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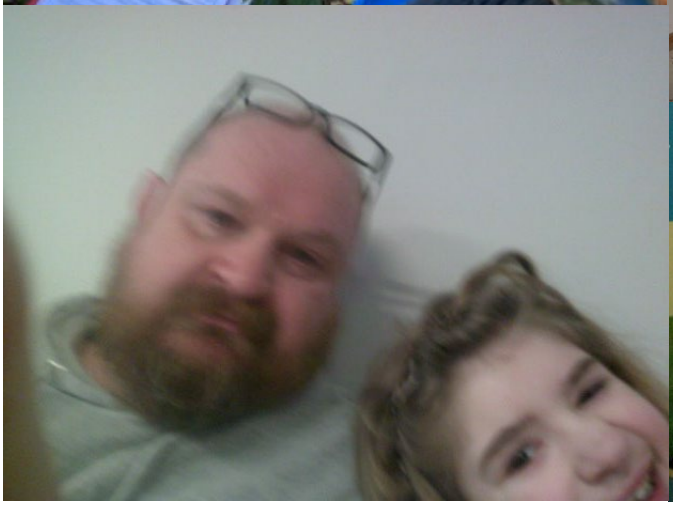
NORTH EAST MUSEUMS

STEM Communities

Interim Evaluation Report

March 2024



Summary of Interim Findings

Project Summary

STEM Communities aims to bring together and facilitate a community of families to explore their interests in STEM and heritage. It is a partnership between NUSTEM, a university outreach and research group; and Woodhorn Mining Museum run by Museums Northumberland, and the STEM community the project serves. This project is enabled by a three-year Science, Technology and Facilities Council (STFC) grant (ST/Y002954/1) which started in 2023.

The intervention model is hyper-local and place-based, working in the area surrounding Woodhorn Museum. It has four phases: 1) in-school workshops, 2) in-school family activities; 3) family workshops at Woodhorn Museum 4) community-led workshops.

Summary of Evaluation Findings:

Phase 1 and 2

- Phase 1 (classroom workshops) and phase 2 (in-school family workshops) evaluated community development outcomes, wonder and feel outcomes. The evaluation showed that the large majority of participants felt welcome, involved and satisfied in the sessions, and expressed high levels of interest in attending future STEM Communities sessions.
- Qualitative feedback identified working as a team, child as the expert, overcoming challenges and learning programming to be successful features of the workshops. Most Significant Change with project team staff identified that meetings with Head Teachers, reflective approaches, nuance and responsiveness were supporting successful delivery of the project.

Phase 3 Findings

- In Phase 3 children and families visited Woodhorn Museum to take part in workshops. Phase 3 workshops were delivered in the weekends and in school holidays. They were evaluated on feel outcomes and community development outcomes. Evaluation responses showed 100% of families reported to feel welcome, involved and satisfied. 93% of families participating said they would 'like to know more'. 39% of families participating in stage 3 have engaged with 3 or more sessions.
- Collection of Most Significant Change stories with families identified learning through play, spending quality time as a family, feeling comfort in the environment and with project team, feeling welcome, and sharing food were successes of the project, but that more could be done to develop the community between families and to support families in developing STEM interests.
- We identified three participatory outcomes will be used in evaluation of cohort 2: Familiarity/comfort with Woodhorn and other museums, learning being not like school, quality time spent with family.

Phase 4 Findings

- Two activities within Phase 4 have taken place. Developing independent stem interests and inquiry has been slower to emerge and will likely require more structured support than first envisaged. We are currently looking and reflecting on the best format for Phase 4 workshop

Lessons Learnt

The project team met to discuss lessons learnt at the half-way point of the project. The key learning from the project can be summarised as:

- **Workshops:** We have tested and refined a model for workshops which is working well. The workshops are hands-on and practical. The STEM topics are varied and related to individual interests and STFC science but follow the same familiar routine. We try to create a fun, relaxed atmosphere, which doesn't feel like school, and were people can be themselves. Food is important for helping people feel comfortable and the group to gel together.
- **Relationships:** We give voice to the community through evaluation and conversations. Listening and responding to the group shows that we care. Doing this means we 'know' these families and are responsive and flexible to their needs, such as remembering specific requests for food as well as allergies. The community values that we do what we say we will, which has established trust. Good relationships have been built with delivery staff.
- **Engagement:** The result of this is that people keep coming back and genuinely enjoy coming to the sessions. We find that parents are enjoying the sessions as well as children. We have a core group of 'super engagers' who have attended more than half of all sessions offered, as a wider STEM community who engage less often.
- **Expectations:** Our plans had factored in buses from schools to attend, but most families have been able to attend without transport, instead taxis have been provided on the occasion they are needed. Our expectations were to follow group interests and facilitate independent STEM inquiry, but group have required more structured support to develop their interests and this has happened more gradually.
- **Evaluation:** Formative evaluation, such as reflexive practice has been a key tool in project development. A quick turn-around of evaluation means it is influencing workshop design and practice. Most significant change evaluation among project team allowed us to 'listen' to each other and where we are coming from, evaluation with STEM community has allowed us to define participatory evaluation outcomes.
- **Dissemination:** We are proud of this project and so have disseminated project methods and early findings in a variety of settings, which has been well received. The following frameworks and theories have been useful in developing our approaches and practice: NIHR Guiding Principles for Community Engagement, The Community Canvas, the ADSC Inclusion Handbook and self-determination theory.

Next Steps

Looking forward into project will be focused on the following areas:

- Next cohort of recruitment to the STEM Community working with six more schools across phases 1-4.
- Embedding our participatory evaluation outcomes into the evaluation of the second cohort of the project.
- Looking at how to best to integrate cohort 2 with the existing community, and how we might best use our super-engagers to support the group.
- Developing and further testing phase 4 activity – What should this look like? What level of autonomy can be expected? How much facilitation will be needed?
- Thinking about project legacy. How can we support the STEM community beyond the project funding window? What follow-on or alternative funding should we apply for?

