



**Northumbria  
University**  
NEWCASTLE

**nustem**



**ANNUAL REPORT**

September 2023 - August 2024

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## Introduction

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**NUSTEM's vision is for a vibrant and sustainable STEM sector which meets the needs of learners and employers, reflecting the diversity of wider society.**

This year we have refreshed our aims and objectives to help us work towards this vision. NUSTEM aims to:

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, programmes and practice
5. Strengthen the (research) evidence base in STEM education and engagement.

The detailed objectives can be found in Appendix 1.

In the last academic year, the NUSTEM team have had over 10,000 interactions with children, families, teachers and STEM professionals. Section 1 showcases some of the activities in more detail from story-time sessions with 2 year olds and their families to university subject experience weeks for sixth formers.

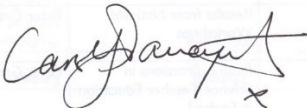
A key part of our work is supporting teachers and other professionals who influence children's education and career aspirations. The NUSTEM team regularly delivers training sessions about our resources and approach. Section 2 highlights training for early years educators, outlines the development of our ongoing work with primary schools, and details the conferences and meetings that the team have presented at.

We also extend NUSTEM's reach through collaborations with university colleagues and with external organisations. Section 3 describes four projects which support children and families to explore different aspects of STEM, with Dr Richard Morton, Museums Northumberland, Science Made Simple and British Engines.

Research and evaluation of activities is an important part of developing our practice and sharing our learning with other organisations. Section 4 describes the reflective methods the team has used this year, and details an exciting opportunity I had to shadow Chi Onwurah MP as part of the Royal Society Pairing Scheme.

NUSTEM has been delivering STEM engagement activities in the North East (and beyond) since September 2014, and so over the next academic year we will be planning some celebratory activities for our 10<sup>th</sup> anniversary.

