges

Making the first contact with schools was commonly regarded as the most significant challenge faced by grant projects. The reasons for this were varied and included the following:

- Compared to other schools, Wonder schools were identified as being more likely to be managing a range of other issues which complicated initial contact and forced STEM PE further down a school's priority list. Some of the reported issues included limited resources; poor educational performance generally and a lack of prior experience of dealing with external engagement, enrichment and extra-curricular opportunities. This is supported by other evidence. For example, Ofsted data in 2018 showed that 1% of the most advantaged quintile of English pupils attended the worst performing schools compared to 9% of the most disadvantage quintile of pupils.

- A focus on Wonder schools required a tighter definition which reduced the overall number of schools that could be targeted for engagement. This was particularly the case for projects seeking to engage secondary schools, which are far less numerous than primary.

- Anecdotally, project leads found that initiating and establishing communication with schools had become a lot harder since Covid-19 as schools faced even more pressures to help pupils catch up on lost learning. Lost learning has been compounded in some Wonder schools because of the 'digital divide' (see later in this section).

- The limited opportunities for in-school/in person activities during Covid-19 lockdowns (plus a range of restrictions to school access from visitors in between) tended to make the PE 'offer' a less attractive option for schools: the hands-on experience that makes STEM PE so engaging was simply not on offer for prolonged periods. This did change over time as the education sector and society more generally adapted to greater online communication.

> *"[since Covid-19] it's been even harder than it would be…[schools] have had so much to deal with…they just haven't wanted to take on stuff unless a particular teacher has been interested in space or science"*
>
> *"If we just send out an email saying we can visit your school, do you want us to come, we know which schools are going to reply – and it's not the [Wonder] schools we're targeting in this project."*
>
> *"The responsiveness from teachers to communications has gone massively down during the pandemic, and that's quite hard when you rely on email as your main recruitment tool"*

4.2.2   What works when engaging schools

While initial reach and contact was widely regarded as the most difficult and time-consuming part of many projects – and few doubted that it was hard work – projects identified a number of examples of how reaching out to schools could be achieved:

- Making clear any links between the activities on offer and the curriculum. Hard-pressed schools and teachers found it easier to understand an activity's relevance and easier to find time in the school diary when this connection was made (not all PE activity can be connected directly to the curriculum, however).

- Reinforcing the free nature of the activities. Some projects had come across teachers and schools who assumed that there would be a cost associated with an event and this had reduced their interest in the initial offer.

- Several projects drew on other contacts to reach schools, such as STEM Ambassadors and organisations like the Ogden Trust who already had networks and relationships with schools. Personal referrals like this ensured that schools had an initial offer from an existing trusted contact rather than an 'unsolicited' approach.

- Creating personal relationships. Many projects recognised that there was a risk in establishing personal relationships with an individual member of staff in that, when they move on, the connection to a school could be lost. However, more commonly they noted how important it was to create a personal link in order to ensure that discussion about PE was not purely transactional and without warmth.

More generally, there was a difference between those projects with an established presence in the science PE 'market' (e.g. having run a project for several years) and those who were new – or brought a new initiative – to the field. The former tended to be contacted more frequently by schools rather than the other way around, with projects seeing schools returning regularly, and previous participants recommending the projects to other teachers and schools. Projects working with particular schools over a prolonged period also tended to have fewer concerns about reach.

"Schools will have more important things [than science PE] so you have to build quite personal relationships with staff in schools. It's not just transactional, about booking things in…[now] we're far more confident they'll remember us"

"Year 5 is where Space is in the national curriculum so that's where teachers want it…it's a way of getting kids excited in those things"

"I put a lot of time into networking before I started so that I knew where there were schools that were very well-run; where the teachers were well-organised and had the capacity to manage people coming in."

4.3 Engaging Wonder audiences: preparation

Many of the ideas shared by project leads to engage Wonder audiences focused on good preparation as the means of ensuring engagement.

4.3.1 Planning for a wider range of education capabilities

Education research has demonstrated for many years that children and young people from disadvantaged backgrounds tend to make less educational progress than their more advantaged peers.[7] PE deliverers commonly concurred with this based on their own observations.

Furthermore, several PE deliverers suggested that the gap in development between disadvantaged and less disadvantaged children and young people had grown as a result of the impact of Covid-19 on education. Again, this is borne out by wider research which suggests that children and young people from disadvantaged or deprived backgrounds appear to have been more significantly affected by learning loss.[8] Anecdotal research by one grant funded project working with primary-age children noted a range of additional challenges that this learning loss brought about which impacted on science PE delivery and engagement. These included a decline in literacy skills and greater disengagement from reading; increased disruption in class; and higher rates of anxiety among children with additional learning needs.

Some projects faced additional challenges including audiences for whom English was not their first language, and activities involving children with Special Educational Needs. These required additional thought and planning to ensure participants' inclusion and involvement.

The consequence of this, according to PE deliverers, was to increase the importance of preparing PE activities carefully to enable the engagement of audiences with a broader range of educational attainment, being mindful not to make assumptions about participants' levels of prior knowledge.

4.3.2 Removing practical obstacles to engagement

The most common theme among PE deliverers for ensuring effective Wonder engagement was perhaps the simplest to describe: the removal of practical obstacles that might preclude certain audiences from taking part. The most frequently mentioned factors were transport, timing, and material resources.

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[7] For example, pupils eligible for Free School Meals make less progress between 11 and 16 years-old than those who are not eligible: Child poverty and education outcomes by ethnicity (ONS 2019)

[8] See for example Learning during the pandemic: review of research from England (Ofqual, 2021)

Project leads stressed the importance of not assuming that families would have access to their own transport, making site choice all the more critical to get right. Equally, it was crucial not to make assumptions about the most appropriate time for an event, given the possibility that parents and other adults might work shift patterns, for example.

Projects also took time to ensure that material resources were available for everyone. This included non-essential 'take-away' items as incentives for participation (e.g. pencils and pens), through to required materials for an activity: from specialist equipment through to resources that might otherwise be assumed as being readily accessible families (such as craft materials). This needed to be built into budgeting for activities and events.

Lighting up Oxford

Glow Your Own was a project delivered by NLPE (RAL) in collaboration with IF Oxford, a local science festival. In a city often characterized as being polarised between 'town and gown', IF Oxford acted as a community partner to ensure effective engagement with audiences from one of the city's less advantaged areas: the Blackbird Leys Estate. **"STFC were seen as an extension of the university…and power dynamics can be important. Partnerships level the playing field a bit."**

STFC provided all the equipment, materials and resources required for participants to design and code their own Arduino-controlled LED lanterns. Packs of materials were put together particularly for families living in digital poverty. Participation at the workshops was free. The final event was an art installation on the estate bringing the lanterns together to form a single interactive digital light experience. Video.

During Covid-19, some projects made special efforts to ensure that remote participants had access to physical materials. This was also in part a recognition of the limitations of a purely virtual approach to PE. By providing materials to participants ahead of digital sessions, they hoped to increase stimulation and engagement and mitigate against the absence of the PE practitioner. Materials included bags, workbooks and items of scientific equipment to show at school assemblies. Projects noted the importance of this approach in breaking up what might otherwise be a very 'screen-intensive' approach to PE delivery.

Asking big questions through discovery bags in Kent

A project run by Canterbury Christ Church University's Epistemic Insight Team explored ways in which children could be encouraged to consider 'big questions' around science, religion and life. To deliver the research activities during the pandemic, children were provided with 'discovery bags' including materials for experiments such as diffraction glasses to explore the nature of light, and investigation cards posing questions. The bags allowed children to conduct their own experiments at home or at school without the need to share or buy materials. Online CPD provided additional support to participating teachers.

"[Wonder] kids just don't have art supplies [at home]. Glue sticks are like gold dust! I've been giving them out to keep and I've seen adults getting emotional about having them. These children are so underserved – how are they going to raise their attainment levels when they haven't got the resources to do so?"

4.3.3   Using a range of promotion methods

Projects highlighted the need not to make assumptions about where or how Wonder audiences might hear about a PE event. More successful projects appear to use a wider range of options for promotion including hard copy fliers which might in other situations seem old-fashioned. While social media was commonly used as a promotional method, PE practitioners noted that Wonder audiences might have less access to IT or the internet.

4.4   Engaging Wonder audiences: delivery

4.4.1   Being flexible, being prepared

Project leads stressed the importance of being flexible when engaging Wonder audiences, being able to respond to changing needs and moods in the moment. This is in relation to delivery – when you're in the room – rather than at design stage.

PE practitioners told us that Wonder audiences tended to have less experience of engaging in science-related activities (aside from traditional classroom-based teaching) and were, as a result, sometimes less readily able to engage compared to those for whom it was an occasional or regular activity. This meant that PE deliverers had to be alert to the mood of the room and adapt their activities as necessary.

"you require a high degree of adaptation"

"be constantly reflecting, re-evaluating and listening"

"I like the chaos and diversity of some Wonder audiences, the real conversations you have with families"

This is not to say that Wonder audiences are less well-behaved than their non-Wonder counterparts: we heard enough stories from PE practitioners to know that wasn't the case. However, the diversity within Wonder audiences, the range of educational attainment and

cultural capital, and the lack of prior experience in science-related events could add more of a burden on PE practitioners and required on-the-spot adaptations.

4.4.2   Challenging traditional views of scientists

Many projects build some or all of their Wonder-focused activities around portraying scientists as ordinary people. This reflects the principles of science capital, in particular that people from low science capital backgrounds are less likely to know a scientist, or someone who works in science, and are more likely to view science as 'not for them'.

Primarily, these projects seek to bring children and young people face-to-face with scientists. But it's important to ensure that the interactions are not simply focused on science as a subject; rather, they help to show that scientists come from a range of backgrounds and have many interests besides science.