STEM Communities Introduction

The STEM Communities project has brought families and researchers together to learn about the local heritage of science and technology in the North East, and explore science and technologies currently being developed that will shape our futures. The project aims to enable local families to develop their STEM interests to become a community of citizen scientists leading their own scientific enquiries. STEM Communities is a collaboration between NUSTEM at Northumbria University, Museums Northumberland, and STFC funded scientists. The project is based at Woodhorn Mining Museum - a former mine situated in what was once the largest pit village in the world. It is funded by the STFC under the Nucleus Grant: STFC ST/Y002954/1.

The intervention model is hyper-local and place-based, working in the area surrounding Woodhorn Museum, designed to resonate with local lived experiences. It has four phases: 1) in-school workshops, 2) in-school family activities; 3) family groups are then invited to join the STEM Community meeting together at Woodhorn Museum to do activities related to STFC science and technology, which are designed to foster curiosity, explore STEM interests and build skills needed for future scientific enquiry; 4) using child-centred approaches and facilitated by the delivery team, the STEM Community members will follow their own STEM interests and lead their own STEM enquiries. The project aims to:

- Increase families' knowledge and understanding of STEM, including of the contribution of STFC Science and Technology, and the people who work in STEM at the STFC
- Develop participants' understanding of the relevance of STEM in their local region, historically and currently
- Provide a broader understanding of current and future careers in STEM
- Create a positive experience of engagement in community activities for families
- Create STEM communities with ownership over their own STEM exploration.

Report Overview

The project will run from 2023 to 2026. This report presents interim evaluation findings at the mid-point of the project. The project will be run across 2 cohorts. This report covers the first cohort of families in the project through phases 1 – 4.

We assess the project against its target reach and the original evaluation outcomes. We also outline the participatory evaluation outcomes, generated with participants of the STEM Community project. These will be used alongside existing outcomes to evaluate the project moving forward.

Developing this interim report at the mid-point aims to consolidate our learning on what constitutes a high-quality community-led STEM engagement and contribute to our intention to publish findings of value to the STEM engagement sector as a whole.

In the final section we share the frameworks that have supported our thinking, and the preliminary lessons learnt.

Evaluation Overview

Evaluation Principles

From the outset of the project design and through its further development, the evaluation plan was guided by the following evaluation principles:

- **Embedding reflection into the delivery life cycle:** It is the moment of stepping back to see what worked; thinking about and questioning one's actions; being self-critical; and constantly learning from what went well, what could have gone better, and what might be done differently. It includes the skill to listen, to have an honest dialogue that is about learning not blame, and being open to challenge, alternative values and working methods.
- **Acknowledging challenges and using these as learning opportunities:** It's ok if something isn't working, or isn't working as planned, is ok as long as you learn from it, make adaptations and share knowledge of how to help others.
- **Including perspectives of participants in the evaluation:** It is important to incorporate the perspectives of participants in defining the questions they want answered and the outcomes they think is important to measure.
- **Feedback and learning are used to inform and influence future direction:** Project teams need flexibility and to be able to adapt based on findings. Make sure record what has changed and why, through reflective practice sessions. For data to be useful evaluation should be easy to process and quickly turned around.

Evaluation Outcomes

Evaluation outcomes identified at the initial development stages were drawn from the STFC's Generic Learning Outcomes incorporating evaluation outcomes. The evaluation plan maps to all 5 of the GLOs and for each phase of the project draws out the most relevant subset of outcomes:

- **DO:** Share understanding of our S&T with learners/peers/community
- **FEEL:** welcome, involved, satisfied
- **VALUE:** Value S&T and local heritage for its economic, social and cultural contribution to society
- **HAVE SKILLS TO:** Have skills to participate in informed discussion about S&T
- **UNDERSTAND:** Understand work in the areas of Big Telescopes, Amazing Materials, Inside the Atom, and Big Data and Computing.

As a Wonder project (working with participants from the 40% most socio-economically deprived areas of the UK, in particular 8 to 14-year-olds and their families and carers), we have also drawn from two specific Wonder outcomes relevant to our younger age group of 8-11:

- Feel able to join in and ask questions
- Want to find out more about science

Drawing on the lessons learnt from past projects, the team also introduced a number of evaluation outcomes about monitoring the health of community development:

- Inspired to pursue own interests within STFC science, technology and heritage and share with family
- Positive relationships are made with delivery staff
- Intention to continue to next phase of the project

Participatory evaluation methods have been used to understand what is important to participants and to develop participatory evaluation outcomes by which we can evaluate the rest of the project. These will be introduced later in the report.

Evaluation Plan

STFC advice for evaluating Wonder projects is to use observation and interviews as tools to give space for unexpected outcomes, and to keep other methods of evaluation short, fun and integrate them into the activities as much as possible. These ways of working have been realised in the evaluation plan.

Formative Evaluation

At each phase, the formative evaluation plays a key role in ensuring that community development and cohesion is on-track, and that ongoing delivery meets the needs of the audience. Evaluation is also used to explore emerging interests. Formative evaluation is used to inform, advise and plan for the later phases.

- **Monitoring and Reporting Data:** Tracking of participants across sessions
- **Participant Evaluation and Feedback:** In-session and post session data collection with participants, including ad hoc and social media
- **Reflective practice:** Post-session reflection sheets and discussion among practitioners
- **Most Significant Change:** Collection of most significant change stories, and story review among practitioners and participants

Reflective practice is used by the project team to guide the workshop development during piloting and delivery. It is a method of considering what has been learned and how it can be applied to improve evaluation practices. Individuals complete on their own after sessions and then come together to discuss findings.

This project also used the qualitative monitoring and evaluation technique Most Significant Change (MSC) as a method for gathering qualitative evaluative data about the implementation of STEM Communities, and for monitoring the social change and learning that results from it. MSC has value for evaluating projects which do not have predefined outcomes or have outcomes that may change during the course of the project, and for identifying unexpected or unintended changes.