Best wishes



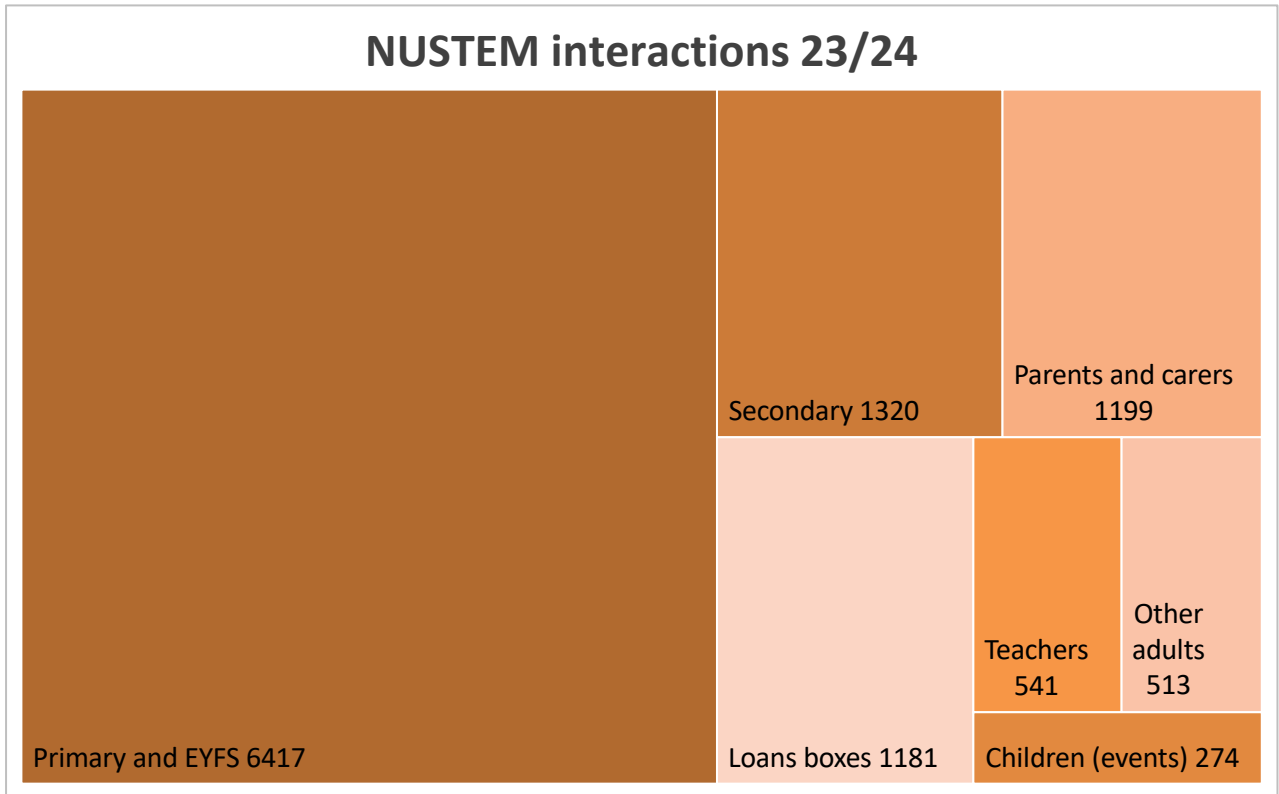
Professor Carol Davenport

Director, NUSTEM

# 1 Children and families

## 1.1 Activities

NUSTEM has led 306 different events and activities this year, with over 400 hours of delivery. The NUSTEM team have had over 10,000 direct interactions with children, their families, and others who are involved in STEM engagement.



We know it is important to tackle stereotypes and to provide career-related learning from an early age, and this is reflected in the proportion of sessions we have delivered to different audiences. 70% of our work is with primary and early years children; 14% with secondary aged children; and 13% with parents and carers.

For a full breakdown of the cumulative interactions see Appendix 2.

## 1.2 Award-winning

For the second year running NUSTEM has won the STEM Initiative of the Year at the Educate North Awards. This year, our Play, Be, C resource was the winner. Play, Be, C is an online resource which supports early years educators to bring STEM careers into their settings in a playful way.



### 1.3 Inviting parents and carers into the classroom

In NUSTEM partner schools, we invite parents and carers into our workshops. The children and their grown-ups work together on an activity which encourages conversations about science and careers.

This year we have invited Year 4 parents and carers to become entomologists and create plasticine insects with their children. Year 2 parents and carers became botanists and created flower-themed pop-up cards, and Year 1 parents and carers worked with their children to build and test tin foil boats as naval architects.



Image credit: Marine Park Primary School



Image credit: Marine Park Primary School

In early years, children and their adults became glaciologists investigating melting ice, marine engineers building junk model boats, and lighting technicians making shadow tubes to investigate light and shadow.

Families have also been involved in the development of two new Play, Be, C units: the civil engineer and the pharmacist. They have tested out activities, such as building bridges for an elephant or investigating the amount of water needed for salt to dissolve, to make sure that they encourage conversation and play.

*Weblink:* <https://nustem.uk/eyfs/>

### 1.4 STEM careers game

Our STEM careers game has been in development for a while, driven by the need to find avenues to introduce lower KS3 pupils to the STEM attributes and explore the usefulness of the science curriculum in everyday life. The game requires pupils to match clue cards to 15 STEM jobs. The clue cards have different categories: job specification, a visual clue, science to know, and STEM attributes.

The game forms part of a workshop where pupils are invited to think about their own attributes. At the end of the workshop teachers are left with further information regarding the STEM jobs. Next year we will train undergraduate and postgraduate students to deliver the session in partner schools.



*Weblink:* <https://nustem.uk/stem-careers-game/>

## 1.5 Sixth form lectures and subject experience weeks

### Sixth form lectures

Our Autumn season of Sixth Form lectures took place in November and December. We continue to use a hybrid model for delivery, with the main lecture in person, but streamed online as well. Although the numbers of online attendees isn't large, we think it provides a good opportunity for students who are not close enough to travel into the university. This year the topics and speakers were:

<i>Topic</i>	<i>Speaker</i>
Nature's blueprint: the physics of bio-inspired surfaces	Dr Prashant Agrawal
Talking in Light: Satellite laser communication	Dr Mojtaba Mansour Abadi
Heating with light: a possible way to new solar cell design	Dr Giulia Longo
Why does space sing? (And why should I care?)	Dr Daniel Ratliff
When plants eat animals: what physics and chemistry can we learn?	Dr Ciro Semperebon
Snowflakes in the oven: Coronal rain in the solar corona	Dr Patrick Antolin
An introduction to quantum chaos	Dr Remy Dubertrand
The complex beauty of fractal geometry	Dr Matteo Sommacal