"It helps them [Wonder audiences] see scientists as normal people. Seeing the relevance of science to their everyday lives. Learning about what it is to be a scientist and researcher. Whereas the kids with higher science capital are more likely to ask, for example, which university is better?... The event works well for both groups but I'm pretty sure we're having the bigger impact on those with lower science capital"

"We encourage the scientists to talk about themselves first and their work second…it's about a conversation and finding what those connections are"

"We're very focused on people – the teachers, the pupils and the scientists"

"Focusing on attributes really helps [because] science is done by people"

4.4.3   Using art and craft

PE practitioners regarded art, craft and creativity good approaches to avoid making assumptions about the levels of educational attainment and understanding among Wonder audiences, especially children and young people. These included:

- A poet working with primary pupils to explore the extreme environment of the Antarctic in North East England.
- 3D crafts for primary pupils in South Wales.
- Illustration and animation for children and older young people in Bristol and at several sites for the Reading Sparks project.

"Because they're having fun, they don't realise that they are working and learning…but teachers see the impact over the longer term in terms of ambition and career options"

"Art is a great leveller – you don't need to be able to read the magazines you're cutting up!"

Taking a planetarium virtual

Lancaster University's project – LUniverse – is a portable inflatable planetarium designed to be taken round schools and non-STEM events with a particular focus on reaching children with low socioeconomic status. The planetarium itself was not usable during the pandemic, so the project team switched to online delivery. This was helped considerably by the recruitment of a team member in October 2021 to lead on this aspect of the project.

The project developed a considerable online offering with most of its materials converted to virtual engagement. Schools could be 'visited' online via MS Teams or with a planetarium projection in the classroom. The team worked off a local list of schools and their proportion pupils eligible for free school meals (FSM) to ensure that more deprived communities were prioritised. It is also one of at least two Wonder projects that worked with the Ogden Trust to ensure effective targeting of schools in areas of social deprivation. As one team member noted, schools serving more affluent areas **"know that they can ask"** for science enrichment activities. This is less of a case among those in more deprived communities.

The project was careful to tailor each school event for a particular school, even if only very slightly: they found that **"making it feel like it's just for them changes the interaction completely."**

School-focused events included question and answer sessions at the end, ensuring that there is a level of two-way interaction. The project team believes that this is one of the best elements of the events – **"it feels personal"** – but it's important to leave enough time in the schedule – children can ask a lot of questions. And while some of the questions can be difficult or impossible to answer, the team views this as a positive: **"it helps them knowing that not everyone knows everything, that science is still a mystery…that we're all still learning."**

Post-pandemic, the planetarium is being used in schools, but with a reduced capacity as a precaution. This means the planetarium can only accommodate about half a class. So the project has developed a craft activity to run alongside the shows to ensure pupils remain engaged while they wait.

4.5 Engagement through virtual delivery

4.5.1 A transformative experience

This section focuses specifically on engaging Wonder audiences through virtual delivery. It was a big part of Wonder during the Covid-19 pandemic and many lessons were learned along the way.

Looking back at the grant project descriptions from before the pandemic, digital delivery was rarely mentioned as a route for public engagement. There are good reasons for this,

most notably because face to face or 'hands on' events and activities are considered more likely to generate an interest and a memorable experience (especially where interaction with materials, equipment or scientists is concerned). Covid-19 saw much of Wonder activity gravitate online as organisations and individuals went into various forms of lockdown. In early 2022, most projects considered that online delivery would likely be a regular part of their future PE work even post-pandemic so it is an important area for learning and development.

There have been several successes with projects reporting sustained or even greater audience reach by using online methods. Activities included live streaming of planetarium shows, participation in online science festivals (as replacements for live science festivals) and online workshops.

> ### Connecting scientists and students
>
> 'I'm A Scientist…' has always been delivered as an online STEM enrichment activity, providing students with opportunities to communicate with scientists through real time chat. The pandemic saw the project expanding its capacity and delivery window to accommodate greater demand. Wonder remains a priority – in particular, schools that have above average levels of FSM pupils and are located more than 30 minutes away from a research-intensive university. The increase in demand was accommodated in part by the extent to which scientists were willing to volunteer – around 2,500 signed up to the project within 12 months.

4.5.2   Benefits of virtual delivery

A number of benefits were identified by projects:

o   Virtual engagement has allowed some projects to broaden their geographical reach, no longer being bound to a physical place or the need to factor in travel. One project based in South Wales for example was able to engage communities in the more rural and remote north of Wales by going online when it would otherwise not have been able to extend its delivery that far. Broadening this reach offers potential opportunities for engaging remote Wonder communities.

o   There is some evidence that projects have found that online delivery has been an efficient way of engaging scientists who might otherwise have had to travel to take part in PE events. On a more general point, project leads expressed a hope that the sometimes heavy burden of travel requirements placed on them per-pandemic would be lessened by a more permanent rebalancing of in person and remote PE delivery.

o   In the absence of some direct school delivery, some projects focused more effort on supporting teachers to improve their own skills, for example by running CPD events and other training to teachers in order for them to be able to deliver STEM PE activities. This also helped some projects to maintain links with schools in the absence of a more comprehensive in-school PE offer.

Supporting teacher CPD in South Wales

AstroCymru had intended to inspire students from low science capital areas in South Wales through 3D space shows and art workshops. With access to schools severely restricted by Covid-19, the project broadened its offer. Among other initiatives, it delivered an online CPD event for 45 primary teachers aimed at training and encouraging the use of space in the classroom, particularly as way of demonstrating to children that creativity and science can be explored together: science can be used as a theme in creative/art lessons as much as creativity and art can be used in science lessons. The CPD was delivered in partnership with Techniquest, another Wonder grant holder.

The evolving use of online communication methods as a result of the pandemic enabled the project to continue to have a presence in schools until it was able to resume its pupil-focused activities.

Student-led online workshops with Somali families in Leicester

This project aimed to bring space science to Somali children and families in deprived areas of Leicester through Saturday learning clubs set up to improve the educational performance of the community's children. Four school students from the community were supported by academics to learn about solar and aurora science and present information back to younger children and their families.

The original plans for a science fair-style event in the community were disrupted by the pandemic and delivery was moved online. Through online sessions delivered to children and families in their own homes, the students were still able to introduce practical activities for children (designed by Sphere Science with materials sent in advance to participating families) and presented information about the research. The students also helped to run a planetarium event hosted online by LUniverse at Lancaster University.

4.5.3   Challenges of virtual delivery

Aside from the obvious challenges of highly disrupted project plans, we identified the following factors which projects commonly faced during the year:

- Many projects had to rapidly develop the relevant technological skills to deliver their activities and events virtually, such as live streaming and video post-production. The monthly drop-in sessions for project leads helped to facilitate this by enabling the sharing of ideas and knowledge between the projects on related issues such as ensuring safeguarding procedures for online events and web design, and measuring reach especially among Wonder audiences

- Several projects reported that they found it more difficult to gather evidence from online sessions, particularly for open public events and where audiences could

log in and out at will (thereby missing out on completing online polls, for example). While a general issue, more specifically it posed problems for identifying Wonder audiences because of the need for some form of identifying information (such as a post code). Some project leads noted that they found it easier to explain the reasons for gathering such data from participants when engaging face to face.

○ Projects noted the broader issue of digital exclusion. It is widely accepted that people in more disadvantaged communities have less capacity for engaging online due to issues such as access to reliable internet and computer hardware. It was a common concern among project leads that the move to online PE risked disenfranchising Wonder audiences because of this digital divide. While quantitative evidence is not available to support or refute this, projects have reported anecdotally that digital-only activities struggled to reach more deprived audiences.

5　Making a difference to Wonder audiences

> **Key findings**
> - Wonder audiences are much less likely to know someone in their family who is into or who works in science (grant projects)
> - Wonder audiences are much more likely to be attending their first STFC event (NLPE)
> - Across the majority of outcome areas, Wonder audiences score very similarly to their non-Wonder counterparts
> - The evidence suggests that STEM events are as accessible and as engaging to Wonder audiences as they are to others

5.1　Introduction

In this section we explore the ways in which STEM PE events and activities have made a difference to Wonder audiences (and, for comparison, non-Wonder audiences). The evidence is primarily from STFC datasets: grant project end-of-year spreadsheets and survey responses from NLPE activities. Some qualitative evidence is also provided to contextualise the figures.

The section is structured around three of the five Generic Learning Outcomes (GLOs) that form part of STFC's Public Engagement Evaluation Framework[9] given that they are an established outcomes set within the PE sector. Evidence was insufficient to report on the remaining two due to very small sample sizes (Figure 9).

Figure 9: Evidence availability for STFC GLOs

Global Learning Outcomes	Evidence available
Do	Yes
Feel	Yes
Value	Yes
Have skills to	No
Understand	No

Source: CCL analysis

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[9] https://www.ukri.org/publications/stfc-public-engagement-evaluation-framework/

5.1.1   NLPE data

STFC data in this section is derived from individual feedback surveys conducted at the end of NLPE-run events. The main requirement of the data was the presence of a participant's home postcode which allowed for IMD classification (all other identifying data having been removed).

The data was analysed in two batches:

- 2018-2020: feedback surveys were much more prevalent in 2020 compared to the previous two years, so the data for these three years was analysed as a single block. There was insufficient data for a strict standalone pre-programme baseline dataset (2018), so we have opted for what might alternatively be viewed as an 'early stage' dataset against which we can compare progress with impact in 2021

- 2021: analysed as a single year.

Figure 10 shows the sample sizes and IMD breakdowns for the two datasets. The Wonder audience (i.e. those living in the 40% most deprived areas) represented 11% of all respondents in 2018-20 and 17% in 2021. By comparison, respondents from the 10% *least* deprived areas of the country represented by far the largest proportion in each dataset (32% and 24% respectively). Sample sizes for Wonder audiences across the analysis are therefore quite small, and this needs to be borne in mind when considering the findings.

Figure 10: Responses by IMD decile (2018-20)

Decile	2018-20	2021
1 (most deprived)	2%	2%
2	2%	4%
3	4%	7%
4	3%	5%
5	7%	9%
6	8%	8%
7	13%	13%
8	15%	13%
9	13%	16%
10 (least deprived)	32%	24%
N	1,009	952

Source: STFC data

Respondents were asked whether they had attended an STFC event before. This represents a basic measure of existing STEM engagement and also helps to understand the extent to which NLPE activities are reaching new audiences. Those from more deprived areas were much less likely to have attended previously. In 2018-20, 61% of the Wonder audience had not attended an event before, compared to 31% for non-Wonder (n=810). In 2021, the figures were 50% and 31% respectively.