The initial MSC scheduled was envisaged to have 5 rounds, but this has been adapted to better suit the project timeline and delivery:

Original Planned	Adapted
Round 1: Feb 2024 (story review: March 2024). MSC collection with project delivery and project planning staff (n=3).	**Round 1**: April 2024 (story review: May 2024) MSC collection with project delivery and project planning staff (n=3). Complete.
Round 2: June 2024 (story review July 2024). MSC collection with project delivery and project planning staff (n=3), and teachers (n=3).	Skipped round, because lower teacher involvement did not warrant an MSC data collection.
Round 3: Nov 2024 (story review: Dec 2024). MSC collection with project delivery and project planning staff (n=3), teachers (n=3) and families (n=3).	**Round 2:** Oct 2024 (story review: Dec 2024). MSC collection with families (n=3). Complete.
Round 4: March 2025 (story review: April 2025). MSC collection with project delivery and project planning staff (n=3), teachers (n=3) and families (n=3).	**Round 3:** March 2025 (story review: April 2025). MSC collection with project delivery and project planning staff (n=3) and families (n=4).
Round 5: July 2025 (story review: August 2025). Final data collection. MSC collection with project delivery and project planning staff (n=3), and families (n=8).	**Round 4:** October2025 (story review: November 2025). Final data collection. MSC collection with project delivery and project planning staff (n=3), and families (n=8).

Summative Evaluation

Summative evaluation methods will be used to report on the project against the evaluation outcomes and in the final reporting. As we progress into second round of recruitment for the community, summative evaluation will be used to assess against the evaluation outcomes at the end of each phase. Participatory evaluation outcomes will be embedded into cohort 2.

- **Monitoring and Reporting Data:** Total numbers of participants at each phase sessions
- **Participant Evaluation and Feedback:** In-session and post session surveying against outcomes, qualitative data collected from ad hoc surveys and observations
- **Most Significant Change:** Final collection of most significant change stories, and story review among practitioners

Evaluation of Phase 1 and 2 Workshops

Phase 1: In-class school Workshops

The workshop

In the phase 1 classroom workshop, children learnt about the STFC Facility of Boulby Mine and its underground laboratory, what the scientists working there do, and how it links to exploration on Mars. Children then designed and tested their own Mars Rover Challenges. Linking to the mining heritage of the North East and Woodhorn Museum helped children value historic mines for their contemporary contributions. Coding a Mars rover helped children to understand STFC research in the area of Big Data and Computing. Group discussions and development of challenges helped children share their understanding of Science and Technology (S&T) with peers, and participate in informed discussions about S&T.

Targets

Our target was to engage 390 families. In the first cohort of phase 1 STEM Communities worked with 316 children in years 4-6 from 6 schools close to Woodhorn Museum. [*Another round of Phase 1 workshops has taken place in six new schools in January/Feb – and will be reported in final report*].

Outcomes

Phase 1 workshops were evaluated against the following outcomes:

Community Dev. Monitoring	Intention to continue to next phase	
Wonder Outcomes	Feel able to join in and ask questions	Want to find out more about science

Data from a representative sample of schools indicated high agreement with both Wonder Outcomes. 78% of children agreed with the statement 'I felt able to join in and ask questions', and 47% of these agreed strongly; only 6% disagreed. 63% agreed with the statement 'I want to find out more about science', with 43% agreeing strongly and14% disagreeing.

Intention to continue to the next phase was measured via pupil tracking. 42% of families came to the second session, with schools generally supporting other pupils to attend Phase 2 workshops if their parents couldn't attend. There was a good response from families in most schools.

Project team reflective diaries revealed that one challenge faced was the complexity of the topic – particularly for year 4 who have not done space. The workshop could feel rushed, and therefore some content was cut to allow better time for explanations and more time with rovers. Another difficulty encountered was that some children found it difficult to design challenges. In response the workshop was adapted to provide more scaffolding and to give model examples.

Informal and ad hoc feedback was documented by delivery staff. School staff fed back that they liked the inclusion of careers information (video of Emma) as it was relevant to their in-school careers work, and that it showed you could get into science as any point because Emma started in the labs as a part-time cleaner).

Phase 2: In-school Family Workshops

The workshop

For this workshop parents were invited to join their children in school. The workshop included an overview of Boulby Mine, the underground laboratory and the links to Mars, and an introduction to EaRL robots. Parents then worked to complete the Mars Rover challenges set by the children by programming the EaRL robots. Parents were able to share their knowledge of mines and relevant STEM knowledge and experience. Children were able to share and discuss their prior knowledge from phase 1 workshop with their parents. The workshop allowed children to take on the expert role of EaRL robots operators and of the challenges.

Targets

The target was to engage 140 families in the phase 2 workshops. Cohort 1 of Phase 2 engaged 316 adults and 176 children. [*Another round of Phase 2 workshops will be taking place in Feb/March approx. 240 children*].

Outcomes

Outcomes at Phase 2 were evaluated with a survey at the end of the workshop. Only 25% of parents completed the evaluation form after the workshop. Workshops were evaluated against the following outcomes:

Feel Outcomes	Welcome, Involved, Satisfied	
Community Dev. Monitoring Outcomes	Inspired to pursue own interests within S&T and heritage and share with family	Intention to continue to next phase

At Phase 2 all three feel outcomes were evaluated and indicated very high approval:

- All family groups agreed strongly with 'we felt welcome'.
- All family groups agreed strongly with 'we felt involved'
- 87% of family groups agreed strongly with 'we felt satisfied', while another 13% agreed.

