Northumbria University NEWCASTLE

nustem

ANNUAL REPORT

September 2024 – August 2025

Contents

Introduction

NUSTEM is unique in the UK Higher Education sector, combining extensive outreach activity with academic research. This year we celebrated our first decade of work with schools at our 'tenustem' event'; Section 1 gives more information about that.

Our work directly contributes to the University Strategy 2030, and the University has consistently supported our efforts to improve outcomes for children across the North East. We are driving social mobility by working with schools in areas of deprivation, particularly through our Early Years and Primary Programme (*Section 2.2*) and Year 12 subject experience weeks (*Section 2.4*). Details of more of our work with children, young people and teachers are covered in Sections *2* and *3*. Our model of sustained school engagement has also acted as a blueprint for the University's new Junior Evolve programme.

While our practice is centred in the North-East region, our influence spreads more widely. For example, our use of attributes in STEM engagement activities has been adopted and adapted by organisations across the UK. Our practice-led research into attributes also illustrates how we generate new knowledge. *Section 4* discusses the range of our collaborations, while *Section 5* gives examples of how we are sharing our practice and research more widely.

Our tenth year has been just as hectic, varied and satisfying as were the previous nine. The team would like to thank all our colleagues who've supported, participated, challenged and extended our work, and we look forward to working with even more of you in our second decade. If you'd like to find out more about the work of NUSTEM, get involved directly, or draw on our experience, please do get in touch.

1 tenustem

In September 2014 the newly-formed Think Physics group (now NUSTEM) began delivering activities to schools in the region.

On 9th July 2025 we were delighted to welcome dozens of collaborators, partners, supporters and others to help us celebrate our first decade of activity. We recapped how we started, took a whistlestop tour through our journey to date, and shared some thoughts about what might be in store for our second decade.

Thinking through what we've learned over the years, what we'd like to shout about, and articulating where we think we're heading was a valuable process for the team. Thank you to everyone who came and helped us celebrate.

We're gradually updating our website to reflect our evolving thinking. The online event page pulls together the ideas we covered at the event: https://nustem.uk/tenustem.

Figure 1 – Attendees discuss secondary engagement and cross-curricular projects with Dr. Antonio Portas

Figure 2 – Mel Horan introduces NUSTEM's approach to role models and career roleplay with primary audiences

Figure 3 – Preparing a display of our STEM Person of the Week resources.

Figure 4 – Northumbria University Vice Chancellor Professor Andy Long reiterating the university's committment to NUSTEM's long-term, evidence-based, strategic approach to widening access and participation.

2 Children and families

2.1 Activities

This year the NUSTEM team have delivered hundreds of hours of activities, in 250 different sessions, to over 11,000 people, from a broad range of audiences (*Figure 5*). As well as workshops and training sessions, we have also supported students and staff to take part in outreach activities, as you'll see throughout the report.

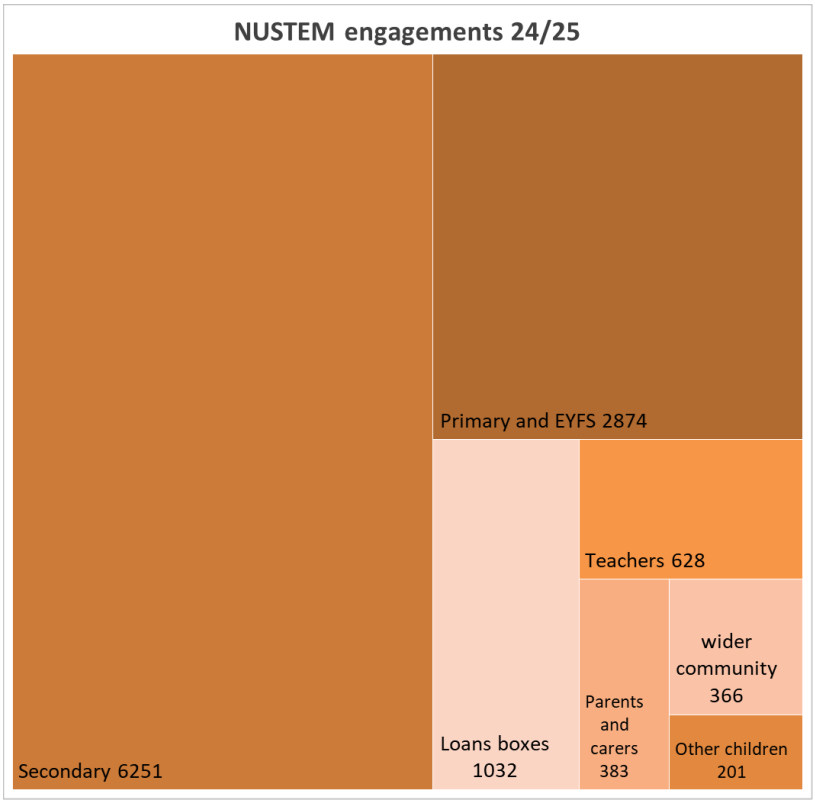


Figure 5 – Numbers of interactions with different groups for the academic year 2024–25 (total number = 11,735)

Over the past 10 years, we have had over 173,000 interactions with children, teachers, families and the wider STEM community (see *Appendix 2: Yearly Interactions*).

2.2 Early Years and Primary Programme update

Launching in September 2024, the Early Years and Primary Programme (EYPP) is the next iteration of our flagship support programme for teachers and schools. Rather than the open-ended approach we've taken previously, we now present partner schools with a specific, staged programme of support, more clearly aimed at embedding changes in classroom and whole-school practice.

Our ten new partner schools joined one of three distinct levels:

- *embedding schools*: new to our work.
- *developing schools:* that had previously worked with us and were putting our ideas into practice, and
- *sustaining schools*: that had already embedded our approaches and were receiving flexible support to continue their work.

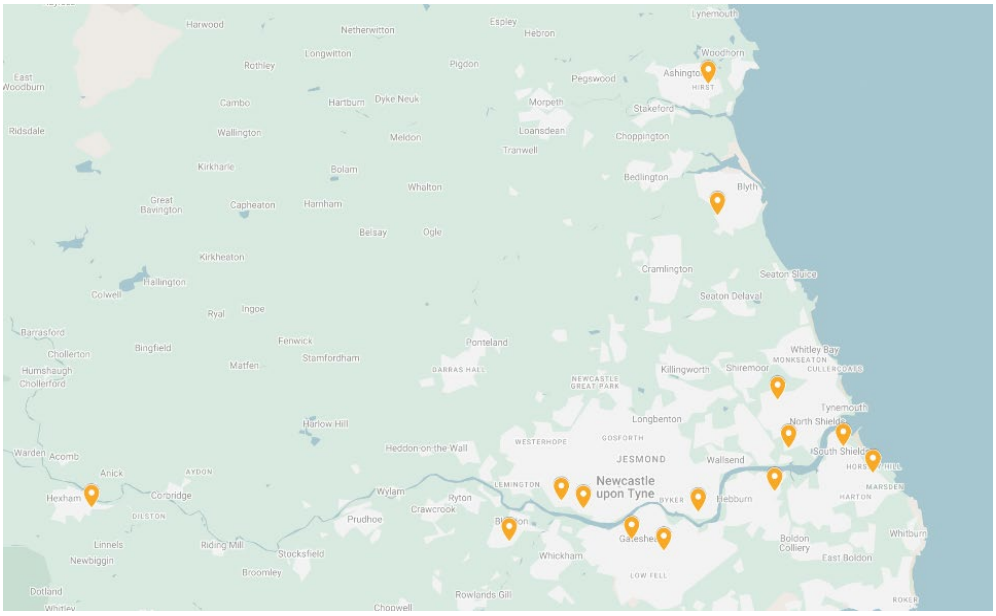


Figure 6 – Location of the Early Years and Primary Programme partner schools

This cohort of schools have now completed their first year, and the EYPP has successfully supported children across the North East (*Figure 6*) from Early Years to year six. Each new school will be part of the programme for two to four years, moving from developing to embedding after two years.

