Sustained STEM engagement framework

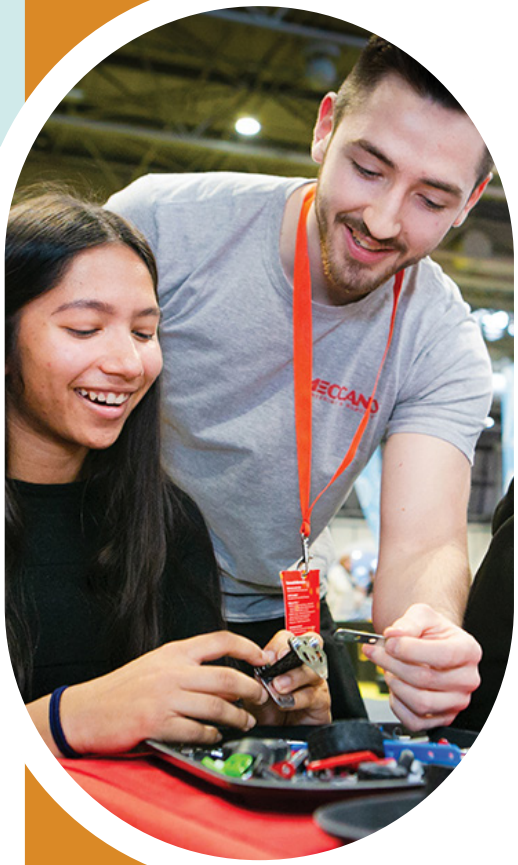
An evidence-based model for delivering meaningful, sustained STEM engagement

EngineeringUK

INSPIRING FUTURES TOGETHER

Contents

A framework for building STEM interest and aspiration throughout school



While a single STEM outreach activity can be inspiring, enjoyable and informative, research suggests that providing young people with ongoing, repeated experiences is more effective.

These repeated experiences are much better at shaping and sustaining their aspirations towards STEM careers.[1] However, with pressure on school timetables and limited resources, planning multiple engagements that reinforce or 'top-up' the impact of one-off interventions is difficult to deliver. EngineeringUK's sustained STEM engagement framework is designed to help schools plan, sequence and deliver meaningful, age-appropriate STEM activities for their students.

Building on the evidence-base for STEM identity development and science capital, our framework maps a young person's journey. From early associations and identity formation in primary school through to their career decisions and pathways. We adopt both a longitudinal and learning ecology approach, meaning that the framework considers how students build their career identities and skills over time and across different learning environments.

1 For example, research conducted by Archer et al. (2021), Archer et al. (2023) and Jiang et al. (2025) suggests that STEM programmes that involve deeper, more sustained participation have a greater impact on young people's aspirations and confidence.

The framework is made up of 3 levels

Career aspiration development

We draw on Howard and Walsh's model of how young people develop their career aspirations across 3 cognitive developmental stages:

Association
(primary school age)

Sequence
(ages 11 to 14 years old)

and

Interaction
(age 14 and upwards).[2]

STEM identity formation

This level presents the outcomes associated with STEM identity formation[3], whereby young people develop an interest and sense of belonging in STEM and STEM jobs.[4]