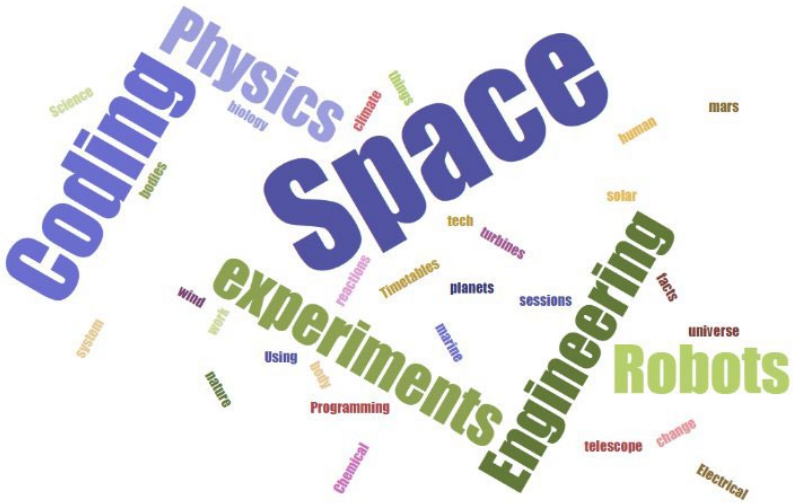
Open responses also provided evidence to support the feel outcomes:

- "I enjoyed how interactive the session was" Parent
- "The session was delivered well, so we could all understand" Parent
- "It was lovely to come into school and seeing what our son has been learning and being a part of it. Thank you!" – Parent

Looking at 'intention to continue to next phase', 88% of families said they were considering further engagement with the project. 58% of these said they were definitely interested and 30% saying they would like to find out more first. Only 12% of families said they didn't think it was right for them.

- "Look forward to finding out what other STEM sessions are available." – Parent
- "Enjoyed the session and interested in learning more" – Parent

To provide evidence for the 'inspired to pursue own interests' outcome, the feedback survey asked families what different areas of science, technology, engineering and maths they were already interested in. Looking at the response word cloud space. coding, physics, experiments, engineering and robots were popular among the group.



We also asked which features of the workshop were valued by the family groups 'what did you like about the session?', and analysed to identify themes in the responses. Whilst some of these are topic specific, others provide the project team with guidance for future workshop planning.

Theme	Indicative Feedback in Survey
Working as a team	• Really enjoyed the challenges set by the children and setting my own challenges for my son • Being able to work together to solve the coding puzzles • Joining my mam to code robots' was my favourite part of the session. 'I liked using the obstacles to set my mam challenges • Having a bit of time bonding doing activities • I enjoyed how interactive the session was, how we managed to work together
Overcoming challenges/ perceptions	• I thought I wouldn't be able to pick up the coding but I did after practice. I enjoyed using the tech and the Earl. • Programming to complete task • It was hard but I liked it
Child as the expert	• She liked showing what she has learned. Putting into practice the coding she has learned • Showing mum how to programme the robot
Workshop topic	• Fascinated to find out that salt is mined and the connections to Mars • How robots can aid space exploration. The considerations for programming tasks in certain environments • That there were underground science labs that replicate the conditions of Mars for experiments. It was interesting learning the things that happen here (research etc) • Hearing about the science lab under the salt mine, where experiments are carried out to reflect Mars.
Programming the robot	• We found the robot interesting • Robot programming • She liked the programming aspect the best • Playing with the robot and programming them to move around • Learning sequences

Reflective diaries from the project staff also identified a number of other points for consideration in planning future workshops:

Knowing who is coming	One assumption we had was that schools would be keeping a booking list for parents who would be coming to the session. Instead, one school had just sent out the invite without monitoring numbers, which meant we didn't know how many families to expect. We adapted communications with schools to ensure we asked them to keep a booking list.
Supporting children without parents at the workshop	Some parents who were expected didn't turn up, which left some children feeling sad. An adaption was made in one school to include these pupils in the workshop, and it went surprisingly well. This was offered for future sessions as long as there was teacher support.
Providing food	Teachers had indicated providing refreshments would support attendance. Families and children enjoyed having drinks in sessions but for delivery it was a bit challenging to set up and manage the table. Teachers were asked to support.
Sharing knowledge	Children were keen on sharing ideas about the topic from the last session, and parents were given opportunity to add in their knowledge. As some parents with STEM background shared their existing knowledge, we reiterated that the project would offer the space to learn about different parts of STEM together. The team reflected on the value of hearing STEM experience with the group, and that we should encourage this so we can learn together.

Most Significant Change (MSC) with Project Team

During phases 1 and 2 of the project the first round of MSC took place. Three stories of change were collected from project delivery and project planning staff. A story review panel was held to listen to the views of practitioners and identify salient points for the project team, rather than select a story as 'most significant'. This session was also about building knowledge and skills of MSC in the project team, in preparation for later rounds with family groups.

The project team were asked what stood out in each story, what resonated with their own experience and to identify common themes. They then agreed what learning should be taken forward. The process revealed that the following were important to project practitioners:

- *Reflective approach*: Creating the time and space to think and process ideas and challenges, and prioritise adaptations
- *Head Teacher meetings*: Listening to each school's context and hearing what the situation for families is like, useful for planning.
- *Nuance*: Time and care put into creating the right thing, softness of approach.
- *Responsiveness*: project planning is responsive to people's needs and interests, contexts and circumstances.

Summary Phase 1 and 2

Phase 1 and 2 evaluated community development monitoring, wonder and feel outcomes. The evaluation showed that the large majority of participants felt welcome, involved and satisfied in the sessions, and expressed high levels of interest in attending future STEM Communities sessions. Qualitative feedback identified working as a team, child as the expert, overcoming challenges and learning programming to be successful features of the workshops. Most Significant Change with practitioners identified that meetings with Head Teachers, reflective approaches, and nuance and responsiveness were supporting the delivery of the project.

Evaluation of Phase 3 Workshops

Phase 3 Workshops

In Phase 3 children and families visited Woodhorn Museum to take part in workshops. Following feedback from families workshops either took place at the weekends or the school holidays. Initial introductions were run for individual schools or groups of schools, but then subsequent sessions were offered to all families from all schools. Each of the workshops included some get to know you time, some coverage of science topics, and some practical hands-on activities.