In our workshops, we've been showcasing a framework we call 'Attributes, Representation and Careers' (ARC). ARC presents a straightforward model with a clear rationale. We continue to refine the approach, but early indications suggest that teachers find it offers an easily adoptable framework with a clear rationale. During the workshops children 'try out' different careers and see representation of STEM professionals from diverse backgrounds from fields such as naval architecture, sustainability planning and sports science. They are designed to broaden children's career aspirations over the long term, and they also form an integral part of teachers' professional development through the EYPP.

In the next year, pupils in developing schools will continue to take part in the workshops, with the goal of teachers embedding these practices in the third and fourth year of the programme. See *Section 3.1* for further details of the teacher and school support aspects of the Programme.

2.3 Evening Lectures

This year's series saw six Northumbria University researchers delivering lectures to an audience of students from local schools and colleges. We welcomed 172 students to campus, from 16 local schools and colleges including Cramlington Learning Village, Jesmond Park Academy and Gateshead College. The speakers were:

Lecture 1 – *Why does space sing?* by Daniel Ratcliff
Lecture 2 – *Should I worry about space weather?* by Clare Watt
Lecture 3 – *How can we store energy, and why is it important?* by Yolanda Sanchez Vicente
Lecture 4 – *How much, how fast? Predicting ice sheet melt* by Jo Zanker
Lecture 5 – *The James Webb Space Telescope: New Eyes on the Universe* by Henrik Melin
Lecture 6 – *The complex beauty of fractal geometry* by Matteo Sommacal

Students were asked to provide feedback after each lecture. Comments included:

> *"I'm currently studying fields in school, so this was great to show the wider research. Thanks."*
>
> *"The James Webb telescope is amazing!!!!"*
>
> *"Magnetism be crazy!"*

2.4 Subject Experience Weeks

This year 55 year 12 students from 20 local schools and colleges joined us at City Campus for a Subject Experience Week. Their time included interviews with researchers, attendance at first year lectures, a campus tour, and creating and presenting their own mini research poster.

This core NUSTEM programme, part of the University Access and Participation Plan, was evaluated using the NERUPI framework recently adopted by the University to measure the impact of some outreach projects.

The Subject Experience Weeks support participants with their sense of what university life is like, build their understanding of the skills needed for research, and help them make informed decisions regarding Higher Education. The evaluation shows that the majority of aspects of the Experience Weeks provide a net positive response. However, one statement 'I can see myself studying [subject] at university' has a small net negative, which may be due to student's understanding more of the reality of a subject at university (*Figure 7*). This is an aspect we will explore more deeply next year.

Each year the Subject Experience Weeks rely on the support of around 30 academic colleagues, alongside professional support staff including technicians, Student Library and Academic services and Global Marketing and Business. Our thanks to our colleagues across the faculty and university for helping make the experience so positive for our guests.

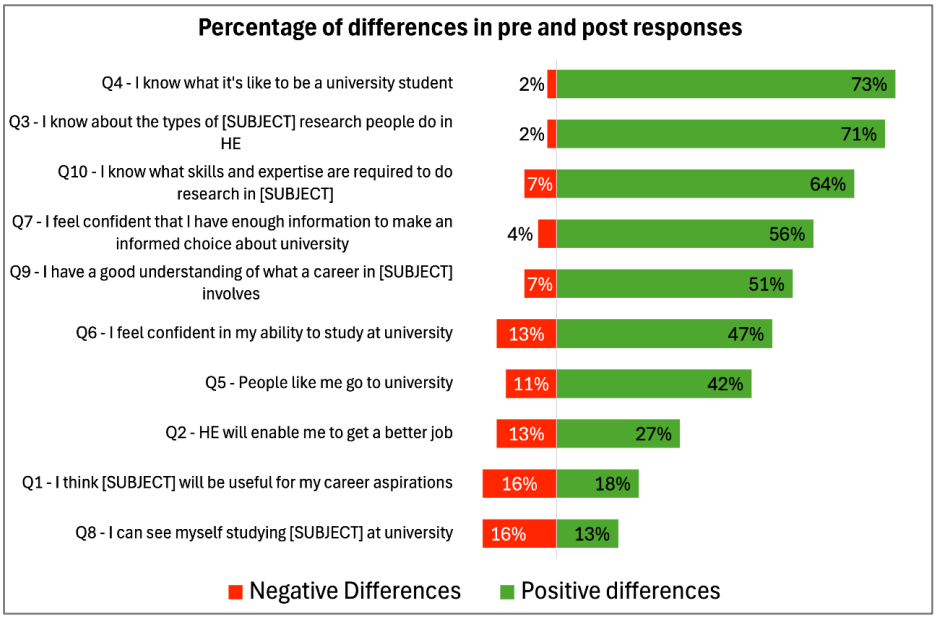


Figure 7 – The impact of Subject Experience Weeks for the students taking part.

2.5 Royal Society Biodiversity project

The Royal Society Biodiversity Project was designed to let school pupils take part in real-life scientific fieldwork within their own school grounds. The children had the opportunity to learn more about biodiversity whilst having hands-on experience of scientific research and investigation (Figure 8).

Figure 8 – An example of a photograph taken by the trail cameras used by the schools

Eleven partner schools took part in the project. Each was paired with a STEM professional – a postgraduate student or academic staff from Northumbria University. The STEM professional visited 'their' school three times, supporting the children in undertaking biodiversity surveys within their school grounds. The children were actively involved in planning their investigations and choosing what to explore; collecting and analysing their data; and presenting their findings as a scientific poster (*Figure 9*).

The programme successfully engaged children from years 2 to 5 (ages 6-10) in learning about nature and the world around them (*Figure 10*). Schools particularly valued the visits from professional scientists and appreciated having expert support to explore environmental science topics in greater depth. This connection with working STEM professionals helped children understand the practical applications of their learning and see the real-world relevance of biodiversity studies.

"…the children became very engaged in the project and [it] inspired them to take more of an interest in the outdoors and insects. Even at the end of the project some of the children were talking about how they were going to carry on observing the birds and animals around their school which they were not doing before the project began." STEM Professional

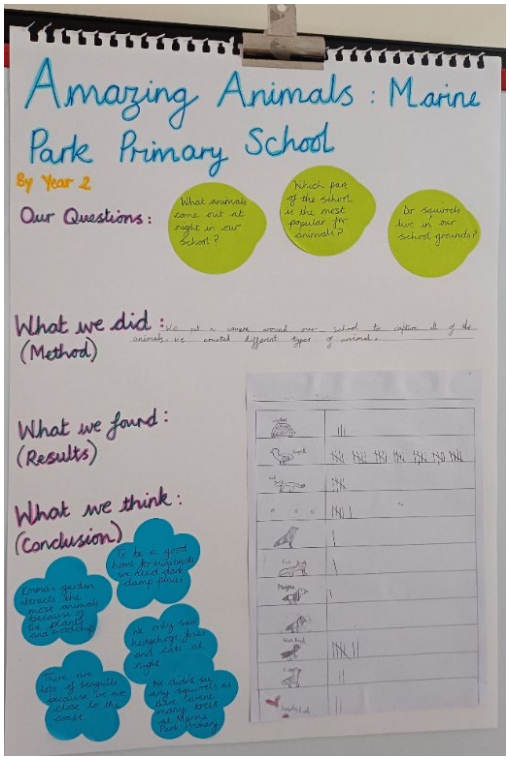


Figure 9 – An example of a scientific poster presenting the children's findings from their biodiversity survey.