It's important to note that not all individuals responded to all the survey questions, and some questions were not asked in every event so the totals within the analysis are often reported as lower than the sample sizes above. We have left out of this section questions that were asked only infrequently within event feedback surveys. Furthermore, we have not sub-divided by other participant characteristics (e.g. age, gender), only by IMD for two reasons. First, the sample sizes were small for sub-categories of respondents. Secondly, we could not determine who within a household may have answered the questionnaire (and they may have been responding for a number of participants who had different characteristics).

5.1.2 Grant project data

To understand outcomes delivered by grant projects, we used evidence of outcomes from projects reporting using the evaluation's Outcomes Toolkit. This was a small set of outcome questions (compared to GLOs) and a simpler evidence collection process designed in collaboration with grant projects in 2019 and 2020 to encourage a greater volume and consistency of outcomes data. We report on the Toolkit in more detail in Section 6.

Because it was rolled out in early 2021, we only have one year of data from the Toolkit approach. Furthermore, take-up and use of the Toolkit (based on data submitted) was quite limited. Our sample is 4,824 responses from 8-14 year-olds attending 66 events. Projects reported the audience Wonder percentage at the level of an event/cohort, rather than individual IMDs. Our analysis therefore used a simple binary classification of every event:

- 'High Wonder audience' represents events with an audience of over 50% Wonder
- 'Low Wonder audience' represents events with an audience of between 0% and 50% Wonder

In practice, the data was quite polarised, with 55% of the sample coming from events with a Wonder audience of 70% or more, and 30% from events with a Wonder audience of 30% or less.

One of the questions in the Toolkit asked participants about family engagement in science. This was used as a proxy for Science Capital, although a single measure does not fully reflect the complexities of the Science Capital concept. Nevertheless, as Figure 11 shows, there was a significant difference between the responses of Wonder and non-Wonder audiences, with the former much more likely to have answered positively. The high proportion of 'don't knows' for the Wonder audience is also interesting, although the explanation for it is not clear.

Figure 11: "Someone in my family is really into science or works in science" (grant projects)

	Yes	No	Don't know
Wonder	7%	8%	85%
Non-Wonder	27%	15%	58%

Difference	*-20pp*	*-7pp*	*+26pp*

N=2,722. Binary Wonder definition. Source: STFC data

As part of our analysis, we also investigated other outcomes data reported by grant projects from their monitoring spreadsheets (i.e. not using the Toolkit). However, we judged it to be too limited in quality and scale to include in the report.

5.2 Do

Outcomes under this theme focus on how a STEM PE activity may change future behaviour, by encouraging further independent exploration of science, sharing their understanding with others, or considering STEM study or careers. Seeking to understand intention to act is a useful proxy for future action in the absence of opportunities to follow up with participants some time after an event has ended.

5.2.1 Exploring STEM further for themselves

Figure 12Figure 10 shows individual responses from NLPE surveys using a ratings system (where 5 = 'Strongly Agree'). In both periods, Wonder audiences scored marginally higher on average than their non-Wonder counterparts when asked whether the event was likely to encourage them to explore science and technology further for themselves. Average scores for both audiences dropped below 4.0 ('Agree') in 2021and it is not clear whether there was any underlying cause for this.

Figure 12: Explore science and technology further for themselves (NLPE)

	2018-20	2021
Wonder	4.19	3.95
Non-Wonder	4.05	3.83
Difference	*+0.14*	*+0.12*

N= 978 (2018-20) and 889 (2021). Individual Wonder definition. Source: STFC data

Figure 13Figure 11 shows the responses from grant projects using the Toolkit (so 2021 data only). This shows a similar pattern, with both audiences strongly agreeing that the event they just participated in made them want to find out more about science. The proportion was slightly higher for Wonder audiences.

Figure 13: "I want to find out more about science" (grant projects, 2021)

	Yes	No	Don't know
Wonder	89%	5%	6%
Non-Wonder	82%	9%	9%
Difference	*+7pp*	*-4pp*	*-3pp*

N=3,263. Binary Wonder definition. Source: STFC data

5.2.2 Sharing their understanding with others

Data for this outcome was only available from the surveys of participants from NLPE-delivered activities. Figure 14 shows that average scores across the two periods and two

audiences have been high (4 = 'Agree' on a five-point scale), with Wonder audiences scoring very slightly higher than non-Wonder audiences in 2021.

Figure 14: Share their understanding with others (NLPE)

	2018-20	2021
Wonder	4.10	4.33
Non-Wonder	4.31	4.29
Difference	*-0.21*	*+0.04*

N= 799 (2018-20) and 316 (2021). Source: STFC data

5.2.3   Considering future STEM studies and careers

Figure 15 indicates that Wonder audiences were more interested in studying science or working in science after an event compared to non-Wonder audiences (72% and 63% respectively). Both audiences had relatively high proportions of participants for whom the event had not changed their mind, but encouragingly events do not seem to be putting young people off.

Figure 15: "Do you feel more or less interested in studying science or working in science after [event]? (grant projects, 2021)

	More	Less	The same
Wonder	72%	2%	26%
Non-Wonder	63%	3%	34%
Difference	*+9pp*	*-1pp*	*-8pp*

N=3,263. Binary Wonder definition. Source: STFC data

5.3   Feel

Outcomes under this theme focus primarily on the experience of a PE activity or event: how involved or engaged participants were, and whether it was pitched at the right level.

5.3.1   Feeling welcome

Figure 16 shows that scores for feeling welcome were very high (4 = 'Agree' on a five-point scale). The outcome for Wonder audiences was higher than for non-Wonder in 2018-20, but across both periods the differences were not great.

Figure 16: I felt welcome (NLPE)

	2018-20	2021
Wonder	4.77	4.46
Non-Wonder	4.57	4.60
Difference	*+0.20*	*-0.14*

N= 236 (2018-20) and 823 (2021). Individual Wonder definition. Source: STFC data

5.3.2   Right level

We only have substantive data on events and activities being pitched at the right level from surveys during 2021. As Figure 17 shows, scores were positive (4 = 'Agree' on a five-point scale) and very similar between the two audiences.

Figure 17: Pitched at the right level (NLPE)

	2021
Wonder	4.14
Non-Wonder	4.18
Difference	*-0.04*

N= 892. Individual Wonder definition. Source: STFC data

5.3.3   Inspired

We only have substantive data on audiences feeling inspired by NLPE events and activities from surveys during 2021. Once again, scores are positive (4 = 'Agree' on a five-point scale) and very similar between the two audiences.

Figure 18:Inspired (NLPE)

	2021
Wonder	4.25
Non-Wonder	4.30
Difference	*-0.05*

N= 618. Individual Wonder definition. Source: STFC data

5.3.4   Involved

Toolkit evidence is available about whether audiences felt that they were able to ask questions and join in during grant project events and activities. As Figure 19 shows, the affirmative results represent by far the greatest proportion, and are virtually the same across the two audience types.

Figure 19: "I was able to ask questions and join in" (grant projects, 2021)

	Yes	No	Don't know
Wonder	75%	11%	14%
Non-Wonder	74%	15%	11%
Difference	*+1pp*	*-4pp*	*+3pp*

N=2,031. Binary Wonder definition. Source: STFC data

5.3.5   Satisfaction

Figure 20 shows the satisfaction ratings for NLPE events over the two analysis periods. As demonstrated elsewhere, responses are very positive and show little difference between the two audiences.

Figure 20:Enjoyment (NLPE)

	2018-20	2021
Wonder	4.59	4.46
Non-Wonder	4.61	4.54
Difference	-0.02	-0.08

N= 994 (2018-20) and 942 (2021). Individual Wonder definition. Source: STFC data

5.4   Value

5.4.1   Value to society

Figure 21 shows the ratings for NLPE audiences when asked about the contribution of science and technology to society. These average scores are the highest ratings across all of the survey results we analysed and were virtually the same across the two reporting periods and the two audiences.

Figure 21: I recognise science and technology for its economic, social and cultural contribution to society (NLPE)

	2018-20	2021
Wonder	4.86	4.87
Non-Wonder	4.85	4.88
Difference	*+0.01*	*-0.01*

N= 172 (2018-20) and 849 (2021). Individual Wonder definition. Source: STFC data

5.4.2   Future impact of science

Grant projects asked participants about the potential impact of science on the future. The results suggest that Wonder audiences were less likely to change their minds as a result of the experience (Figure 22). Two-thirds of Wonder audiences from grant projects said that they felt more certain that science would have a positive impact on their future after the event compared to 96% among non-Wonder audiences. Wonder audiences were much more likely to say that the event had made no difference to their perceptions (31% vs. 2%). This was the widest variation in responses between Wonder and non-Wonder audiences within the dataset.

Figure 22: "Do you feel more or less certain that science will have a positive impact on our future after [event]?" (grant projects, 2021)

	More	Less	Same
Wonder	67%	2%	31%
Non-Wonder	96%	2%	2%
Difference	*-29pp*	*0pp*	*+28pp*

N=579. Binary Wonder definition. Source: STFC data

5.5   Outcomes for community organisations

In addition to individual-level outcomes, the evaluation of EYU4 – ASDC's strategic programme of PE delivery through science centres – identified some benefits of

engagement for community organisations themselves. For example, with organisations retaining the knowledge and learning from a PE activity so that they could continue with the activities themselves. In another example, some local community partners expressed an interest in being trained to deliver activities themselves. These point to potential lasting impacts within communities through the transfer of knowledge, skills and enthusiasm for science.

6 Building the capacity of public engagement

> **Key findings**
>
> o Wonder is an effective vehicle for STFC to provide a clear lead in the area of broadening science engagement among new and under-served audiences
>
> o Wonder is shaping STFC's approach to public engagement, and is influencing grant processes and applications
>
> o Group learning for PE practitioners has been facilitated through informal drop-ins and has led to some new collaborations
>
> o There is potential to improve the collection and quality of Wonder

6.1 Introduction

In this section we consider the extent to which Wonder has built the capacity of STFC and its partners to deliver PE with Wonder audiences.