Introduction to Woodhorn	9th, 27th April and 31st May	Woodhorn Engineering Challenge- families invent a way of moving a piece of coal using a selection of equipment provided. Then Mini Tour of site/coal town. Lunch in cafe and free time. Photography challenge – Something that made them laugh, and something interesting around site. Photo sharing and feedback.
Introduction to Woodhorn AM Chocolate Welding PM	31st March	AM: Shortened version of Woodhorn Engineering challenge for families new to Woodhorn. PM: Mostly families who have been before. Chocolate welding, bridge bowling, foam block to build a bridge and see how they fare under cannon fire.
Particles and Pyramids	7th July	Breakfast to start. Short talk on what a muon is and how muon detectors have been used to scan the pyramids. Activity building tetrahedrons in families. Then put them together giant one.
Giant Bubbles	28th July	Two bubble sessions one AM and one PM (same). Snacks to start. Introduction to bubbles. What questions they would like to explore. Experimenting with different bubble mixtures. Making foam blowers, table bubbles, and bubble wands, and free time to explore bubbles.
Wildlife and Teddy Bears Picnic	20th August	Teddy bears were brought by the kids. We did cyanotype pictures (and talked about Anna Atkins and Sir John Herschel), cheerio bird feeders, butterfly feeders, and then bug hunt with Jenny and Katie. Wildlife quiz to finish.
Space Week	5th October	Children looked at life for astronauts in space. Children tried space food, such as freeze-dried fruit, and made their own space smoothies. They heard from Northumbria University postgraduate researcher Atlas Patrick about study of the aurora. They made stomp rockets in families to test and fire.
Spooky Lights for Dark Nights	29th October	Workshop looking at glow in the dark including fluorescence and bioluminescence. Carousel of glow in the dark activities.
Christmas session	7th Dec	This session was cancelled due to snow blizzards – but would have been about fizzing.
Zoom Christmas quiz	19th Dec	Children took part in a Christmas zoom quiz including STEM, music, film and general knowledge.

Across the Phase 3 workshops there has been 73 interactions with adults and 104 with children thus far. Looking across the sessions we can see a steady participation across the sessions. The least popular session was an online one.

Intro to Woodhorn	**Intro and chocolate**	**Particles and Pyramids**	**Giant Bubbles**	**Wildlife and Picnic**	**Space Week**	**Spooky Lights**	**Zoom Quiz**
11 adults 17 children 9 families	15 adults 22 children 11 families	12 adults 17 children 7 families	16 adults 17 children 9 families	6 adults 14 children 6 families	9 adults 12 children 6 families	6 adults 13 children 6 families	4 adults 5 children 3 families

Targets

The target for this phase was to work with 20 families. We tracked attendance of Cohort 1 across the 8 Phase 3 sessions delivered at Woodhorn Museum to see how often families were engaging with the sessions. 39% of families have engaged with 3 or more sessions.

1 family session	6 families	26%
2 family sessions	8 families	35%
3 family sessions	2 families	9%
4 family sessions	6 families	26%
5+ family session	1 family	4%
TOTAL	23 families	100%

The prior commitments of families at weekends (such as childrens sport) meant that not all families are able to come to all sessions. At weekends some could only come on Saturdays, others on Sundays, in school holidays, different families could attend different days. The project team tried to offer a variety of days and times.

Outcomes

Outcomes at Phase 3 were evaluated with surveys at the end of the workshop. These surveys were only used at the first three sessions (n=14).

Feel Outcomes	Welcome, Involved, Satisfied	
Community Dev. Monitoring Outcomes	Inspired to pursue own interests within S&T& heritage and share with family and community	Intention to continue to next phase

The feel outcomes were measured individually on the survey and indicated very positive responses:

- All families agreed strongly with 'I felt welcome'.
- All families agreed strongly with 'I felt satisfied'.
- All families agreed with 'I felt involved', with 93% of these agreeing strongly.

Open responses indicate some reasons for positive feel outcomes including the environment which is seen as friendly, relaxed and supportive:

- "We felt involved and had fun in the activities. Also appreciated all the info given about coal and the mines (how things worked)" Parent
- "Really enjoyable, nice and relaxed and children allowed to be themselves and explore their personalities through the day" Parent
- "I love Woodhorn so so much. I always make a new friend." Child
- "Way better than normal things we do in science. Normally we learn about things we don't need to know about. Would like more science that is important bits." Child

Food was frequently mentioned by the group, with comments suggesting it helps create belonging and a sense of being valued.

- "A big thank you for such a fun morning! It was very kind of you all to put on a lovely breakfast spread too with so many options to please everyone. Thank you so much for yet another super session!" Parent
- "It was very nice eating the chocolate. We also had fun building the bridge and knocking it down! Lots of learning with lots of fun!" Child

Intention to continue to the next phase was also measured through a survey question:

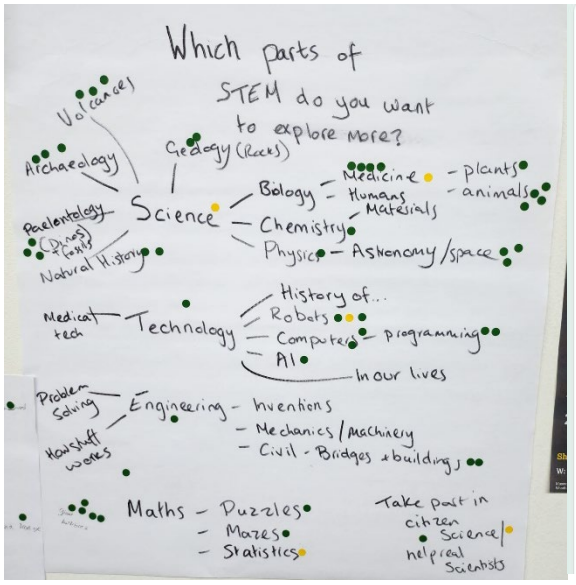
- 93% of families participating said they would 'like to know more', with 7% (1 family) saying 'not sure yet keep me update'.