### Subject experience weeks

Each year, in February half-term, NUSTEM hosts year 12 pupils for a subject experience week. During the week, pupils take part in an undergraduate lecture, interview researchers about their research topic, and create a high-quality academic poster about the research. This year there were three separate strands: Physics, Mathematics and Chemistry. Over 60 pupils took part in the event along with 36 university academics, postgraduate students and technicians.





## 2 Supporting teachers and STEM professionals

### 2.1 Early years educators

During the year we have promoted Play, Be, C at North Tyneside and Newcastle Council’s EYFS training sessions, and at the Association for Science Education annual conference in Northampton. We have also hosted online training sessions for teachers introducing Play, Be, C and how it could be implemented in an EYFS settings.

We have visited all of our partner primary schools and conducted sessions using Play, Be, C activities to let practitioners see how the different units could be applied in their settings. Next year we will work with EYFS leads to explore how they can incorporate the Play, Be, C resource into their curriculum visions and aims.

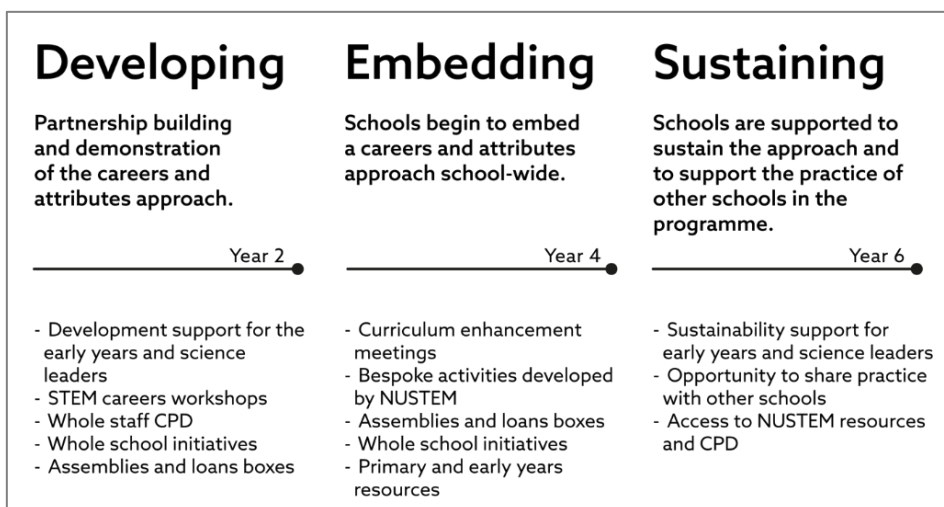
We are also delighted that our work was recognised in a recent Ofsted inspection report of a partner nursery school with the inspectors noting:

*“The school’s links with a local university enhances and enriches children’s understanding of careers. For example, children look at freezing and melting through the work of a glaciologist.”*

### 2.2 Development of the Early Years and Primary Programme

This year, we’ve been developing our new Early Years and Primary Programme (EYPP) offer for schools across the North East. The EYPP is a reset of our offer to primary schools, building on the experience and learning we’ve developed over our first decade. It has also been included as part of the wider university work on widening participation as part of the Access and Participation Plan.

The new programme launches in September 2024 with a full cohort of school partnerships. It will support schools to deliver their science curriculum through a careers and attributes led approach. The EYPP has three phases as shown in the diagram. We will be collaborating with our new partner schools over the next 2 – 6 years. We will be working closely with senior leadership teams to make sure that our activities and support are right for each school’s circumstances.