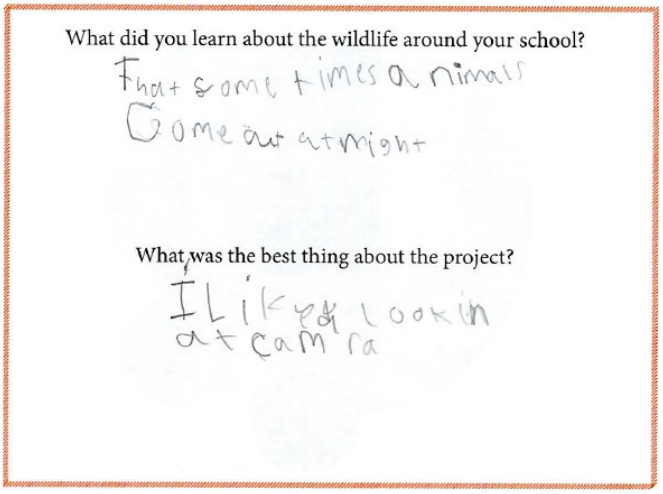


Figure 10 – Feedback from a Year 2 child who took part in the project.

The Biodiversity project was funded by a partnership grant from The Royal Society.

3 Supporting teachers and STEM professionals

3.1 Staff support in the Early Years and Primary Programme

The aim of the Early Years and Primary Programme (EYPP) is to support teachers to embed career related learning into their science teaching practice and curriculum. To ensure that the programme is as effective as possible, the NUSTEM team have taken their original Theory of Change and used a model of behaviour change to expand on the existing 'teachers' section. The behaviour change model helped us to clarify the importance of support from headteachers and senior leadership, and from science coordinators and early years leaders. The resulting new EYPP Theory of Change (*Figure 11*) contains a range of different outcomes.

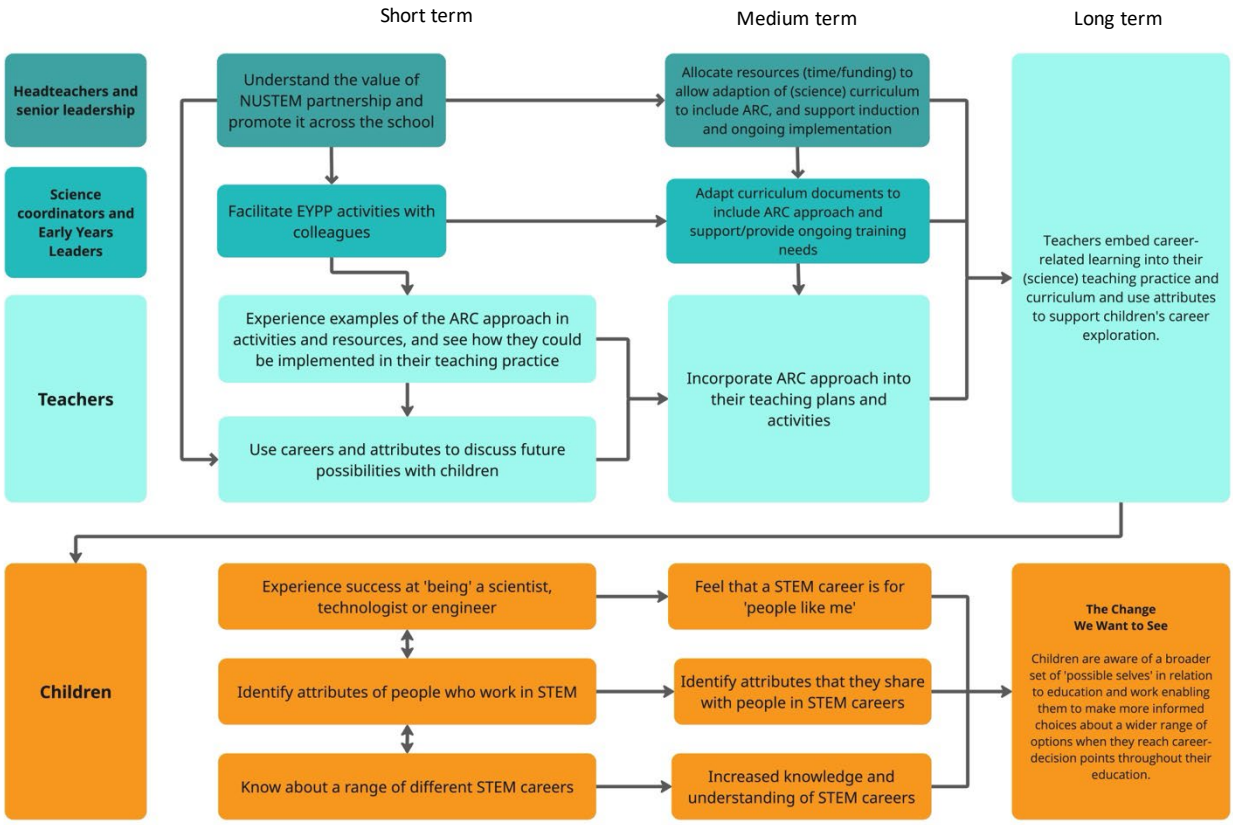


Figure 11 – Theory of Change for the Early Years and Primary Programme

As schools progress from the *developing* to the *embedding* phase of the programme they will move from the short to medium and then long-term outcomes. Our previous experience means we know that schools require an individual approach, and the flexibility of the EYPP programme has allowed us to tailor the support we provide each school, better to serve their individual needs and approaches. We're proud of our collaborative approach.

The comprehensive support includes continuing professional development opportunities, teachers observing and taking part in NUSTEM-led workshops with their classes, co-planning sessions, and trialling new ideas together. Importantly, this partnership means that we are discovering new ideas and innovative ways of embedding our programme effectively, by drawing upon and exploring the expertise in curriculum development that exists within our partner schools.

3.1.1 Play, Be, C support

Play Be C is an award-winning resource which supports the delivery of STEM topics in Early Years and Foundation Stage (EYFS) settings. The resource is packaged as a set of ten units, each themed around a different STEM career. The units offer a range of linked materials, including story books, role-play activities and provocations for child-led exploration. In-setting and at-home family activities are also included. The resources prompt children to 'try on' different STEM roles, broadening their understanding of workplaces. They're also straightforward and flexible for practitioners to integrate with their curricula.

We have been meeting with EYFS lead teachers on a termly basis to produce an implementation plan to help them to include *Play, Be, C* resources in their setting. This plan is regularly reviewed, reflected upon and updated, taking into consideration the needs of the school and individual staff. We initially looked at each school's EYFS topic overview and identified where we could link *Play, Be, C* units to topics (*Figure 12*). We completed confidence questionnaires with staff and used these to identify training needs. We then modelled *Play, Be, C* sessions in school and held reflective practice conversations with staff to further identify areas of confidence and training needs and barriers to implementation. Training in some schools has involved meeting with EYFS staff to show them how to use the units, and in other schools planning activities together for practitioners to deliver in class.