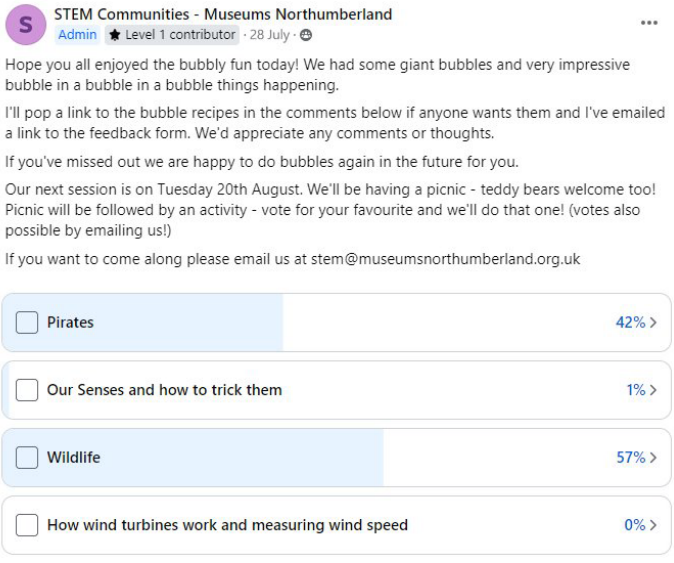
In later surveys we see the comments of families who are returning time and time again:

- "This is the third STEM session we have been to and we have enjoyed them all. We can't wait for the next one already!" Parent
- "The boys both had an amazing time, as always and said they were so glad we'd went!" Parent
- "The kids and i are really enjoying these sessions" Parent

The last of our evaluation outcomes at this phase was 'inspired to pursue interests'. In a reflective diaries we noted, "*Again, it's quite difficult to elicit from people what other forms of science they might be interested in as it's such an open question. Maybe we could have a power-point presentation with an overview of photographs and ideas of other workshops/experiments/ projects we could do in future to see if that sparks any interest.*"

In following sessions, we tried these alternative ways of exploring interests among the group. In-session we tried interest mapping, asking families to vote on different areas of science they would be interested in exploring more. We also used voting on session ideas via our social media channels to follow interests within the group.





Participants suggested ideas for the session in other ways too, not only about the science topic. In the wildlife week, a child asked if they could bring their teddy bear, which sparked all the children to bring their teddies for a teddy bears picnic. Children also gained practice in voicing their ideas by suggesting different types of food they would like.

Reflective practice: Phase 3

Reflective diaries were used to guide session development during phase 3 and highlighted a number of important points for future workshop development.

"No-one needed help with transport today, food was welcomed as ever. "	Move over the sessions to offer snacks at the start of the session rather than lunch at the end. Moving to the beginning is a useful way of introducing new groups together. It helps group bonding, alleviates hunger, and doesn't have the additional costs or time challenges of eating in the canteen. In the first few sessions buses were offered, however transport was not a barrier to most families. Therefore, taxis are now offered to families who need transport to attend.
"I think they would need a bit more scaffolding to help them come up with ideas for experimentation themselves."	In the bubbles session, families were introduced to asking their own questions and having ideas for experiments. They didn't always find this easy. This will need to be something that is continually grown if we want to achieve a later phase of 'leading own enquires in S&T'.
"I've also offered to put on a picnic as part of the session and one of the children asked if it could be a teddy bears picnic so I've said they can bring them if they'd like."	Following children's and family groups ideas shows views are valued.

Most Significant Change: Phase 3

Three MSC stories were collected from family groups in-between and at the end of sessions, either in-person or online. During the story selection session with the project team, the stories were read aloud and discussed in turn to identify the important points raised in them. After the discussion of each story, the group clarified the most significant change presented in each story. Project team members advocated for the story they felt was the most significant, presenting arguments for this story and against others, before a vote took place. One story was selected as the most significant. The group then identified themes across the stories and identified learning to take forward from the discussions.

Participants voted unanimously for Story 1. This selection was clarified after the vote as the most significant in terms of strongest STEM community around a child, and in terms of project legacy "that's kind of what we wanted after the project isn't it, that they build those communities around them and explore the STEM themselves". Advocates for story 1 said it was the most significant because of both the impact across a split family, and because neither the daughter nor the mother had any particular interest in STEM before. Other points raised for selecting Story 1 was around it reflecting the formation of a community around the child to support her STEM learning, from school to the mum, who then worked to include wider family members. This group of people, all worked together, despite challenges, to support the child to access the project. Thinking about the project outcomes, one participant felt that "that we are getting there and still have a way to go". Another said that since we are only in phase 3 of the project, we aren't expecting a fully formed community in people who have only had 3 sessions.

The project staff also identified the themes that ran across the stories that were important to running sessions for the community.

Themes	References within stories
Learning through play	learning without knowing, difference to school, learning but fun, not like school
Quality use of family time	using your brains together, time away from screens/ sitting around at home
Enjoyment of food	Eating nice things, trying new things
Comfort in the STEM community setting	relationship with Liz, Katie; affection for Woodhorn, visiting on their own
Community could be stronger	more could be done to help the group get to know each other, build relationships in the group
Being invited, feeling welcomed	"*as long as we are allowed to come we would come*"

Most Significant Change Round 2: The Chosen Story

The opportunity created by STEM Communities allows mum and daughter to spend time together

Lucia* goes to a local school. She likes science in school, and likes playing Roblox and other games after-school. She first heard about STEM Communities when they did a class session about mars rovers. The mum first heard about it when she was invited into school to do the related family session. Aimee is interested in history and heritage but wouldn't say she is particularly interested in STEM. When the opportunity came up to attend the Woodhorn sessions, Lucia said that she would want to do it.

Aimee and Lucia have now attended a few STEM Communities sessions at Woodhorn: the Woodhorn mining challenge, and the bubbles one. They chose whether to come based on the topic and if they are free. Some of the other children from school came along to sessions, but it was an individual decision, not as if they all decided to come together.