We have conceptualised this (drawing on wider capacity building research) as comprising the following elements:

o Setting a clear direction through effective leadership

o Sharing knowledge and good practice

o Providing the necessary resources to achieve success

We also offer some reflections on Wonder monitoring data, which might be regarded as part of the knowledge sharing element of capacity building.

6.2 Direction and leadership

Through Wonder, we assess that STFC has provided a clear lead for science public engagement in the area of broadening participation to new audiences. We have evidenced this from the feedback from project leads; the way in which grant applicants have been encouraged to consider incorporating Wonder audiences into their PE activities; and our knowledge of the efforts STFC have made to promote Wonder more broadly, for example through social media and at STEM/PE events.

Wonder as a concept has provided a framework for the focus on low science capital audiences – seen through the lens of socio-economic disadvantage. The Wonder definition, while broad, is widely understood. None of the people we spoke to during the evaluation had any problem understanding what Wonder audiences were or why they are

a particular focus. The use of the term 'Wonder' was also welcomed as a positive construct that did not infer disadvantage or deficit.

> *"People know exactly what you mean [when you mention Wonder] without having to go into huge detail"*
>
> *"Wonder gives you a target to aim at"*

We understand that within UKRI, Wonder has been used as an example of good practice and may in due course influence wider public engagement strategies.

> *"It's the lens we apply to everything…it will always be an active consideration in what we're doing – grants and programming…it's hard to imagine it going away" (STFC stakeholder)*

For projects, Wonder has represented a welcome way of reinforcing the importance of extending engagement beyond those audiences already convinced about science.

> *"The fact that the funder is specifically saying, 'go to these audiences' is really, really good and it focuses people's minds…otherwise people will do the easy thing"*

Some project leads expressed a belief that engaging Wonder audiences should ideally be the norm rather than the exception, although recognising that this was not currently the case.

> *"Even for those for whom it's not a focus, they have to ask themselves 'why not' [Wonder]? Why wouldn't you if you can?"*
>
> *"[working with Wonder audiences] gives the best return for investment"*

When speaking to NLPE practitioners, we heard a common and positive view about the way in which STFC was supporting them to pursue Wonder activities.

6.3   Sharing knowledge and good practice

During the evaluation, we trialled two approaches to collaborative learning with Wonder project leads: monthly online video 'drop-ins' and use of a dedicated Slack channel.

6.3.1   Monthly drop-ins

In August 2020 we began hosting monthly drop-in meetings via Zoom for Wonder project leads (primarily grant holders). The intention was to provide some group support to project leads who were having to deal with a number of challenges related to Covid-19. All project leads were invited but there was no obligation for them to attend. The tone was kept deliberately light – they were lunchtime sessions and some people ate their lunch during the call.

While the sessions were facilitated by the evaluator, the subjects covered in the sessions were predominantly chosen by the participants. They covered subjects including evaluation of online activities, safeguarding, and website design. Around these subjects, the sessions allow participants to share stories from their projects and give and receive mutual support. STFC also regularly attended so there was a chance to ask questions of the grant funders.

The drop-ins ended in April 2022 as the evaluation fieldwork came to an end. The feedback has been very positive from those who attended (see quotes below), although only a proportion of grant holders took part – about one third – and fewer still (6-8) were regular attenders.

> *"The kindness of it is really helpful"*
>
> *"I probably plug in more than if it was a formal session"*
>
> *"It led to things we wouldn't have done otherwise"*
>
> *"It's space for reflection as well as gathering information"*
>
> *"I didn't learn anything specific but I usually left the meeting feeling better…it's good to hear you're not the only one struggling with things"*
>
> *"It's been really supportive. It's helped raise my game"*

We know of at least three instances where grant projects collaborated with each other as a result of connecting through the drop-ins. They would not otherwise have known about each other and, while small in number, suggest that concrete opportunities can result from such interactions.

Not all project leads were as positive about the drop-ins. Small in number, they tended to be more experienced practitioners who gave more than received during the sessions that they attended. We understand also that STFC provides separate regular drop-ins for all of their PE grant holders (i.e. not focused on Wonder). This created confusion for some project leads and led to some comments about duplication and a lack of coordination.

6.3.2   Slack

At the same time as the monthly drop-ins, we also created a Slack channel for Wonder project leads. Slack is a collaborative online workspace for communication and file sharing. The intention was to use this as another form of peer-to-peer support and information sharing between Wonder projects. In practice, it has been little used by the projects themselves. Project leads report not needing the channel – most are content with the drop-ins as their means of keeping in touch and sharing information and learning – and some felt 'Slacked-out' due to the number of online collaborative channels and systems they were already part of through their other obligations.

6.4   Providing the resources to achieve success

Finance was not part of the remit of this evaluation, so we are unable to comment in any great detail on the value or appropriateness of funding. Grants are the main mechanism through which STFC can influence and support Wonder activity and they report that Wonder is now much more likely to be mentioned in, and relevant to, grant applications.

> *"We're able to prioritise [grant decisions] around the Wonder initiative…some applicants may only make a passing reference [to Wonder] but we can work with those grant holders to improve their understanding and take Wonder more seriously"* (STFC stakeholder)

Generally speaking, existing Wonder projects considered that they had been appropriately resourced for the work that they intended to carry out. The one exceptional element to this was monitoring, where the data collection demands – particularly for smaller projects – were an area of minor complaint. We return to this in the next sub-section on monitoring.

More generally, Wonder project leads were very positive about the support they had received from STFC, particularly in the light of Covid-19. They commented on the understanding shown by STFC in the face of multiple pandemic-related issues (school closures, furloughed staff, etc.), which allowed them to respond flexibly to the challenges they faced. Several contrasted this with less supportive approaches of other funders.

> *"I didn't get that [kind of support] from any other funder"*
>
> *"hugely supportive and flexible"*

As a result of the pandemic, many projects were granted unfunded extensions which relieved some of the anxiety project leads felt about their inability to meet original deadlines for delivery. Project leads also appreciated the willingness of STFC to accept sometimes quite dramatic changes in activity as alternatives were found that were deliverable online, or when existing activities could only accommodate smaller numbers due to Covid-19 restrictions.

6.5   Monitoring data

6.5.1   The challenge

The collection and – more importantly – use of monitoring data affords STFC and projects the potential to improve their knowledge and understanding of what works in Wonder delivery.

The effort devoted to monitoring activity, particularly for projects in receipt of relatively small grants, is in our broader experience always an area of some tension. Wonder is no different. NLPE and grant projects spend a lot of time and resource collecting data about

event participants: who they are (reach) and what they get out of the experience (outcomes).

In our analysis of data, we found collection (and completion/submission) to be inconsistent between and within the different project 'types' (NLPE, the different grant award schemes and strategic projects). Of these, NLPE was most consistent. This is perhaps not surprising given the scale of the organisation's PE efforts and the long term nature of much of its activity.

The reasons for these inconsistencies are various. Some of it is due to the capacity of projects to collect and collate data; the practicalities of data collection at a given event; and the relative freedom granted to projects to decide on their own monitoring approaches. Just as Wonder is a diverse set of audiences, so is the set of Wonder projects.

There is no easy solution to the challenge of improving data collection, and making better use of it, while simultaneously minimising the burden on PE practitioners. For Wonder, however, we would highlight some particular challenges that arise from the evaluation:

Identifying Wonder audiences

The most significant new data point needed to monitor Wonder activity is the Wonder identifier itself. Other participant characteristics (e.g. age, gender) were already part of normal STFC monitoring requirements. The IMD proxy, while not without its problems, remains probably the best option (see Appendix 2 for a review of alternative options). It is currently most frequently used in terms of the location of a PE activity (primarily schools). Getting individual IMD data depends on a postcode which is personal information and has proved more difficult for projects to collect.

If there is a preference for easing the demands placed on projects (in the hope of better data) it may be worth reinforcing the place-based metric used so commonly for schools as the norm, i.e. the postcode of the location where a Wonder event takes place. Online tools are readily available to help with identification. This may also serve to encourage further delivery within Wonder communities, although it doesn't exclude non-Wonder audiences from elsewhere attending (see our comments on good promotion).

This isn't a perfect solution of course:

- It works less well for organisations like STFC (and NLPE specifically) who seek to bring Wonder audiences in to experience their facilities. Similarly, some university-delivered PE is in part about welcoming Wonder audiences into their institutions.

- It leaves the Wonder definition at the level of the event rather than the individual: a 'Wonder' event may include participants from non-Wonder communities. However, the data we have analysed for this evaluation tends to show events are relatively but not completely polarised.

- It doesn't work for virtual delivery where there is no 'location'.

6.5.2 Lessons from the Wonder toolkit

As a result of conversations with STFC and project leads during 2019 and 2020, we agreed to design an outcomes toolkit for Wonder projects (see Appendix 3). It was co-created with project leads to address some of the issues listed above, namely to simplify the evidence-gathering process in the hope of improving the volume and quality of data.

The toolkit covered seven data points, as set out in Figure 23. Wonder projects were expected to use this as the minimum level of data they collected from their events, although they were encouraged to gather more if possible. Advice was provided on how to collect the data (for example, at which points before, during or after an event the information should be gathered).

Figure 23: Wonder outcomes toolkit – the seven data points

Category	Explanation	Specific data points
Context	Background and baseline information on participants	o Age o Deprivation o Current exposure to science
Reaction	The immediate views of participants having taken part in an activity	o Felt welcome o Felt inspired
Reflection	More reflective views on the implications of the experience for participants	o View science as relevant/valuable o Consider science as a study and/or career choice

The Wonder dataset covering 2021 includes some evidence from Wonder grant projects using the toolkit, but participation was very limited. Despite our and STFC's attempts to encourage its use, only five Wonder projects used the toolkit and reported the results. The main reason put forward for not using the toolkit was that it had come too late in projects' development and delivery to alter monitoring processes (e.g. event feedback forms). This was disappointing given the efforts that had gone in to securing projects' involvement in the design and rollout of the toolkit. It also makes it difficult to draw any substantive conclusions from its use.