Most schools identified a lack of resources (the storybooks) as a barrier to implementation. We therefore provided copies of the books for the schools to use.

In some schools *Play, Be, C* has already been integrated into the EYFS curriculum for September 2025 and we are beginning to plan, model and deliver family sessions with other schools.

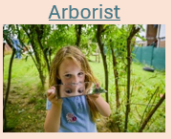
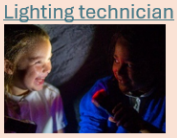
	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Preschool	Marine Engineer 	Glaciologist 	Pharmacist 	Arborist 	Meteorologist 	Fluid scientist 
Nursery A	Arborist 		Pharmacist 		Arborist 	
Nursery B	Magnet engineer 	Lighting technician 	Marine Engineer 	Glaciologist 		Fluid scientist 
Reception	Arborist 	Glaciologist 	Pharmacist 	Civil Engineer 	Robotics engineer 	Meteorologist 

Figure 12 – An example of a topic overview and the links to the Play, Be, C units

3.2 NU Ideas science communication support

This year we have been delighted to again support the NU Ideas project. Organised by Professor Martyn Amos, this initiative sees academics from across Northumbria University delivering public talks at the Newcastle Literary & Philosophical society. NUSTEM supports this activity by providing science communication training for the staff involved, helping them to engage effectively with public audiences and share their research beyond the academic community.

We ran two training sessions this year and we've enjoyed meeting colleagues from diverse disciplines: the range and depth of research being conducted at Northumbria University is fascinating.

Feedback from the attendees at the lectures has been excellent.

3.3 Online support

We believe that the direct connections we make and the relationships we build with teachers, families, colleagues and collaborators are the most important aspects of our work. To facilitate this, online support and extension material has been a constant feature of NUSTEM's delivery. We've not previously published website statistics, in part because 'counting web page views' is a deceptively subtle art.

However, it's been apparent for some time that the majority of NUSTEM's wider audience is online. We continue to believe that most of our *impact* results from our in-person delivery and publications, and the headline interactions data we present will continue to reflect direct deliveries only (*Figure 5*). We now think, however, that our web audience is sufficiently developed that we should separately report data around website views and resource downloads.

3.3.1 Headline page views/visitors

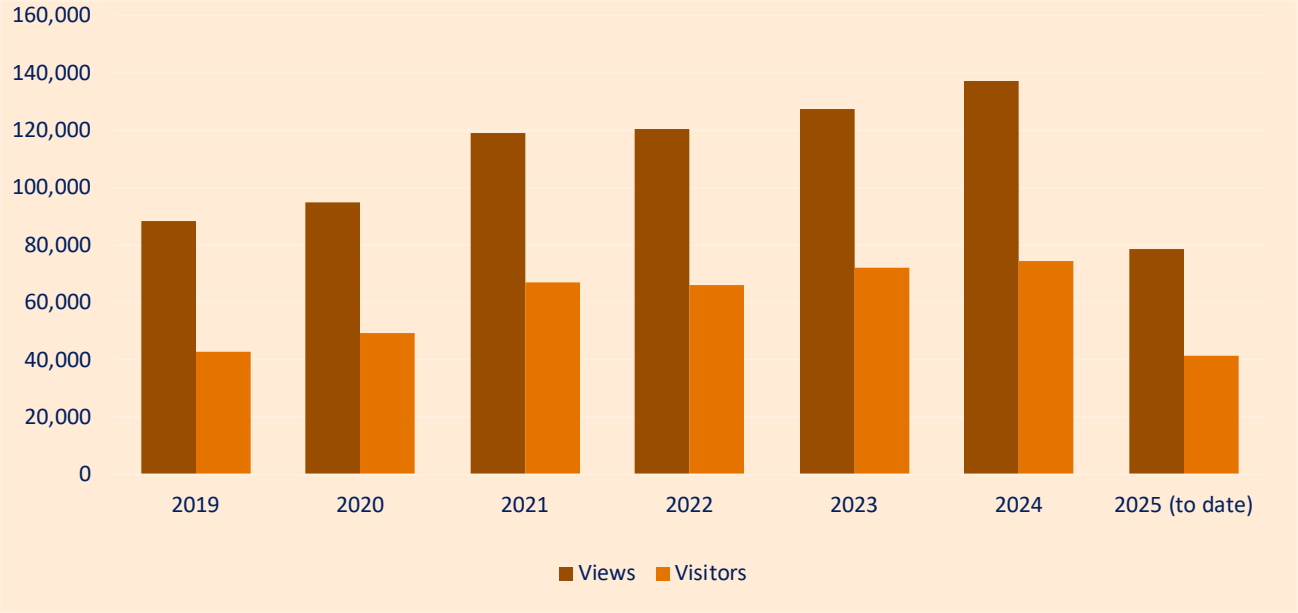


Figure 13 – Website page view & visitor counts, calendar year (Wordpress stats)

These basic data (*Figure 13*) illustrate a modest but steady audience growth, and respectable numbers of visits. More detailed analysis suggests that – excluding traffic from search engines and, increasingly, crawlers supporting AI training – most of our web audience is UK-based. Access patterns (times of day and quiet weeks) are consistent with a significant proportion being teachers. While visit durations and pages per visit metrics vary, the averages suggest a relatively highly-engaged audience which typically explores the site in some depth.

The website now carries more than 2,000 content pages, arranged via multiple taxonomies. Most pages are served under generic paths ('activity', 'careers' etc.); this was an early structural decision which, we believe, helps resources from

multiple projects and activities achieve secondary value by contributing to an overall body of resources. Grouping content by project typically happens via project landing pages and secondary taxonomies within our content management system.

Disentangling content groups for reporting purposes has long been a challenge. This year we've invested some time in building tooling to help us better understand our content groups, and to be able to track their performance.

3.3.2 Content group performance

The following table shows content collections and individual pages of particular interest (broadly, our most popular content). 'Engagement time' is a count of total visit duration to those pages. This should be taken as indicative only: the data collection methodology is not flawless.

Page group	Description	Views	Engagement time days:hours:mins
Activity pages (all)		43,192	21:23:42
— of which: Gears, Levers, Pulleys	*Specific Key Stage 1/2 resource page*	*10,833*	*7:03:32*
A-Level Physics required practicals	Video resource collection	16,629	7:10:20
Play, Be, C	EYFS support resources	13,783	7:11:25
Careers pages	Resource collection	8,337	3:13:28
STEM Person of the Week	Specific careers resource collections	3,964	1:13:40

Table 1 – Page view performance, AY 2024–25. Google analytics, custom processing

The page supporting the teaching of the 'Levers, Pulleys and Gears' topic at Key Stages 1 and 2 is by far our most popular, ranking highly in search engine results for this under-resourced curriculum topic. This appears to be serving a specific teaching need: visitors to this page typically do not continue to explore further resources around the site.

The A-Level Physics required practicals support films are also an older resource which continue to be popular. The figure noted above is only for visits to the NUSTEM webpages; most views of the films are on YouTube where the films have had over 279,000 views. We estimate that every year most A-level physics students will see at least one of these films during their studies.

A much more recent resource collection is Play, Be, C (*Figure 14*). Designed to help early years educators to deliver high-quality STEM provision for children aged 3–5, this is an award-winning, rich collection of resources which visitors explore in depth. We look forward to monitoring the performance of these pages over the coming years.