## 2.3 Presentations

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

- Talking Maths in Public, Newcastle, 31<sup>st</sup> August 2023.
- IOP Communicators Conference, London, 16<sup>th</sup> November 2023.
- NELEP Primary Careers Network meeting, Newcastle, 24<sup>th</sup> November 2023.
- ASE Annual conference, Northampton, 4 – 5 January 2024.  
We delivered 3 sessions at the ASE: one aimed at Early Years educators to showcase our Play, Be, C resources; one theory based session about Primary Careers and attributes; and a secondary session which looked at embedding employability skills in science lessons.
- Tomorrow's Engineers Live, London, 5<sup>th</sup> February 2024.  
Report from the event: <https://www.tomorrowsengineers.org.uk/tomorrow-s-engineers-live/>
- Glasgow City Council Teacher Network, Online, 27<sup>th</sup> February 2024.
- British Science Association Symposium 'Engaging young people who are under-represented in STEM', London, 27<sup>th</sup> March 2024.
- BSA Engage Teacher Network conference, Online, 10<sup>th</sup> June 2024.
- Campaign for Learning 'Generations of Tomorrow' Family Learning Conference, Online, 20<sup>th</sup> June 2024.
- ASE Inclusion in Science Conference, Online, 1<sup>st</sup> July 2024.
- Pioneering Outreach and Public Engagement in STEAM Conference, Liverpool, 5<sup>th</sup> July 2024.
- Network Gender and STEM Conference, Germany, 19<sup>th</sup> July 2024.
- Exploratorium Computational Tinkering Hangout, Online, 22<sup>nd</sup> August 2024.



## 3 Collaborations

### 3.1 Solar Stanzas

Dr Richard Morton has been working closely with us to develop a cross-curricular approach to developing young people's understanding of the Sun. Working with poet Francis Leviston, Richard and NUSTEM have developed a two-part workshop that explores solar science through the medium of poetry.

The workshop, Solar Stanzas, has recently been tested in one of our partner primary schools, and the children involved created some incredible poetry that helped them explore solar cycles, coronal mass ejections and sunspots.

From September, Richard will be taking the workshop into more schools across the North East. NUSTEM will also work with him to create an anthology of solar poetry written during the project.

### 3.2 STEM Communities

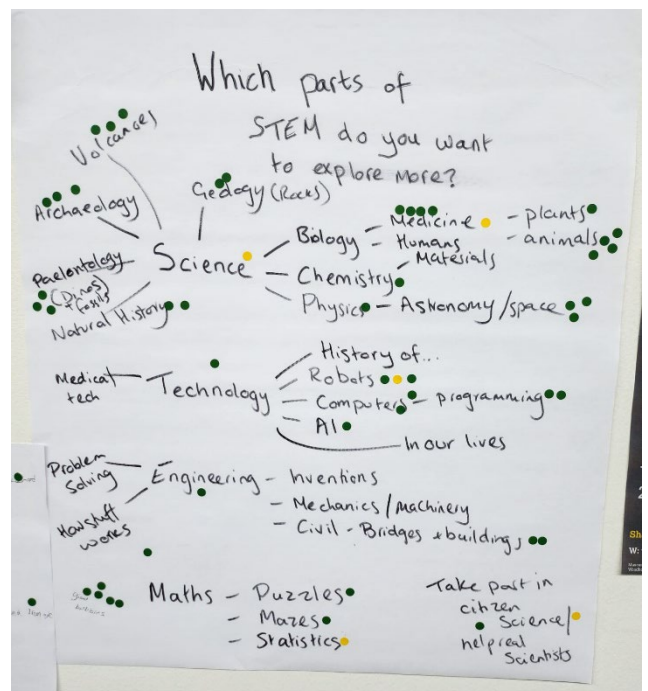
A joint project of NUSTEM and Museums Northumberland, STEM Communities aims to support local families to develop their STEM interests and become a community of scientists leading their own scientific enquiries.

The project started with school and family workshops delivered in schools, with activities later moving to Woodhorn Museum. To support this, families have been given annual passes to Woodhorn.

So far this year project staff have led in-school workshops for 316 children and 104 families, and 4 family sessions at Woodhorn museum for 65 adults and children from 20 families.

The first workshops and activities have explored STFC science and technology alongside the industrial heritage of the region. For example, the STFC Boulby underground laboratory is based in a working potash mine near Whitby, and one of the project workshops compares this with the mining heritage found at Woodhorn itself.