Those who used the toolkit (and many who didn't) regarded it as a practical and understandable approach to data collection. Reducing the number of outcome options was particularly welcome. The data from those who used the toolkit was, on the whole, well presented and understandable.

7 Modelling an audience-focused approach

> ### Key findings
>
> - Wonder projects demonstrate an ability to reflect the needs, interests and life experiences of their audiences
>
> - This is driven primarily through open, constructive, well-balanced relationships with community partners which take time to develop
>
> - PE practitioners need to be proactive in pursuing Wonder-connected partners while being mindful of the power dynamics
>
> - There may be a set of characteristics emerging for what Wonder PE practitioners need to succeed

7.1 Introduction

In this section we explore the extent to which Wonder has modelled an audience-focused approach to PE. Evidence is taken from interviews with all evaluation stakeholders.

It is important to note that neither the Wonder initiative nor the evaluation sought to mandate a particular approach to this aspect of delivery, or what 'depth' of consultation or co-design was necessary. This section therefore considers the evidence across a spectrum of what might be considered audience-focused approaches and how these might inform future PE activity.

7.2 What is an audience-focused approach?

Research indicates that public engagement interventions that consider the needs of the target audience from the very start of the design process (and throughout) are more likely to succeed in generating positive engagement. For example, research by the Wellcome Trust in 2014[10] explored how young people from low social economic status families could best be engaged in informal science learning. One of the key themes identified was collaboration: involving young people in the planning, design and execution of activities meant that activities were developed with the skills and needs of young people at their heart and were much better-placed to foster sustained engagement.

This is likely to be particularly important for Wonder, which is specifically seeking to broaden the base of science engagement with those audiences who have not previously

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[10] https://iiif.wellcomecollection.org/file/b21243402_experiments%20in%20engagement.pdf

been engaged through 'traditional' approaches. This implies a lack of focus on these audiences in the past.

In this evaluation, we define audience-focus as **the extent to which a PE activity reflects the needs, interests and lives of its audiences**, which will often depend on:

- The understanding of the audience by the PE practitioner. This may be prior knowledge or previous experience of working with the audience as a minimum.

- The ways in which audiences – as individuals, groups or via intermediaries such as community organisations – help to design, shape and sometimes co-deliver the activities.

- The extent to which the outcomes of an activity are relevant to the audience.

7.3 Factors that drive an audience-focused approach

7.3.1 Working through community partners

For some projects, an audience-focused approach has involved working with and through other organisations; organisations who are better-placed to engage target communities, recognising that PE practitioners do not always know their intended audiences well.

The organisations that projects have worked with have been highly varied, from minority ethnic community organisations to cubs/brownies and local science festivals. During the pandemic, projects sought to work with a wider range of partners and organisations to facilitate engagement with Wonder audiences. There were examples of projects using food banks, family support centres and social exclusion charities to reach the right communities.

STFC also organised 'Wonder Match' events in 2018 and 2019 to encourage community organisations and PE practitioners to come up with new collaborative projects.[11]

Project leads emphasised several important factors when successfully working collaboratively with community organisations:

- Listening to and understanding the needs of the target communities, as explained by the partner organisations, recognising their expertise and knowledge of the locality. This came through particularly strongly from the EYU4 evaluation.

- Being willing to be flexible with the science that is to be delivered, ensuring that it fits with the life experiences and interests of the community.

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[11] https://www.publicengagement.ac.uk/nccpe-projects-and-services/nccpe-projects/stfc-wonder-match

o   Creating lasting relationships with contacts. This is much easier for projects with more of a lasting local presence (as in the case of some NLPE projects, for example).

> *"You have to spend time understanding the community landscape."*
>
> *"Take your time. Build in a lot of time to just wait for things to happen. Be aware that your timescales and other people's timescales won't always match and you have to be flexible."*
>
> *"What's most important to them is not what we tell them; it's what's important to their lives."*
>
> *"Community centre partnerships know their audiences much better than I do. You can't go in thinking you know everything. You have to listen and then approach with the right personality. So by time you run an event, you've heard it all and people feel comfortable walking through the door. It's like a house – it has to feel right walking through the door."*
>
> *"It's about creating friendships. That doesn't happen overnight and there's no science to it. It's about finding common purpose."*

7.3.2   Being proactive

Project leads told us how important it was to be proactive in seeking out relationships and partnerships in target communities, and then driving collaborative engagement. They contrasted it to more traditional approaches where activities tended to be standardised and better-resourced audiences would take the initiative in signing up.

> *"Where before we were responsive [to enquiries] we have had to become more proactive…That takes more relationship-building, seeking out other organisations and thinking through why we would work with them."*
>
> *"If you're not careful, you spend all your time talking to quite well-resourced people because they are the ones who have the capacity to proactively say: will you come and give a lecture in our school? You do actually have to seek out the less privileged audiences and proactively put the effort in to reach them."*

7.3.3   Having the right personal approach

From interviews, we have identified a number of personal traits and characteristics among PE practitioners that, in our estimation, improve the chances of delivering a more audience-focused approach:

o   An understanding of collaborative methods and processes: these are not necessarily approaches that are commonly used or understood by those who deliver PE projects – a cohort that draws people in from a wide range of

backgrounds (and therefore skills) including academia, not-for-profits and commercial science.

- A enthusiasm for reaching and engaging new audiences: it should not be taken for granted that all PE practitioners want to work with Wonder audiences *per se*. Sometimes that enthusiasm is evident from different perspectives, such as a broader desire to see social justice. Several project leads said that working with Wonder audiences was more rewarding as an experience.

- A willingness to relinquish power and leadership: as noted earlier in this section, it's important that PE practitioners are willing to give up some control over their projects to pursue a more audience-focused approach, and this is not always easy to accept.

- A degree of lived experience: several of the PE practitioners we spoke to had themselves come from what might be described as non-traditional science backgrounds. This clearly reinforced their motivations to enthuse similar audiences about science and acted as an additional driver.

We describe these as personal traits and some of them, such as lived experience, cannot be learned. But the majority of them are teachable, and this may be an area for funders of PE to consider lending support. Equally, those most committed and passionate to engaging new audiences in more collaborative ways may serve as excellent people to champion the cause with their PE practitioner peers.

> *"[Wonder] gave me confidence that it wasn't just my crusade"*
>
> *"It's a chance for us [in disadvantaged communities] to be heard"*

7.4   Differences between projects

In our analysis, we identified some differences between projects as follows. These are very general observations based on our qualitative fieldwork.

With several notable exceptions, grant projects appeared to be a bit less flexible when it comes to working with audiences in designing activities. We are speculating, but we think that this may be due to several factors:

- Many of the grant projects worked with schools and our sense is that this leaves less opportunity for a more audience-focused design: working with pupils to co-create projects is very time-consuming, while schools often seek quite specific content to meet the needs of the curriculum.

- Some funding has gone to projects with an existing track record of delivering particular activities, and so there has been a tendency to continue with a tried and tested approach rather than take delivery and engagement in wholly new directions.

- A lot of the grant projects we engaged with had relatively small budgets which may have left less room for more collaborative approaches.

- Grant processes tend to require grantees to deliver what they have described and been funded for, leaving them only a small degree of additional adaptability.

> *"It's harder [to co-design with schools] than with a community organisation. Teachers just don't have time, and the STFC offer is too big – you need to go with at least a theme or outline. Sometimes the finished plan looks very different to the original outline."*

Asking questions in Bristol

We The Curious, a science centre in Bristol, collaborated with a local primary school in a very deprived area of the city to encourage an interest in science. Working with three space scientists, the pupils came up with 180 questions about space science and these were used to frame subsequent activities. Content generation based on the questions included animations using flipbooks, and a film which was created entirely by the pupils themselves.

The project found that, beyond outcomes focusing on science, pupils have benefited by developing the skills of enquiry and agency, building a skillset for further learning and exploration.

NLPE practitioners were commonly very committed to audience-focused approaches where this was feasible within their wider PE portfolios. They stressed the importance of listening and responding to the needs of audiences wherever possible.

The two strategic projects have done possibly the most in a practical sense to embrace the most collaborative approaches. Audience focus was more embedded into their aims and objectives from the outset, and they have had the resources to devote to exploring new ways of engaging audiences in design and delivery.

Explore Your Universe

EYU4 was designed with the specific intention of co-developing activities with audiences, primarily through and with community partners. The project's evaluation identified several key features of good co-development:

- o Establishing close, collaborative relationships with community partners
- o Sharing leadership, with science centres leading on content but community partners leading on interpretation of that content in a way to make it accessible to audiences
- o Having an open, inquiring relationship where clarity of purpose is generated through asking lots of questions
- o Flexibility both in terms of content and the amount of involvement offered by and available from the community partner
- o Taking time to develop a relationship and collaborate to design activities
- o Give ownership and agency to participants, make them feel part of the process

One of the outputs from the EYU evaluation was an Inclusion Handbook which draws on the evaluation findings to provide guidance to science learning practitioners on issues including community engagement, partnership working, and evaluation with a focus on equity and inclusion.

The Inclusion Handbook is available [here](#).

7.5   Is there an effect on reach or outcomes?

7.5.1   Reach

We might assume that a more audience-focused approach would be more successful in reaching the communities at which a PE activity is targeted. Certainly, developing partnerships with community organisations does seem to have been successful in bringing PE activities into Wonder communities.

However, it is also clear that the amount of time and effort required for a more collaborative, co-designed approach requires a degree of additional resource that does not necessarily result in larger reach, i.e. in the number of people who participate.

As we mentioned earlier in this report, this trade-off is something that STFC are conscious of, accept, and communicated this to grant holders. However, it was clear from our conversations that some project leads remained anxious about whether they might be penalised for delivering lower reach numbers, so the principle (of this being an acceptable trade-off) may need further reinforcement.

7.5.2 Outcomes

The interest in audience-focused approaches is based on an assumption that a greater audience focus will generate more or better outcomes for the participants. There is not enough evidence in this evaluation to make an assessment either way – it was not a focus for the evaluation – although it would be an interesting area for future research.