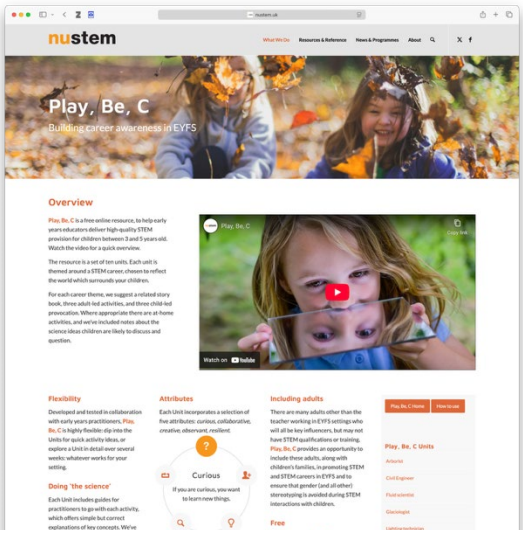


Figure 14 – Play, Be, C resource collection landing page

3.3.3 Careers resources

Also of particular interest are our careers resource pages, which have now achieved significant annual traffic. These comprise a database of individual STEM workers and employers, and a primary-targeted collection of STEM jobs, the 'Curriculum Careers Tool.' This last is particularly interesting: it's a sparse and simple resource, which has nevertheless found significant traffic and engagement. We continue to explore further development in this area, and collect data on the use of these resources to inform that thinking and to support potential future funding bids.

3.3.4 Resource downloads

While website page views and session dynamics can give us an indication of resource use, these metrics are best thought of as relative rather than absolute. Given vagaries in the collection methodology (in our case, Google Analytics) the real value comes in tracking page performance over time. We now have the tooling required to do that, and will report further next year.

What's more definite is counting resource downloads. We provide resources directly from our website, via STEM Learning's eLibrary, and more recently via Northumbria University's Resource Bank. In the former case, we can detect to some extent whether a user is 'real' or a robot/software crawler, but the eLibrary and Resource Bank implement user registration systems and are hence more robust, if less accessible.

3.3.4.1 eLibrary and Resource Bank downloads

Location	Resource	Type	Downloads
eLibrary	Climate Change: It's In Our Hands	Board game	1,836
eLibrary	Climate change & renewable energy	Worksheet	88
eLibrary	Space travel	worksheet	38
eLibrary	*Other resources*	various	193
Knowledge Bank	STEM Person of the Week sets	Posters and postcards	466

Table 2 – eLibrary and Knowledge Bank resource downloads, AY 2024–25

3.3.4.2 Website downloads

Resource	Description	Downloads
STEM at Home	Resources supporting activity collection	2,176
Inventive	Resources supporting Inventive podcast series	825
Mini Mangonel	Tinkering activity worksheet	716
Position papers and reports	Annual reports, Unconscious Bias in the Primary Classroom, *etc.*	605
Loans Boxes	Resources supporting resource provision to primary schools	539
A-Level Physics Required Practicals	Resources supporting film resources	389
British Gear Association	Resources supporting primary workshop delivery by a client organisation	166

Table 3 – significant website resource downloads, AY 2024-25. Web server statistics, omitting obvious bots

3.3.4.3 Discussion

It's apparent that resources freely available on the NUSTEM website typically achieve more downloads than those gated through the eLibrary. However, it's also clear that some resources (Climate Change: It's In Our Hands board game) can achieve substantial download figures despite the requirement for user registration.

We continue to monitor these data to help choose appropriate download routes for different resources, which balance ease of access with robustness of data collection. We also continue to develop our tooling, better to assess resource performance over time.

4 Collaborations

4.1 Interact Symposium

On 19th September 2024, NUSTEM and Northumbria University hosted the Interact Symposium at City Campus East. The symposium was organised by the Science and Technology Facilities Council (STFC), The Ogden Trust, the Institute of Physics, the South East Physics Network (SEPnet) and the Royal Astronomical Society.

The aim of the symposium is to "support and enable the physical sciences community to carry out impactful research linked engagement with audiences not provided with opportunities to access the sciences."

There were six parallel themes running through the day: Evaluation and impact; Working with audiences under-represented in the Physical sciences; Engagement mediums and practice; Creative engagement mediums and practice; Leadership in Outreach and Public engagement; and Planning for the long term. The NUSTEM team contributed to several workshop sessions (see *Section 5.3*).

As well as the wide choice of sessions and workshops, the event included interactive performances from the Rock Circus and a visit from the Moon bus.

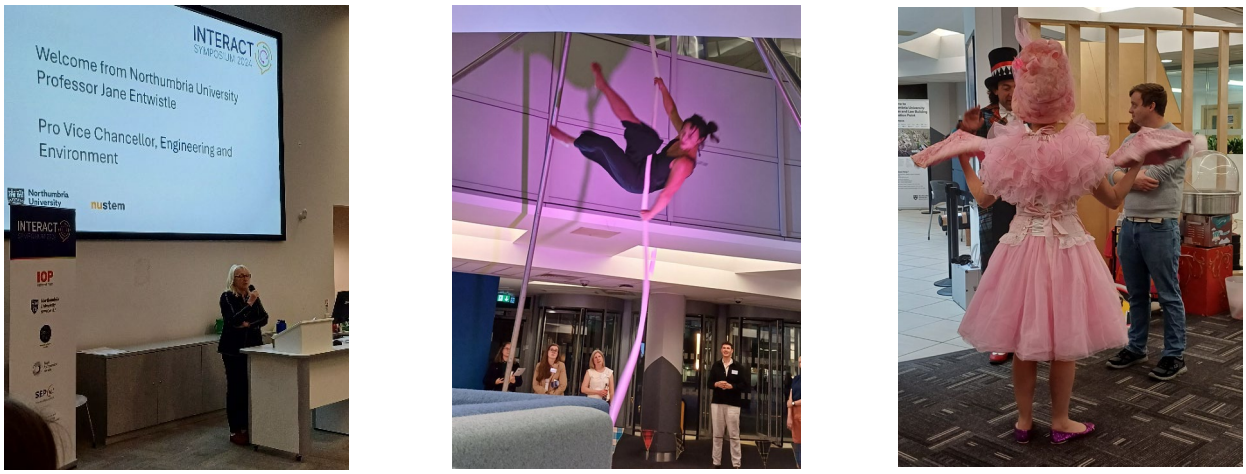


Figure 15 – (left) Prof Jane Entwistle opening Interact. (middle) Aerial performer exploring astrophysics through movement. (right) Members of the Rock Circus discussing circular motion

Weblink: https://www.interactsymposium.org/

4.2 Ogden Outreach Officers Annual Meeting

In September 2024 the Ogden Outreach Officers Annual Meeting was hosted by Northumbria University to coincide with the Interact Symposium. The meeting is an opportunity for physics-related outreach and public engagement practitioners to come together and share best practice. During the meeting, Professor Nic Whitton delivered a session about playful learning and Sarah Bakewell from the Institute of Physics introduced the new inclusion model for physics departments.

The three-day meeting ended with the prestigious Ogden Outreach Awards ceremony.

Weblink: https://www.ogdentrust.com/university-support/ogden-outreach-awards/

4.3 STEM Communities

The STEM Communities project aims to bring together and facilitate a community of families to explore their interests in STEM and heritage and lead their own scientific enquiries. It is a partnership between NUSTEM, Woodhorn Mining Museum (now part of North East Museums), and the STEM community the project serves.

The project was the winner of STEM Initiative of the Year at the Educate North Awards 2025.