However, over time the theme of the activities will be shaped by the families who join the STEM community. They have already started to think about what areas of STEM they would like to know more about – as you can see in the picture.

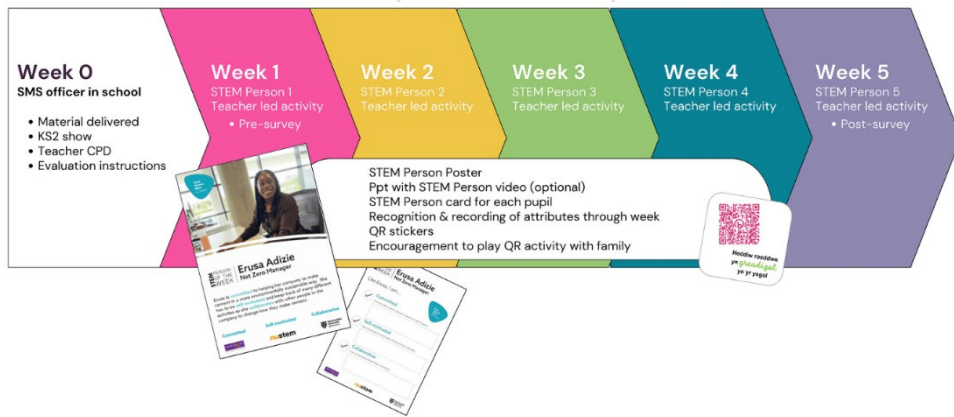


STEM Communities is funded by STFC (reference ST/Y002954/1)

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

### 3.3 STEM Person of the Week Cymru

Science Made Simple (SMS) is a social enterprise based in Wales, and we are working with them on a project called 'STEM Person of the Week Cymru'. SMS have developed a school show that features STFC scientists and engineers who all have a connection to Wales. SMS will deliver the show in a school and then provide teachers with a set of STEM Person of the Week cards that feature five of the people from the show.



The resources will be produced in Welsh and English, with 50 primary schools across Wales taking part between September 2024 and January 2026.

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/>

### 3.4 British Engines and the NUSTEM Encounters model

The NUSTEM Encounters model provides an engaging way for STEM professionals to deliver assembly-style presentations in schools. The model seeks out questions from children in a school prior to the STEM professional's visit. Thus, the STEM professional can frame their presentation not in terms of what they think children want to know about their job, but through the questions children have already asked.

The Encounters model piqued the interest of Elaine Roy, Group Learning and Development Manager at British Engines. NUSTEM have now trained STEM Ambassadors at British Engines to use the Encounters model in schools. Partnering with the company has allowed us to support STEM engagement in more schools across the North East.

## 4 Sharing good practice and research

### 4.1 Reflective methodologies in the development of workshops

This year we have embedded reflective practice in NUSTEM’s evaluation methodologies and tools. Reflective practice is a structured process that takes you from the past (‘what happened?’) to the present (‘what do I make of this?’) to the future (‘how does this inform my next steps?’).

We started this journey by exploring how to incorporate learning from individual projects into wider team and organisational learning, and into the development and planning of future projects. We initially developed a ‘lessons learnt’ tool for use at the end of each project. In these we looked back at our expectations and adaptations, our successes and shortcomings and the possible causes, and on ideas we would like to develop in future projects.

We’re now building reflective practice into formative workshop evaluation to consider ‘how can we make the workshop better?’ at the pilot stages. The method was tested during the development of ‘The Mathematician’ for Year 6 pupils using a reflective diary (see diagram). The trial worked well, and we are now rolling out the use of reflective practice in the design of all new workshops. The reflective diary has also been incorporated into the STEM Communities project (page 9) and is being used by the Museums Northumberland project team.