7.6 What has been the specific contribution of the Wonder initiative in modelling an audience-focussed approach?

While we highlight above a range of findings related to audience-focused approaches, it is difficult to attribute these directly to the initiative itself. Most commonly, project leads established their own approaches based on their existing experience and knowledge of their intended audiences. However, there are a number of factors which are likely to have helped including:

- Wonder Match: a process which sought to facilitate engagement and partnership between PE practitioners and community organisations

- The initiative's focus on a defined Wonder audience, as opposed to the public more generally, which helped deliverers to hone in on particular groups

- Providing opportunities for PE practitioners to exchange ideas and work together

What wasn't available, however, was a forum for the community organisations to come together – alone or with PE practitioners. One or two project leads noted the absence of a community voice in the regular Wonder drop-in sessions, for example. This is something that might be worth considering in future.

8   Conclusions

8.1   Introduction

In this section we draw together some final conclusions from the evaluation grouped under the evalution's key questions.

8.2   To what extent has Wonder been successful in reaching greater proportions of Wonder audiences through its activities compared to pre-Wonder performance?

Through the Wonder initiative, STFC set out "to significantly increase the proportion and absolute number of STFC's reach that is with audiences from socioeconomically deprived areas of the UK". In terms of the proportion, Wonder appears to have made a noticeable difference. The 40% 'threshold' was never a target as such, but STFC may wish to consider it as a notional benchmark or floor target for future years, representing as it does the point where Wonder reach in PE activities broadly matches the proportion of people living in Wonder communities across the UK.

The 40% level represents a degree of equality of engagement; a point at which Wonder audiences have broadly the same representation in STEM PE as their non-Wonder counterparts. It might be argued that Wonder audiences should represent a much larger share of STEM PE than 40% to address long-standing inequalities in access to opportunities.

The absolute reach among Wonder audiences has not increased year-on-year. In 2020 and 2021, it was lower than pre-Wonder (2018) levels, although 2021 figures are likely to grow retrospectively due to retrospective data entry. This has not adversely impacted on the Wonder audience proportion because the reach among non-Wonder audiences has also fallen. It is difficult to discern a specific reason for these falls, although we suspect that Covid-19 is a factor. However, absolute numbers are certainly metrics that STFC should continue to monitor closely, particularly to determine if Wonder is resulting in lower volumes more generally.

8.3   What has been learned about how best to engage and enthuse Wonder audiences about STEM?

We highlighted the issue of school engagement in this section because of the weight put behind it by so many PE practitioners. We considered schools to be viewed rather differently as partners compared, for example, to community groups. Relationships with the latter are discussed as part of the reflections on audience-focused approaches. School engagement felt more like a gateway process, with schools less flexible in terms of how

activities could be tailored to specific groups (because of curriculum requirements, fewer opportunities for co-design with pupils and other pressures).

With so much PE activity necessarily being delivered via schools, there deserves to be some acknowledgement of the difficulties in engaging these institutions and the time and effort it is requiring many project leads to succeed (further complicated by Covid-19 during the course of the evaluation period).

With all audience groups, not just schools, preparation appears to be the key to successful Wonder engagement. It's about not making assumptions about the assets available to Wonder audiences: physical and intangible assets like transport, time, materials, and educational ability. It's also about recognising the potential diversity of audiences (and their needs) and thinking through what that means for effective delivery.

In terms of content and approach with Wonder audiences, PE practitioners generally did not see their delivery as being markedly different to their usual ways of working, with a few exceptions. As we saw in the outcomes analysis, outcomes are similar between Wonder and non-Wonder audiences, so it is perhaps more about initial reach and engagement that makes the difference rather than the content of the activities themselves. However, we would note that many of those PE practitioners we spoke with during the evaluation tended to have prior experience of working with Wonder audiences, were already committed to reaching new audiences, and so we may not have seen much of what might be described as 'traditional' non-Wonder delivery to make a comparison.

Virtual or blended PE delivery has extended beyond the more intensive pandemic periods and is likely to continue. There are practical and financial reasons why these approaches are now part of the PE delivery mix compared to when we began this evaluation. But for Wonder audiences, it is something of a double-edged sword. Once again, it risks PE practitioners making the wrong assumptions about the access audiences may have to the physical and virtual resources needed to engage (and the routes through which events are promoted). Furthermore, practitioners need to be fully equipped to make the most of digital opportunities to ensure they engage and enthuse. It is still a relatively new operating space for many of them.

8.4 In what ways is Wonder making a difference (in terms of outcomes) to its target audiences?

The evaluation evidence supports wider research about science capital: audiences from more socioeconomically deprived backgrounds were much less likely to have been to an STFC event before; they were also less likely to know someone in their family who was into, or who worked in, science. Furthermore, it demonstrates that PE events – be they NLPE or grant-funded projects – appear to be reaching new STEM audiences.

Once at an STFC event, the evidence suggests that Wonder audiences feel broadly as welcome, inspired and involved as their non-Wonder counterparts. This suggests that the events themselves are tailored well to a range of audience backgrounds. Future intentions

– to explore science further, to consider STEM careers and study, and to talk to others about their experience – were also similar across the two audience types, with Wonder audiences being slightly keener to share their experiences and consider future STEM studies and careers. Again, this points to events that are appropriate to their audiences, irrespective of background. It's an encouraging finding.

The only major difference in the outcome results was about the future impact of science, which Wonder audiences scored much lower than their non-Wonder counterparts. It is not clear to us why this should have been so different: whether it is a statistical anomaly or an indicator of a more fundamental difference in the ways the two audiences engage and/or what they take in from PE activities.

One broader observation from this data is how positive it all is. This is by no means a criticism, but when almost all average scores on a five-point scale are above four, there is a limited amount to explore.

8.5   To what extent has Wonder built the capacity of STFC and its partners to deliver public engagement with Wonder audiences in the future?

The Wonder initiative is successfully building capacity to support future Wonder public engagement. It has a good and understandable conceptual framework. It has strong backing from STFC's PE teams who have taken a lead and integrated Wonder thinking into their own PE delivery. Wonder is beginning to shape PE grant decisions and other processes in STFC and is has the potential to be something of an exemplar to other funders.

Knowledge about engaging with Wonder audiences is being shared, especially between grant projects. More engagement between those projects and NLPE would probably help even further, even though delivery contexts are a little different. Overall, informal networking and conversations seem to be the preferred learning approach, especially for those PE practitioners who are new and/or do not work in larger institutions. This informal networking is generating new collaborations between practitioners.

While we have not evaluated project finance, feedback suggests that they are appropriately resourced and project leads have in general been very positive about the support they receive from STFC. Their flexibility during the Covid-19 pandemic was especially welcome.

Monitoring data remains a challenge, and probably always will be given the diversity of projects, settings, methods, deliverers, and audiences. The one new important characteristic for work with Wonder audiences is socioeconomic disadvantage as the proxy measure for science capital. IMD is still probably the right measure, despite the difficulties of securing it from individual participants. There may be an option to focus on IMD for delivery locations rather than individuals for some projects.

More generally, there may be potential for a more graduated approach to monitoring demands. Small, 'one-touch' projects will necessarily have less resource and opportunity to gather information, particularly on outcomes. Others may welcome the challenge of seeking evidence of longer-term impact, but this may require additional support.

The toolkit designed in the course of the evaluation may be a good start in simplifying data collection – it was viewed positively by the small number of projects that used it. But it needs to be used by more projects – from the start of their delivery – for us to be certain about its practicality.

8.6 To what extent has Wonder modelled an audience-focused approach to public engagement?

Wonder projects have been able to demonstrate an ability to reflect the needs, interests and life experiences of their audiences. This has been driven primarily through open, constructive, well-balanced relationships with community partners. These take time to find and to develop – PE practitioners have to do the hard work in finding the right partners – and require flexibility, a willingness to listen to the needs of communities, and the ability to share power and control over events.

While the Wonder initiative has helped to encourage this audience-focused approach, for example through Wonder Match, the ideas and approaches used have come more from the prior experience and creativity of the PE practitioners themselves.

There may be a set of characteristics emerging for what PE practitioners need in order to succeed when engaging Wonder audiences. These include:

- An understanding of collaborative methods and processes
- A passion for reaching and enthusing new audiences
- A willingness to relinquish or share power and leadership with communities and audiences
- If possible, a degree of lived experience.

The difference seems to be in the approach, the mindset, and the motivation more than the content of delivery. Whether this is for every PE practitioner remains to be seen. Some of the traits we have identified can certainly be taught – and STFC may wish to consider the value in doing so – but others are personal. Wonder to date has tended to work with PE practitioners who were already bought into the Wonder concept before the initiative began. The longer term challenge for STFC is whether this focus on Wonder can be expanded beyond these 'early adopters'. Emerging evidence from STFC's PE grants programmes would suggest that Wonder is being considered more frequently among a wider group of practitioners.

What we are not able to say on the basis of the evaluation's evidence is whether, or to what extent, different degrees of audience focus translate into reach metrics or outcomes performance. This would be worthy of further investigation.

9   Recommendations

9.1   Introduction

This final section includes some recommendations based on the findings of the evaluation.

9.2   STFC

9.2.1   The Wonder initiative

- Promote an assets and needs-based model for Wonder engagement, seeing PE as being responsive to communities' wishes and interests rather than assuming communities must accommodate the requirements of PE deliverers. This will help to rebalance the power in PE-community relationships away from traditional 'figures of authority' (PE practitioners, academics, scientists) and on to the communities themselves. EYU4's Inclusion Handbook[12] is a good resource to demonstrate this ethos and is deserving of STFC's promotion and dissemination.

- Retain – but keep under review – the strategic principle that a reduction in overall reach volumes is an acceptable consequence of placing a stronger focus on engaging underrepresented (Wonder) audiences, and that engagement with these audiences takes time; and seek to encourage other funders/grants panels to adopt a similar approach.

- Retain the current deprivation definition of Wonder (40% most deprived by IMD). While not perfect, it is not too restrictive on PE activity, is easy to describe, already has some traction within the PE community, and we are not aware of a better, simple-to-monitor proxy for underrepresentation.