Evaluation of the first year of the project has shown that the majority of participants felt welcome, involved and satisfied in the sessions, and expressed high levels of interest in attending future STEM Communities sessions. We have a core group of 'super engagers' who have attended more than half of all sessions offered, and a wider STEM community who engage less frequently. Rapid formative evaluation has been a key tool in the project development, influencing workshop design and practice. Evaluation with families found that key successes of the project were learning through play, spending quality time as a family, feeling welcome and comfortable in the environment and with project team, and sharing food. These have been used to define participatory evaluation outcomes to evaluate the second year of the project. We attended the STFC's Advisory Panel for Public Engagement in June to talk about the learning from the project, and the value of reflective practice and participatory evaluation in understanding what works in this context.

In the second year of the project, families from six more schools will join the STEM Community. We will be looking at how to bring the two cohorts together, and how to best support the development of STEM interests and independent enquiry within the group.

STEM Communities is funded by STFC (reference ST/Y002954/1)

Weblink: https://museumsnorthumberland.org.uk/project/stem-communities/

4.4 STEM Person of the Week Cymru

This project is led by Science Made Simple (SMS) who are based in Wales. The SMS team have recruited five STEM workers who have links to Wales and to the Science and Technology Facilities Council (STFC). NUSTEM and SMS have created English and Welsh versions of the STEM Person of the Week resource (Figure 16).

SMS have also developd a science show which features the five STFC people, and have a presenter who is fluent in Welsh. There are limited STEM resources available in Welsh, so this project has been welcomed by Welsh-medium schools. SMS deliver the show in a school and leave the STEM Person of the Week cards with the teachers to use in the next five weeks. This provides longer term engagement with the project for the children and schools.

the Week card

So far 21 schools in Wales have taken part in the project. 33% of these have been Welsh medium schools, 87% have been English medium schools, and 10% have asked for both English and Welsh medium shows to be delivered.

Next year NUSTEM will be supporting SMS with the evaluation of the project, to explore the impact it is making on teachers and children across Wales.

STEM Person of the Week Cymru is funded by STFC (reference ST/X006190/1).

Weblink: https://sciencemadesimple.co.uk/item/stem-person-of-the-week-cymru/

4.5 Sonic Intangibles

Sonic Intangibles is a two-year project between Northumbria University and Newcastle University, led by Professor Paul Vickers. It is centred on creating an interdisciplinary and collaborative research hub for the discipline-spanning field of sonification. Sonification represents data and relationships between data through sound.

NUSTEM, as part of the project team, is developing a Sounds Club which will allow us to research how primary school children could understand sonification. Sounds Club is a cross-curricular after-school activity for pupils aged 8 to 9.

Sounds Club complements national curriculum learning in Year 4 for science and music by helping children to:

- find patterns between the pitch of a sound and features of the object that produced it
- find patterns between the volume of a sound and the strength of the vibrations that produced it
- represent data using charts
- improvise and compose music for a range of purposes using the inter-related dimensions of music

The pilot for our Sounds Club took place between June and July 2025. We worked with a Year 4 class to test possible activities for the club and give us feedback. These pilot activities included storytelling through pixel art (*Figure 17*) and sonification of simple bar charts with data collected by pupils about their birthdays. Reflective practice, pupil voice, teacher feedback and workshop observation have been used in the evaluation of the pilot. Learning from these activities will help inform the final 5-week Sounds club which will be delivered in two primary schools next year.

Sonic Intangibles is funded by UKRI's Cross Research Council Responsive Mode Scheme (Grant Number MR/Z506448/1)

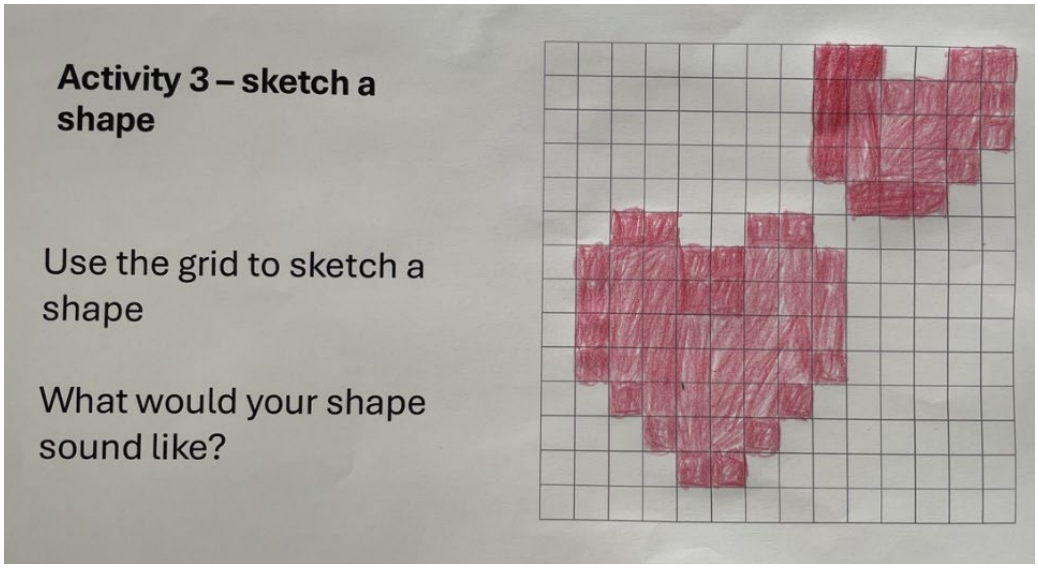


Figure 17 – An example of pixel art created by a pupil during the pilot activities

Weblink: https://sonicintangibles.github.io/

4.6 Summer Workshop: Communicating on Earth and beyond

NUSTEM worked with Juna Sathian to develop and deliver a research-linked workshop around her work on masers. "Maser" is an acronym for Microwave Amplification by Stimulated Emission of Radiation; maser devices can be used to detect and amplify extremely weak microwave signals.

The workshop developed was called 'Communicating on Earth and Beyond'. Children in Year 5 (ages 9–10) visited Northumbria University. They were invited to reflect on problems and solutions of communication at different distances: from sitting next to each other in Newcastle, to communicating with a Mars rover. The latest generation of rovers transmits information encoded in binary system through microwaves: this concept was then used to explain to the children how masers work.

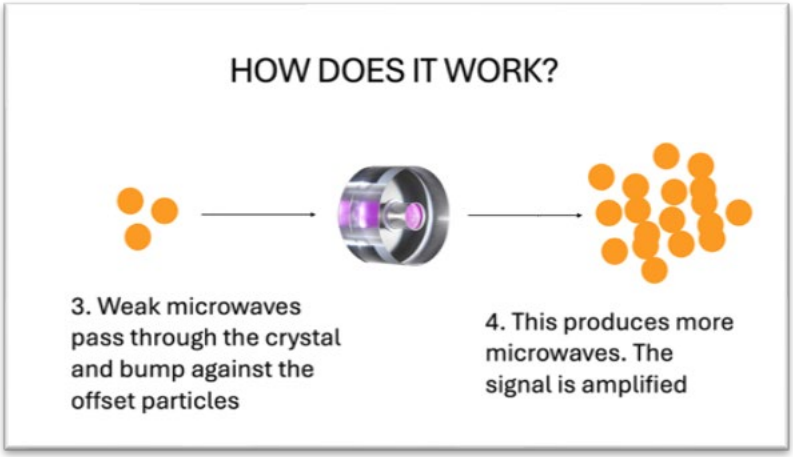


Figure 18 – How pumped masers amplify microwave signals

The evaluation found that that the workshop was well received by teachers and pupils. Children commonly described the workshop as "interesting", "fun" and "amazing", with 90% rating their visit to the University as 4 or 5 stars. Teachers said that the workshop was pitched correctly for the age group, tying in nicely to curriculum topics, and that it provided adequate challenge but was accessible for all. Through open questions some children identified learning about masers and how they work, "*That it can go through space with microwaves and masers amplify the images from probes*".