Practitioner Reflective Diary							
Delivery staff name	Date	Venue	Time/Duration	Child Numbers	Adult numbers	Female ratio (Approx %)	% that have been before

How did it feel? (circle as many as relevant)  
 Confused confident exhausted rushed enthusiastic energized inspired elated respected motivated fearful disrespected proud under-prepared tired excited apprehensive in-control supported hopeful apathetic sceptical out-of-control bored curious frustrated

Who? What?	So what?	Now what?
<b>What did you do today?</b> (brief description of session, format and topic) <b>Who were your participants?</b> <b>Were you expecting anyone who didn't come?</b> (Do you know the reasons they weren't there?)	<b>What elements did you find challenging/stimulating?</b> <b>What questions are you asking yourself as a result?</b> <b>Were there any meerkat moments?</b> (Lightbulb moments, or moments where individual participation or behaviour was different from normal?)	<b>So, what could we have done better or differently?</b> <b>So, what conclusions can we draw?</b>

This year Carol and Annie have trained in an evaluation technique called Most Significant Change. This focusses on identifying changes and why they are significant with participants in the project. We have collected significant change stories with the NUSTEM team, which provided opportunity to listen to what each team member finds important and consider our team identity and future directions. We will be using the method as part of the STEM Communities project, and to gather stories of impact for our 10<sup>th</sup> Year Celebration.

## 4.2 Royal Society Pairing Scheme

Each year the Royal Society Pairing Scheme matches 30 researchers with civil servants, Members of Parliament and Lords to allow them to develop an understanding of each other's work.



*The researchers taking part in the Royal Society Pairing Scheme in March 2024*

This year Carol was paired with Chi Onwurah, MP for Newcastle Central. Chi trained as an electrical engineer and is Chair of the All Party Parliamentary Group on Diversity and inclusion.

Carol spent four days in London learning about policy and parliament, which included 1.5 days 'shadowing' Chi as she went about her work in parliament. One of the key points of learning was seeing the huge amounts of information and communication that is directed towards MPs and civil servants, and the importance of brevity in policy communication work.



## 4.3 Evaluation of external activities

We have further developed our evaluation consultancy offer this year. We now offer evaluation to serve a variety of needs and aims: to demonstrate delivery and value; to help demonstrate impact; to better understand how interventions work, and in what circumstances and for whom; to give participants a voice in programming and activity design and to support organisational development and learning.

We continued our established evaluation service for RTC North's STEMFest, extending our coverage to their two events in Bradford and Sunderland. We are also undertaking evaluation of STEM engagement projects for Physics Partners Early Careers Teaching Hub and the British Science Association's North Tyneside Learning Trust Science Ambassadors project.

## Appendix 1: Aims and objectives

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### 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 – 2022	2022 – 2023	2023 – 2024	Total to date
Children and young people	Pre-school and Primary	43347	12490	8934	8159	6417	79347
	Secondary school	32073	6158	3593	2711	1320	45855
	Community and family events	7590	526	160	1261	274	9811
Key Influencers	Teachers	4901	1441	1193	992	541	9068
	Parents and Families	6878	1147	231	1230	1199	10685
	Wider community	3888	1223	564	725	513	6913
	<b>Totals</b>	<b>98677</b>	<b>22985</b>	<b>14675</b>	<b>15078</b>	<b>10264</b>	<b>161679</b>



## Appendix 3: NUSTEM projects in 2023/24

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Project	Duration	Notes
Career Learning in Chemistry <i>Royal Society of Chemistry</i>	Sept 21 – Feb 24	Collaboration with Dept of Applied Sciences
STEM Communities <i>STFC</i>	July 23 – Feb 26	Collaboration with Museums Northumberland – led by NUSTEM
STEM Person of the Week Cymru <i>Science made Simple / STFC</i>	Sept 23 – Apr 26	Collaboration with Science Made Simple – led by SMS

### Academic Led Projects including NUSTEM

Project	Duration	Planned activity
Revealing the pattern of Solar Alfvénic Waves (RIPSAW) <i>Dr Richard Morton</i>	Nov 20 – July 24	Supporting Dr Morton to develop an outreach programme for a rural community.
Renewable Energy Northeast University (RENU) <i>Professor Neil Beattie</i>	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 <i>Prof Mike Lim</i>	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.

### Evaluation projects in 2023/24

Event	Organisation
North Tyneside Science Ambassadors	British Science Association / Promoting Women in STEM
Physics Partners Early Career Teachers Hub	Physics Partners / REECE Foundation
STEMFest 2024 <i>Two 3 day careers festivals for children aged 8 – 14 (July in Bradford, October in Sunderland).</i>	RTC North

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