At first it was really strange for them to be doing these workshops together as a family. Aimee says, "I've not been back to school for 20 years". They worked together to do the coal-mining challenge, and both had to use their brains together to make it work. Lucia likes the sessions because they are fun. Aimee because they are learning through play, and so the kids don't realise they are learning.

It is also about spending time together. Because Aimee works full-time, and Lucia splits her time between her dads, and her grans, they don't really get much time to just hang-out together. Coming to the sessions is taking a bit of time out for just them. As Lucia usually goes to her dad's on a Friday, sometimes they have to shuffle the times around to attend. Her dad has said that we would come with her to the sessions too, if the timings didn't work out, but there hasn't been the opportunity yet. Aimee told her sister about the workshops at Woodhorn, and their cousin also said she would like to come. Lucia's cousin came with them to the bubbles session too.

Aimee and Lucia both plan to come to the future STEM Communities sessions when they can, and are planning to come to the next couple. Lucia would like to see future sessions that are linked to her interests, such as gaming.

[*Dad attended the next session with Lucia. He made rockets and enjoyed flying them to see how high he could get*]
** Names changed for reporting*

This process has allowed the project team to identify what is important about the project for participants. This will be used to develop the participatory evaluation outcomes that will be used alongside other pre-defined outcomes to evaluate the project. Possible participatory evaluation outcomes could be:

- Familiarity/comfort with Woodhorn and other museums
- Learning being like/not like school
- Quality time spent with family.

Summary Phase 3

In Phase 3 children and families visited Woodhorn Museum to take part in workshops. In phase 3 workshops were delivered in the weekends and in school holidays. Phase 3 workshops were evaluated on feel outcomes and community development outcomes. Evaluation responses showed 100% of families reported to feel welcome, involved and satisfied. 93% of families participating said they would 'like to know more', and 39% of families participating in stage 3 have engaged with 3 or more sessions.

Collection of Most Significant Change with families identified learning through play, spending quality time as a family, feeling comfort in the environment and with project team, feeling welcome, and sharing food were successes of the project, but that more could be done to develop the community between families and to support families in developing STEM interests. From this we have developed 3 participatory outcomes we will use in the cohort 2 evaluation: Familiarity/comfort with Woodhorn and other museums, learning being not like school, quality time spent with family.

Phase 4 Emerging Community-led Workshops

Community-led Activities

The original intention for this phase was that use child-centred approaches and facilitated by the delivery team, the STEM Community members will follow their own STEM interests and lead their own STEM enquiries.

One challenge faced was how to define a stage 4 workshop. We believe two of the workshops delivered so far are phase 4 workshops:

RS book award judging panel and activities	3rd and 4th Jan	STEM Communities group are involved in the Royal Society's STEM book reviewing panel. Relaxed session of pizza and fruit. Time to look at the books and to do a couple of experiments suggested by the different books. Group could choose when and which experiments they wanted to try and that there would be plenty of time to look at the books and do the experiments. The experiments were making bioplastic out of cornflower and chromatography.
Field Trip to Centre for Life	1st Feb	Coach trip to the Centre for Life – families collected. Group tour of the Centre for Life Museum. A trip was suggested by the

		project team, and the community chose where they wanted to go on a trip to.

Phase 4 Outcomes

No formal evaluation was undertaken for these two events. Future phase 4 activities will make use of existing outcomes and participatory outcomes. Informal feedback was received from participants.

"We absolutely loved the Centre for Life trip. Amy especially loved doing the experiments, she was fascinated by using the microscopes they had. She's been so inspired that I have bought her her own little microscope so she can use it at home to explore. She's fascinated! She wouldn't have discovered this interest without this trip so thank you!" Family

Reflective Practice: Phase 4

The reflective practice diaries have supported us in understanding what a phase 4 workshop should look like with this group.

- *"We are getting to know the group we are learning what they enjoy, what they are capable of and what more we can do with them. Having the books was great as it gave us a focus and they came with some great ideas for experiments and study which we might not have thought of. The experimentation worked extremely well we just need to think carefully about how we can do more of this in larger groups. Giving the group the chance to choose their activities was successful as it is giving them autonomy but again, we need to make sure we can make this work in larger groups and managing the different characters we can have." Book session*
- *"I think it was good to have a shared experience and one that we can remember and talk about in the next few sessions. It might also spark ideas as to what we can do in the future so hopefully we will have more input into future activities." Centre for Life Trip*

Summary Phase 4

- Two activities within Phase 4 have taken place. Developing independent stem interests and inquiry has been slower to emerge and will likely require more structured support than first envisaged. We are currently looking and reflecting on the best format for Phase 4 workshops.

Lessons Learnt

The project team met to discuss lessons learnt at the half-way point of the project. The key learning from the project can be summarised as:

Workshops: We have tested and refined a model for workshops which is working well. The workshops are hands-on and practical. The STEM topics are varied and related to individual interests and STFC science but follow the same familiar routine. We try to create a fun, relaxed atmosphere, which doesn't feel like school, and were people can be themselves. Food is important for helping people feel comfortable and the group to gel together.

Relationships: We give voice to the community through evaluation and conversations. Listening and responding to the group shows that we care. Doing this means we 'know' these families and are responsive and flexible to their needs, such as remembering specific requests for food as well as allergies. The community values that we do what we say we will, which has established trust. Good relationships have been built with delivery staff.

Engagement: The result of this is that people keep coming back and genuinely enjoy coming to the sessions. We find that parents are enjoying the sessions as well as children. We have a core group of 'super engagers' who have attended more than half of all sessions offered, as a wider STEM community who engage less often.

Expectations: Our plans had factored in buses from schools to attend, but most families have been able to attend without transport, instead taxis have been provided on the occasion they are needed. Our expectations were to follow group interests and facilitate independent STEM inquiry, but group have required more structured support to develop their interests and this has happened more gradually.