The workshop was funded as part of Dr Juna Sathian's EPSRC grant (reference EP/X016633/1)

4.7 Space Camps

Northumbria University hosted two Space Camps for Lockheed Martin and Viasat in October half-term. The NUSTEM team provided logistic support to ensure that the camps ran smoothly. This involved welcoming over 50 children and young people onto campus during term time. The aims of Space Camps are to introduce pupils to a broad range of careers linked to space, to allow them to meet guest speakers from the space sector, and to try out different space-themed activities.

NUSTEM also evaluated the impact of the Space Camps on the pupils and found that the aims of the camp were met, with pupils learning new things about space and the types of jobs available in the space sector.

> "*I want to work at NASA doing aerospace engineering and help people land on Mars*"
>
> "*You can take a completely different path but still find yourself on the road to space*"
>
> *Year 6 participants*

5 Sharing good practice and research

5.1 Developing Theory of Change with UK National Nuclear Labs

This year NUSTEM worked with staff from the United Kingdom National Nuclear Laboratory (UKNNL) to support them to develop a Theory of Change (ToC) for their social value work. As part of this, we carried out a Rapid Evidence Review into the 'Determinants of public support and acceptance of nuclear power, and theories and strategies to increase public support and acceptance'. This review helped us to identify important theoretical aspects to consider when creating the ToC.

To start to develop the ToC we spent an afternoon with staff from different areas of UKNNL to explore the long-term outcomes that they would like to achieve, and which groups they thought were important to those outcomes. Over the space of a few months these outcomes were iteratively refined and appropriate short- and medium-term outcomes also identified until a final ToC was produced.

5.2 Engineering Educates

Led by SEERIH at Manchester University Engineering Educates is aimed at 7–14 year-olds and lets them think like engineers, finding solutions to real-world problems and challenges. The resources are linked to the school curriculum in Design & Technology, Science, Computing and Literacy.

SEERIH are using NUSTEM's attributes in their 'Careers Chat' resources which are part of their Engineering Educates annual campaign (Figure 19).

The team at SEERIH also provide professional development for teachers to support them to use the resources in their teaching.

Weblink: https://www.engineeringeducates.org/

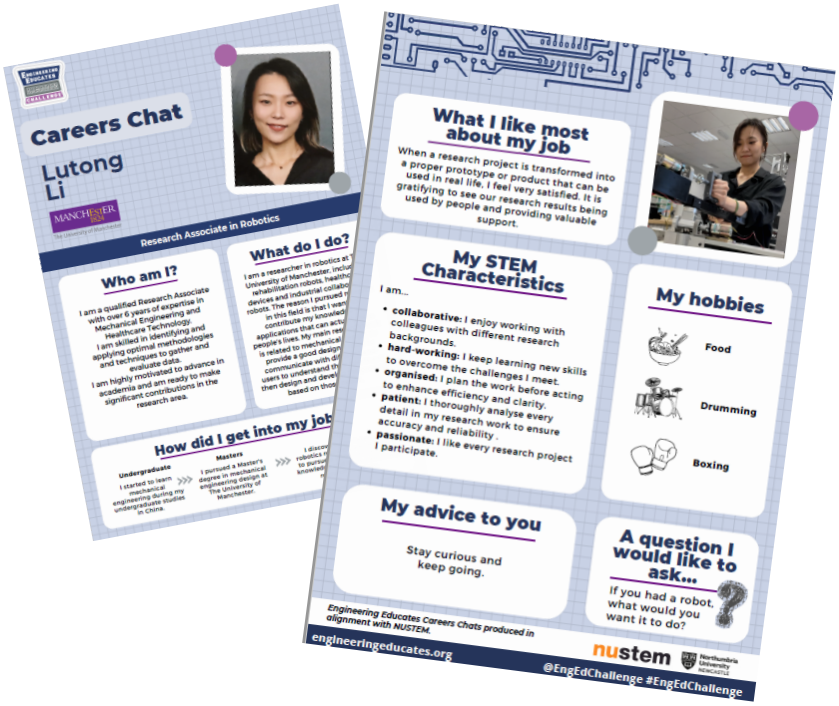


Figure 19 – One of the Careers Chat resources from Engineering Educates with NUSTEM STEM Attributes (characteristics)

5.3 External Presentations

This year the NUSTEM team have presented 19 sessions at a range of practitioner conferences and meetings.

Research:ED National Conference (7th September 2024)
Careers in Primary School: What, where and why?
Carol Davenport

BERA National Conference (9th – 12th September 2024)
Changing career aspirations: a longitudinal study of primary school children in NE England
Carol Davenport

Westminster Education Forum: Next steps for careers guidance in England's schools and post-16 settings (*10th September 2024)*
Assessing the impact and progress of careers guidance in primary schools so far.
Carol Davenport

Interact Conference (*18th September 2024)*
Connect – A case study on computational tinkering for families
Jonathan Sanderson, Elin Roberts (Life Science Centre)
Providing meaningful work and subject experience programmes for young people interested in physical sciences
Jenny Search (Life Science Centre), Antonio Portas
Solar Stanzas: understanding solar physics through poetry
Joe Shimwell, Dr Richard Morton
Evaluation methodologies for formative outreach development: reflective practice & Most Significant Change
Annie Padwick, Joe Shimwell, Liz Ferguson (Museums Northumberland/North East Museums)

Primary Science Annual Conference (*6th November 2024)*
Play, Be, C: Supporting STEM in Early Years
Carol Davenport

Complete Career Company Conference (*13th November 2024)*
Careers resources for early years and primary classrooms
Carol Davenport

Heritage Forum (26th November 2024)
The power of partnership working
Liz Fergusson (Museums Northumberland/North East Museums), Carol Davenport

Inaugural Professorial lecture (27th November 2024)
Tackling diversity in STEM one aspiration at a time
Carol Davenport

Durham Primary Science Network (23rd January 2025)
Tackling stereotypes with STEM careers
Carol Davenport

Association for Science Education (ASE) Annual conference (9th – 11th January 2025)

Board games and tipping points: exploring climate change in the primary classroom

Joe Shimwell

Flux and Stability: Changing career aspirations of 78 primary school children in NE England.

Carol Davenport

Play, Be, C: Supporting STEM in early years

Mel Horan, Carol Davenport

NU Ideas Series 3 (20th March 2025)

When I grow up…? Exploring young children's career aspirations

Carol Davenport

Educon Conference (22nd – 25th April)

Effective evaluation and unintended consequences of STEM interventions: a case study from NE England

Carol Davenport

IEEE International Women in Engineering Day Symposium (23rd June 2025)

Keynote: Who's in? Promoting ongoing inclusion in STEM from an early age.

Carol Davenport

Pro^2 Network Device Prototyping Summer School (18th July 2025)

Connect2: A research platform for family computational tinkering.

Jonathan Sanderson

5.4 Published research and articles

It's In Our Hands: Facilitating agency, personal connections and collective cohesion in climate education through board game play.