- Use 40% as the minimum expectation for the proportion of PE audiences that should come from Wonder communities across STFC-supported PE activity as a whole, although STFC should aim to exceed this proportion as a stretch goal (given 40% represents a measure of equality of access only). Individual projects may have specific reasons for not being able to meet this threshold, but some projects may also wish to be more ambitious with their targeting, either among Wonder communities more generally, or specific groups and intersectionalities that exist within under-represented audiences.

- Retain Wonder as an initiative rather than, for example, a ring-fenced grant programme. Wonder appears to be influencing PE practitioners and generating positive debate about inclusion and wider PE reach as it is. Giving the initiative

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[12] https://www.sciencecentres.org.uk/projects/explore-your-universe/inclusion-handbook/

more defined boundaries risks creating an impression that reaching new and more underrepresented audiences is something for specific projects or programmes rather than a more universal ambition.

- Explore the value of looking in more depth at Wonder communities for pockets of greatest need. The current definition is broad, which is important to encourage more activity in the Wonder space without making it seem too difficult for those new to the idea. But some PE practitioners who are more advanced in their thinking or who are particularly motivated by Wonder might be interested in taking the concepts further.

9.2.2 Support for PE practitioners

- Provide a platform to allow PE practitioners interested in Wonder to continue to share stories, collaborate and support one another. The evaluation found that informal online discussions worked best. This need be little more than a monthly or quarterly meeting following an agenda set by practitioners themselves. It may be possible to find a practitioner who is willing to lead on this community of practice, thereby limiting the burden on STFC.

- Broaden any collaborative platform to include STFC's own PE practitioners and encourage their participation. While it made sense for their participation to be restricted when the evaluation was using meetings to discuss learning with grant funders, it is clear from our research that NLPE staff have much to offer their grant-funded peers in terms of ideas, experience and thinking around all aspects of Wonder engagement, and vice versa.

- Support the development of PE practitioners' skills and knowledge in the area of collaborative working. This may be simple signposting/encouragement during the grant application process through to something more tangible and resource-intensive such as training and professional development.

- Support the development of PE practitioner skills in the area of virtual and blended delivery, ensuring that they are able to make the best use of new methods of engagement.

- Provide clarity in grant application and monitoring processes to ensure that grant holders understand clearly their obligations – particularly around reach and engagement numbers. Consider encouraging an outcomes-based approach to project design which enables greater flexibility when it comes to delivery.

- Ensure that grant funding and support reflects the likely increased time and resources required to engage with Wonder communities.

- Reflect on the success of Wonder Match and consider whether there is scope and value in STFC being more proactive in facilitating links between PE practitioners and community organisations.

9.2.3   Monitoring

- Retain IMD as the key Wonder identifying characteristic, but consider wider promotion of a location-based IMD metric – beyond schools – where projects are working in and with communities.

- Consider graduating the monitoring requirements placed on grant holders to ensure they are proportionate to capacity and resource, particularly at the small project end of the scale. Further testing of the toolkit may demonstrate its potential here.

- Explore the potential to include additional funding specifically for monitoring and evaluation where individual projects might offer opportunities for greater understanding of Wonder audiences and the longer term effect on outcomes.

- Consider ways of sharing monitoring outputs back with projects to demonstrate how their information is used and the value of good data collection. This may improve collection and submission rates.

9.2.4   Areas for potential further research

- Examining the role of adults from Wonder communities in encouraging an interest in science among children and young people, and specifically how PE projects can maximise their impact with adults and demonstrate the impact of doing so. Much PE activity is concentrated on influencing the ambitions and aspirations of younger people to enable them to make more informed decisions later in life. However, we also know from the science capital research how influential adults can be on children's perceptions of and interest in science.

- Longitudinal monitoring of impact among Wonder audiences involved in projects with multiple activities/touchpoints to understand the longer term impact of PE engagement on views of and aspirations towards science study and careers. Tracking pupils through key educational stages would help to identify a which stage(s) the influence of PE activity has the greatest chance of 'sticking' as children grow and develop.

- Exploring and understanding in more detail the specifics and intersectionalities represented within underrepresented audiences currently defined as being Wonder.

- Exploring the extent to which Wonder and non-Wonder audiences may have different outcomes from PE interventions.

- Analysing the PE workforce to understand the extent to which its characteristics reflect the Wonder communities with which it is seeking to work; and attitudes towards engaging Wonder audiences.

- Exploring the extent to which different audience-focused approaches make an impact on Wonder audience outcomes.

9.3   Public engagement practitioners

Many of these recommendations are variations of those we have suggested for STFC. This reflects our assumption that, in some circumstances, PE practitioners may be able to effect change directly without waiting for, or requiring, direction from STFC.

9.3.1   Project design and delivery

○   Where possible, place under-represented audiences at the centre of what you do

○   Adopt an assets and needs-based approach to working with Wonder communities: avoid focusing on deficits and disadvantages, understand the resources that they bring to the table and what they want to get out of an activity. This involves listening and sharing power and authority. It may also require adapting project objectives to be more suitable to the wants of the community.

○   Seek where possible to design and deliver projects with multiple touchpoints with Wonder audiences to generate more lasting impact and provide opportunities to understand how interventions affect audience outcomes over time.

9.3.2   Monitoring and evaluation

○   Approach monitoring and evaluation from the perspective of it as a potential benefit to learning and understanding rather than as a funder obligation. Be open to opportunities for gathering evidence on the impact of activities.

9.3.3   Informal collaboration

○   Develop and use informal networks to share knowledge and learning about engaging with Wonder audiences. There is a lot of experience already out there.

9.3.4   Skills

○   Continue to develop an understanding of the collaborative methods and processes that help to work in partnership with community organisations and audiences, especially those that are underrepresented.

○   Develop or maintain strong online communication skills to ensure that virtual or blended delivery has the potential to be as engaging and impactful as face-to-face interaction.

10 Appendix 1: data

10.1 General observations

We make the following general observations about the data and its analysis:

- We have not considered the geographic spread of audiences. For the National Labs in particular, audiences frequently come from close to the STFC sites so geographic representation may be misleading. Furthermore, increased online delivery in 2020 and 2021 due to Covid-19 has meant that the geography of participants is often not known.

- We have used IMD databases to determine whether a school might serve a Wonder community, based on the school postcode. This is not a very accurate measure of deprivation, as a school's postcode refers only to its site and not its catchment area, but it is our agreed indicator for the analysis until a better (i.e. more accurate and easily determined) alternative is available.

- We have had to make some pragmatic judgements on occasion where we were unsure of specific data points (for example whether a number represented a percentage or not) so our numbers may not match those used by STFC for its own reporting purposes.

10.2 STFC NLPE data

10.2.1 Explanation of analysis

Data was provided by STFC for all National Labs PE projects for the calendar years 2018 to 2021 across three sites (RAL, Daresbury, and the Royal Observatory Edinburgh). Data was broadly consistent in terms of formatting and content from all three sites.

The reach data in Section 3 was sourced as follows:

- **Total audience engaged**: data from column 'Total number of attendees'

- **Total audience engaged from 40% most deprived areas**: where data was collected by STFC it reported 'Percentage of audience from Wonder demographic' on an event-by-event basis. We understand that this is often based on the IMD for a participating school. We have used this percentage multiplied by the event's audience (Total number of attendees) to estimate numbers for the Wonder audience. IMD data is not available for every event, so we have scaled up to total reach based on the proportions available from those events where IMD has been provided.

- **Total audience engaged aged 8-14 years old**: this is summed from three columns of data in the source spreadsheets which best match this definition: 8-14 year-olds attending public events plus school pupils in upper primary and lower secondary

10.3 Grant project data

10.3.1 Explanation of analysis

Project data was provided by STFC for the calendar years 2018 to 2021. The data was provided in two parts:

- ResearchFish entries which we used for overall numbers as it had been completed more systematically by projects and therefore was more manipulable

- Metrics spreadsheets which provide STFC with more information on individual projects and 8-14 year-olds. We used this data for assessing the 'Wonder' nature of events (see below)

It should be noted that spot tests of the data showed inconsistencies between data of similar or equal fields reported in both forms (ResearchFish and metrics spreadsheets). We are unable to account for the reasons for this but we flag it as a data health warning.

Grant projects report reach by event and by resource. For simplicity (and to allow the merging with National Labs data) we only analysed event metrics. So in practice, reach would have been wider if resources (such as booklets and posters) had also been included.

The grant project data was much more susceptible to variation depending on whether particularly large audiences for given events were included or excluded. This is very much a judgement call. We eventually decided to exclude just one particularly large outlier from the data (an event reporting an audience of 5 million) which was the only event reporting an audience of over one million.

Because grant holders are able to update their ResearchFish data retrospectively, the figures for any given year change over time. This might, for example, include grant holders who missed the data submission deadline. In the interim evaluation report, we reported the figures for each year from the corresponding year's dataset (i.e. data for 2018 delivery came from the 2018 spreadsheet). However, further analysis for the final report confirmed that this under-reported the cumulative values.

Figure 24 gives the example of 2018 reach data, as reported via ResearchFish over four consecutive years. For the final report, we decided to assume that the most recent data was the most accurate. We have therefore used the data provided in the most recent (i.e. 2021) spreadsheet for all four years. This means that the final report figures will not match those in the interim report. It should be noted that we might therefore expect the figures we report for 2021 to increase over the next year as additional data is added by grant holders (we estimate that this could be in the region of 10-15%).

Figure 24: Data for 2018 delivery by ResearchFish spreadsheet

	Spreadsheet year			
	2018	2019	2020	2021
Lower secondary students reached	5,550	5,785	4,739	4,739
Upper primary students reached	17,594	19,754	18,376	17,776
Upper secondary students reached	7,430	7,405	7,405	7,448
Public reached	458,299	520,276	527,726	527,726
Total	488,873	553,220	558,246	557,689
Year-on-year change		64,347	5,026	- 557

The data in Section 3 was sourced as follows:

- **Total audience engaged**: data from ResearchFish in Key Audiences Event worksheet (2021 data extract) within the relevant date (year) column and selecting 'Total public reached' plus school-based audiences (upper primary, lower secondary, upper secondary)

- **Total audience engaged from 40% most deprived areas**: projects report the schools they work with, from which we can define an area IMD score. However, these are reported in the metrics spreadsheets simply as a list of schools (i.e. unattached to specific events). We therefore selected all events delivered at a school, academy or college (text search in the 'Event Name' column) and used their respective postcodes as the basis for our Wonder calculations using the same method as for the National Labs above.