Evaluation: Formative evaluation, such as reflexive practice has been a key tool in project development. A quick turn-around of evaluation means it is influencing workshop design and practice. Most significant change evaluation among project team allowed us to 'listen' to each other and where we are coming from, evaluation with STEM community has allowed us to define participatory evaluation outcomes.

Dissemination: We are proud of this project and so have disseminated project methods and early findings in a variety of settings, which has been well received. The following frameworks and theories have been useful in developing our approaches and practice: NIHR Guiding Principles for Community Engagement, The Community Canvas, the ADSC Inclusion Handbook and self-determination theory.

Next Steps

Looking forward into project will be focused on the following areas:

Cohort 2: Next cohort of recruitment to the STEM Community working with six more schools across phases 1-4.

Participatory Evaluation: Embedding our participatory evaluation outcomes into the evaluation of the second cohort of the project.

Integration: Looking at how to best to integrate cohort 2 with the existing community, and how we might best use our super-engagers to support the group.

Building Phase 4: Developing and further testing phase 4 activity – What should this look like? What level of autonomy can be expected? How much facilitation will be needed?

Legacy: Thinking about project legacy. How can we support the STEM community beyond the project funding window? What follow-on or alternative funding should we apply for?

Supporting Frameworks and Resources

Our work is currently informed by a number of different community-building frameworks:

NIHR Guiding Principles for Community Engagement

Firstly the NIHR's Guiding Principles for Community Engagement, which were co-produced based on the experience of Community Engagement and Involvement practitioners and academics.

Principles
Do the groundwork and prepare
Find trusted community workers/leaders who can help broker introductions with wider communities
Respect the vast knowledge and experience of communities
Be honest about the scope and resources, don't over promise. Agree ways of working and core values
Be flexible about where and when you arrange meetings
Be generous, build in impact and consider ways to give back beyond your specific project needs
Invest time, genuine relationships take commitment and time to develop trust
Be creative and innovative about different ways to work and collaborate
Listen attentively and engage fully with the needs and priorities the community share
Be responsive, communicate regularly, feedback and outcomes and say thank you

Self-Determination Theory

Self-Determination Theory is a psychological framework which maintains that three needs – autonomy, competence and relatedness – are fundamental for determining motivation and individual well-being[1]. The central features of child-centred approaches - autonomy, relatability and play - align well to these[2]. Situating learning in the interests, issues and challenges of the local community, has been shown to enable higher levels of autonomy, competence and relatedness, and stronger STEM identity[3].

[1] Legault, L. (2020). Self-determination theory. In Encyclopedia of personality and individual differences (pp. 4694-4702). Cham: Springer International Publishing.

[2] Bodrova, E., & Leong, D. J. (2005). The importance of play: Why children need to play. Early Childhood Today, 20(1), 6-7.

[3] Chiu, T.K.F., Ismailov, M., Zhou, X. et al. Using Self-Determination Theory to Explain How Community-Based Learning Fosters Student Interest and Identity in Integrated STEM Education. Int J of Sci and Math Educ 21 (Suppl 1), 109–130 (2023). https://doi.org/10.1007/s10763-023-10382-x

ASDC Inclusion Handbook

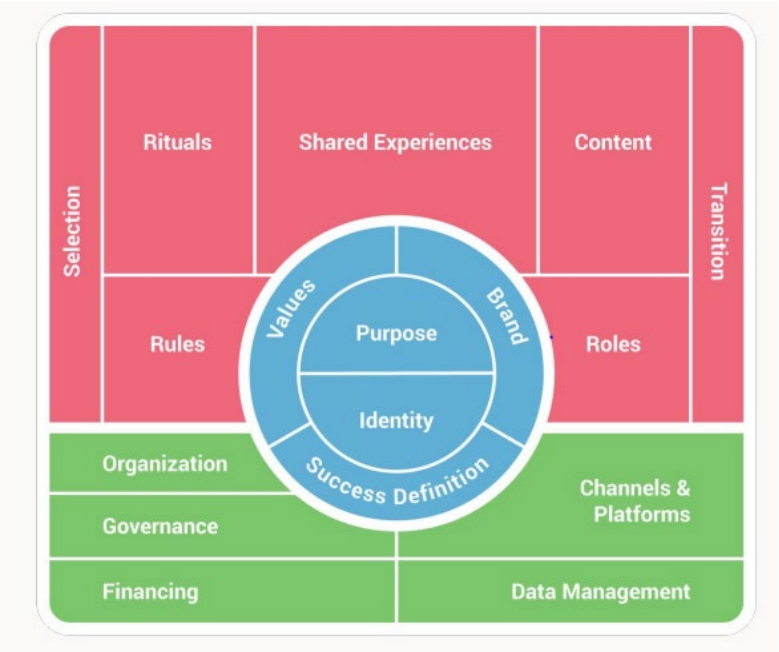
We are also utilising the learning outlined in the Inclusion Handbook, which pulls together learning from science engagement projects with community groups.

The Community Canvas

The Community Canvas Guidebook offers a guide to building meaningful communities. https://community-canvas.org/.

The community development strategy explores and test types of activities that have been found to provide meaningful experiences for communities.

It offers value for thinking about member selection, transition, shared experiences, and our expectations of the community



Dissemination and Recognition Activity

- 19th September 2024: Interact Conference, Evaluation methodologies for formative outreach development: Reflective Practice & Most Significant Change (Liz Ferguson, Joe Shimwell, Annie Padwick)
- 11th November 2024: Heritage Forum, Museums Northumberland and NUSTEM: The power of partnership working (Carol Davenport, Liz Ferguson)
- 30th November 2024: Submission to Journal of Science Communication Special Issue on Science in Unexpected Places: Creating a community of family STEM explorers: Working out what's important (– unsuccessful) (Liz Ferguson, Katie Smith, Joe Shimwell, Annie Padwick, Carol Davenport)
- STEM Communities shortlisted in the Educate North Awards 2025 – STEM Initiative Award (winners announced 4th April 2025).