Annie Padwick, Emma P. Hocking, Joe Shimwell, Carol Davenport, Alan Ramsay, Edward Blazey, Julia Bourne, Kayleigh Ransome, Chelsea Baxter (2025) in *Journal of Environmental Studies and Sciences* doi.org/10.1007/s13412-025-01045-0

This paper presents the co-design and piloting of a serious game about climate change, designed for civic as well as educational purposes. Ethnographic analysis of data indicates the game can support children to develop their agency in climate decision-making, foster real-world connections with climate change, and realise the collective cohesion and urgency needed to tackle climate change, as well as develop understanding of the climate change system.

Effective Evaluation and Unintended Consequences of STEM Interventions: A Case Study from North East England.

Itoro Emembolu, Carol Davenport, Annie Padwick, Holly East, Joe Shimwell, Rebecca Strachan. (2025) in 2025 IEEE Global Engineering Education Conference (EDUCON).

This case study presents the design and evaluation of a school-based workshop called the Environmental Planner. We use a community of inquiry action research approach to explore intended outcomes of the workshop: including knowledge, aspirations, and understanding of careers. The developed evaluation tools also allowed identification of unintended consequences from the intervention, which indicated a damaging misunderstanding of timescales in coastal changes.

Making their minds up: flux and stability in young children's career aspirations in North East England.

Carol Davenport, Annie Padwick (2025) *Humanities and Social Sciences Communications*, 12, 1038. doi.org/10.1057/s41599-025-05364-z

This study tracks career aspirations of 78 young children over a 3-year period. It shows that there is both flux and stability in children's aspirations between the ages of 7 and 11, and that career aspirations were strongly gendered. Thematic analysis of the reasons given for different aspirations identified four themes: self-actualisation, altruism, characteristics of the job, and role models. These themes were related to existing careers and aspiration frameworks.

Using a behaviour change framework to develop an Early Years literacy and science project to support parental engagement.

Carol Davenport, Annie Padwick, Joe Shimwell (2024) Journal of Emergent Science. 27, p.5-14

This paper presents the development and evaluation of a literacy and science project for families with children aged 3 to 5 at a school in the North East. The project was developed using a Theory of Change and incorporating a behaviour change framework. We report how the framework supported strong and regular engagement in the project by families and guided necessary changes to the project during the COVID-19 pandemic.

"We would just assume the wolf would be a boy…" critical engagement with children's literature by Early Years Educators

Carol Davenport, Kay Heslop, Annie Padwick, Joe Shimwell. (2024) *International Journal of Early Years Education.* 1-17 DOI: 10.1080/09669760.2024.2444876

This paper presents a case study of the impact of an unconscious bias training intervention on early childhood educators' awareness of unconscious bias and their professional practice. 23 educators from early childhood education settings took part in two sessions of unconscious bias training two months apart, and undertook a literature audit of books used within

their settings. The paper shows that the intervention raised participants' awareness of the impact of stereotypes and brought a medium-term change of practice for individuals.

Let's Do Engineering: Engineers and Creative Practitioners Experiences of Co-creating Activities and Resources for 3–7 Year-Olds, and Teacher Evaluation of Resource Effectiveness.

Helen Bridle, Rebecca Donnelly, Annie Padwick, Thusha Rajendran, Joe Shimwell, Carol Davenport (2025) *Early Childhood Education Journal*, 1-17. DOI:10.1007/s10643-025-01858-2

This paper presents the evaluation of Let's Do Engineering, a research and engagement project aimed at broadening perceptions of engineering in the early years, focusing on the impact of the project on the engineer role models, creative practitioners and educators. It draws out best practices for fostering collaborations between science, technology, engineering, and mathematics (STEM) professionals and creative practitioners (artists) as well as for designing engineering activities for early years audiences.

Embedding career-related learning in primary science.

Carol Davenport, Annie Padwick (2024) Primary Science, 183, pp24-27

This article is aimed at teachers. It reports on a national survey of career-related learning across primary schools in England and suggests how career-related learning could be improved. The survey highlights a need for, and willingness to deliver, career-related learning among teachers in primary schools, but also identifies several challenges in implementation. Existing solutions have been trialled in the North East with successful results.

Appendix 1: Aims and objectives

NUSTEM Aims

1. Broaden children's and young people's knowledge and understanding of STEM careers and attributes
2. Promote equity in STEM education and learning
3. Promote positive shared family and community experiences in STEM
4. Work with organisations, including employers, to develop effective STEM engagement policies and programmes
5. Strengthen the (research) evidence base in STEM education and engagement.

NUSTEM Strategic Objectives	**Aims**
Develop, deliver and evaluate early years, primary and secondary programmes for schools	1,2,3,4,5
Develop, deliver and evaluate memorable family and community learning activities in schools and beyond	1,2,3,5
Support teachers through CPD opportunities	1,2,3,4,5
Support STEM engagement providers to develop strategy, learning resources and activities	2,4,5
Strengthen current partnerships and explore new relationships with internal and external organisations, including institutional citizenship	2,4
Regularly submit public engagement or research funding bids and write papers, articles and reports relating to STEM engagement and education.	4

Appendix 2: Yearly Interactions

Total Interactions to date

	Interactions	2014 – 2019	2019 – 2021 (Covid Lockdown Years)	2021 – 2024	2024 – 2025	Total to date
Children and young people	Pre-school and Primary (including loans boxes)	43,347	12,490	23,510	3,906	85,253
	Secondary school	32,073	6,158	7,624	6,251	52,103
	Community and family events	7,590	526	1,695	201	10,012
Key Influencers	Teachers	4,901	1,441	2,726	628	9,696
	Parents and Families	6,878	1,147	2,660	383	11,068
	Wider community	3,888	1,223	1,802	366	7,279
	Totals	98,677	22,985	40,017	11,735	173,414

Appendix 3: NUSTEM projects in 2024/25

Project	Duration	Notes
STEM Communities *STFC*	July 23 – Feb 26	Collaboration with Museums Northumberland – led by NUSTEM
STEM Person of the Week Cymru *Science made Simple / STFC*	Sept 23 – Apr 26	Collaboration with Science Made Simple – led by SMS
Biodiversity Project *Royal Society*	Dec 24 – July 25	Facilitating schools and STEM professionals to work together on biodiversity surveys of school grounds.

Academic Led Projects including NUSTEM

Project	Duration	Planned activity
Diversifying the Talent Pipeline *Dr Emma Hocking*	Apr 23 – Apr 25	NUSTEM carried out a rapid evidence review of current good practices for increasing diversity of those studying geography and environmental sciences.
Renewable Energy Northeast University (RENU) *Professor Neil Beattie*	Apr 19 – Sept 27	NUSTEM provides training for students and supervisors, along with EDI support for the CDT as a whole.
Nuna: Effective mitigation and adaptation to changing ground conditions for resilient coastal futures *Prof Mike Lim*	May 22 – May 25	Working with community and school in Tuktoyaktuk, Canada to create resources which explore the findings from the wider project. Also includes costs for NUSTEM travel, consumables and design work in each of the 3 years of the project.
CONNECTing past, present and future *Dr Jan de Rydt*	Aug 22 – Aug 26	Leading science communication workshops with PhD students and postdocs.
Decoupled space and time gradients for particle enrichment, sorting and isolation *Dr Prashant Agrawal*	Sep 23 – Sep 26	Developing and evaluating a research-linked workshop for primary school children based on the findings from the project.
Sonic Intangibles *Prof Paul Vickers*	Feb 25 – July 27	Exploring how sonification can be used in interdisciplinary ways, including with young children.

Evaluation and research projects in 2024/25

Event	Client
STEMFests Bradford and Sunderland	RTC North
Theory of Change for Social Value	UK NNL
Space Camps	Lockheed Martin and Viasat