- **Total audience engaged aged 8-14 years old**: this is summed from the ResearchFish spreadsheets, which record upper primary and lower secondary pupils in the same way as for National Labs data

10.4 Wonder and 8-14 year-olds

In the report, we ended up reporting Wonder reach in terms of all ages of attendees, rather than the more specific sub-set (per the Wonder definition) of 8-14 year-olds who come from target IMD locations. The main reasons for this were two-fold:

- Data from both project and NLPE spreadsheets records a Wonder proportion for a whole audience, not an age-specific subset. Given that the Wonder proportion is already often a 'best fit' for an all-age audience, we considered it would be inappropriate to assume that such a proportion would automatically apply in the same way to the 8-14 age group.

- For projects, we used ResearchFish data for the total 8-14 year-old audience because the numbers appeared more robust, consistent and bigger (see report comments on the ability of projects to retrospectively add data to their ResearchFish entries). ResearchFish data did not provide IMD/Wonder proportions (this was from project spreadsheets only) and a direct cross-reference between this data and the IMD data from project spreadsheets was not possible.

11 Appendix 2: benchmarking

11.1 Introduction

For the interim report we summarised the findings from a desk-based benchmarking review. We include it in the final report for information.

The intention of the review was to explore how other organisations measure similar outputs and outcomes, and to establish whether the performance of the Wonder initiative might be compared with other similar programmes. Some of the review took place as part of our development of the Wonder outcomes toolkit. We do not comment on science capital as this is already a well-known concept in public engagement.

In short, we found no analogous monitoring and evaluation approaches against which we might compare the Wonder initiative. Guidance on STEM PE evaluation and monitoring, particularly in Higher Education, is quite generic and focuses on providing frameworks within which individual initiatives design their own particular research questions. This means that there is little or no potential for comparability across initiatives.

11.2 Proxies for individual disadvantage

One of the key challenges for Wonder evaluation and monitoring is establishing an individual's level of socio economic disadvantage. It can be quite an intrusive and potentially stigmatising question, depending on how it is framed, particularly when asked of children and young people. It also often involves asking personally identifiable information, which has implications for data protection and governance. A home postcode remains one of the best sources of information because of the IMD database, but asking a child's home postcode, for example, is problematic.

We explored the area of child poverty to determine whether there were any non-monetary measures that might be less sensitive to ask. Poverty is not totally analogous to socio economic disadvantage, but it is heavily associated and has been researched thoroughly. However, the measures we identified still tended to risk being potentially stigmatising: whether parents work, for example, or their qualification levels; housing tenure or acquisition of material possessions.

The alternative to individual level data is organisational level information, for example a measure based on the location or catchment area of a school or community group. This is easier, if possibly less accurate. We comment on school-level data below.

11.3 STEM-related proxies

We also considered other potential measures where a question focused on STEM (or similar) might be reasonably cross referenced with socio economic disadvantage. For example, would a particular question on science be likely to get a different response dependent on an individual's socio economic situation?

The 'Taking Part: Who Participates?' survey of 2015/16, undertaken for the Department of Culture, Media and Sport, asked questions about attendance of museums and levels of socio-economic disadvantage. It demonstrated that children from the lower socio-economic group were less likely to have visited museums or art galleries than those from upper groups (50.2% vs. 64.4%). Framed for adults, another question asking how often people had visited a museum or art gallery in the last year found a similar difference: 62.6% of respondents from the lower socio-economic group said they had not visited in the last year compared to 38.5% in the upper group.

The second measure, from the Public Attitudes to Science survey (2019), asked how often someone had visited or attended a science talk or lecture outside of school, college or work in the last 12 months (a science capital question). We have not yet been able to gain access to the underlying data, but this might be possible and we are pursuing it.

What we are describing here are potential ways of, in a sense, turning the Wonder definition on its head by first focusing on STEM engagement and then making assumptions about someone's background. If we knew, for example, that children from disadvantaged backgrounds were disproportionately less likely to have had an extra-curricular science experience than those from more advantaged backgrounds, might this be used as a non-sensitive proxy measure? This would require a much bigger debate about the definition of Wonder.

11.4 How to identify Wonder schools

Much Wonder activity is focused on schools. Our outcomes toolkit currently suggests that projects use either the IMD of a school or the proportion of Free School Meals (FSM) as an indicator of socio economic disadvantage. We have reviewed the data sources used by government and other bodies to determine what others use.

As we have noted earlier in this report, IMD by school postcode risks being inaccurate as the location of the school does not necessarily dictate where its pupils live. However, it benefits from being easy to check. IDACI (Income Deprivation Affecting Children Index) is a subset of the IMD dataset which scores income deprivation for children only. As such, it is part of the school-based measure that we have included in the toolkit. IDACI is as easily sourced as the IMD data and could be used as an alternative, although we feel that IMD is more widely-recognisable and already accounts for IDACI in its calculation. Furthermore, it doesn't make up for the imperfections of using IMD based on a school's postcode and it is not available for nations other than England.

The proportion of pupils in a school receiving FSM is also readily available at school level from the National Schools Census. However, it is not indexed, so we are not able to say where Wonder 'starts' and 'ends' in terms of the proportion of FSM in a given school (we might collectively try to define this). Furthermore, the treatment of FSM differs across the UK.

One other measure that is sometimes used is POLAR2/TUNDRA. These are area-based measures of young people's participation in higher education according to where they

live. We have ruled this out as it is more relevant to an older group of children and young people than the focus of Wonder.

In summary, while the IMD of a school's address is imperfect, it does benefit from being easy to source. Any definition of Wonder at the school level is going to be a generalisation as it cannot account for the differences within its pupil population. FSM is a possible alternative in England, and benefits from being more pupil-focused, but would not necessarily work in other UK nations.

12 Appendix 3: Wonder evaluation toolkit

12.1 Introduction

The Wonder evaluation toolkit was designed in collaboration with the STFC Wonder team and Wonder project leads. It sought to simplify outcome evidence collection at the project level while also offering guidance on gathering deprivation data (crucial to establishing an audience's fit with the Wonder definition).

In the sections below, we provide the relevant parts of the toolkit spreadsheet that projects were required to complete. While the wording of questions and statements was provided, a specific form or questionnaire was not, allowing projects to integrate our suggested questions into their own research and feedback instruments.

12.2 Contextual data

Projects were asked to provide the location of the event, where possible with a postcode to help with IMD identification for any physical event.

Location of event (postcode or online)	Event Name

Baseline data collection focused on the target age group for Wonder (8-14 year olds) who were expected to complete the questions relating to Reaction and Reflection outcomes below.

Projects were asked to identify the proportion of the 8-14 audience who fit the Wonder demographic in terms of socioeconomic deprivation, either by estimate or through individual information (i.e. home postcode translated to IMD decile).

A single 'Science Capital' question was also included for use in baseline surveys.

Context					
Number of 8-14 year-olds	Percentage of 8-14 audience from Wonder demographic *(if exact proportion is unknown, please estimate)*	Is your percentage an estimate? *(enter 'y' for yes or leave blank for no)*	"Someone in my family is really into science or works in science" *(enter number of responses)*		
			Yes	No	Don't know

12.3 Reaction

Two 'reaction' questions sought to explore participants' immediate responses to the activity or event they had just taken part in.

Reaction					
"I felt able to join in and ask questions" *(enter number of responses)*			**"I want to find out more about science"** *(enter number of responses)*		
Yes	No	Don't know	Yes	No	Don't know

12.4 Reflection

Projects were offered two options for the 'reflection' questions, depending on whether or not their projects offered the opportunity to ask participants questions before and after an activity. Option One was for projects where a post-activity survey only was available.

Reflection OPTION ONE					
"Do you feel more or less interested in studying science or working in science after [event]?" *(enter number of responses)*			**"Do you feel more or less certain that science will have a positive impact on our future after [event]?"** *(enter number of responses)*		
More	Less	Same	More	Less	Same

Option Two was for projects that were able to ask participants pre-activity, post-activity and then potentially during a later follow-up. These were framed as Likert statements to allow for the measurement of change over time at a cohort level.

Reflection OPTION TWO (a)					
"I would like to study science or work in science" *(enter average score for the group as a whole plus the number of responses for each time the question was asked)*					
Pre (average)	Pre (responses)	Post (average)	Post (responses)	Follow-up (average)	Follow-up (responses

Reflection OPTION TWO (b)					
"I feel science will have a positive impact on our future" *(enter average score for the group as a whole plus the number of responses for each time the question was asked)*					
Pre (average)	Pre (responses)	Post (average)	Post (responses)	Follow-up (average)	Follow-up (responses

12.5 Mapping the toolkit outcomes onto GLOs

The Reflection and Reaction questions listed above were selected to match some of STFC's existing GLOs. Through discussion with STFC, we collectively decided to focus on four of the GLOs which seemed most relevant and consistent across Wonder projects. The intention was to simplify data collection, so the number of outcomes covered was deliberately kept to a minimum.

GLO category	Detail	Covered in toolkit
Do (these are all reflective – takes time for evidence to become available)	explore our science and technology further for themselves	
	share their understanding of our science and technology with learners, peers, family and their community	
	consider choosing, or encouraging others, to study and pursue careers in science and technology	Yes
Feel (instinctive post-event, refers to the quality and relevance of the event)	Welcome	Yes
	at the right level	
	Inspired	Yes
	Involved	
	Satisfied	
Value (reflective)	science and technology for its economic, social and cultural contribution of to society	Yes
	employment in science and technology at all levels	
	the sharing of their understanding and skills with others	
Have skills to (reflective/reactive)	carry out scientific or technical activities themselves	
	participate in informed discussion about science and technology	
	share their skills, understanding and values with others	
Understand (reflective)	We study the universe on the very large and the very small scale	
	The marriage of scientific method and large facilities	
	Finding benefits for society	