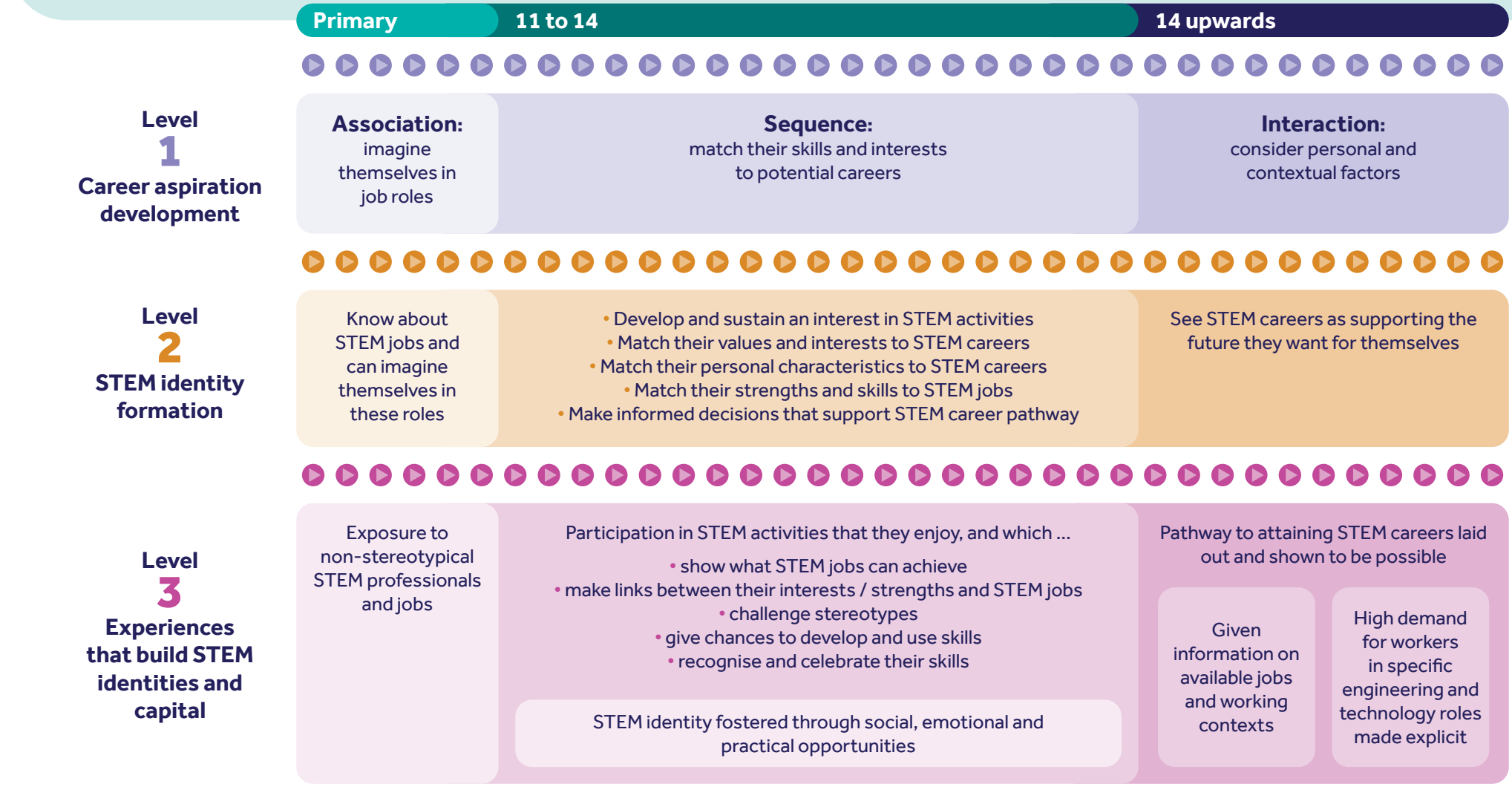
Experiences that build STEM identities and increase STEM capital

This level represents the broad types of experiences that shape young people's developing career aspirations and STEM identity formation. It relies heavily on the concept of STEM capital[5]. This posits that young people who accumulate more STEM-related experiences, knowledge and social connections will be more likely to aspire to a STEM career.

The 3 levels build upon and interact with one another in a reciprocal way. The STEM capital that young people accumulate via the experiences described in level 3 contribute to their STEM identity formation. But as their STEM identities develop they will also seek out more of these experiences. Together, these continue to build and refine young people's career aspirations described in level 1.

2 Howard & Walsh (2010). Children's conceptions of career choice and attainment: Model development.
3 For example, the early works of Carlone and Johnson (2007) and Hughes, Nzekwe, and Molyneaux (2013) looking at science identity as a way of explaining gender differences in science performance and success.
4 Where possible we have aligned the language used here with EngineeringUK's **Impact Framework** (published in 2021).
5 The concept of Science Capital was developed by Louise Archer and colleagues, for example: **Archer, Dawson, DeWitt, Seakins & Wong** (2015). **"Science capital": A conceptual, methodological, and empirical argument for extending Bourdieusian notions of capital beyond the arts**. Journal of Research in Science Teaching, 52(7), 922–948.

Figure 1: EngineeringUK's sustained STEM engagement framework



A longitudinal approach that facilitates targeting and extends the window of opportunity

We adopted a longitudinal approach that maps STEM identity formation and age-appropriate STEM experiences against the developmental phases presented in level 1 (Figure 1).

This perspective allowed us to identify key stages in young people's STEM journeys and then match STEM activities to each of these. This approach helped us make sure that the experiences a young person has in any stage are meaningful and aligned with long-term outcomes.

However, while a longitudinal approach suggests a linear progression through these stages, in reality, young people will take their own track towards identifying career choices. Some may have fixed ideas early on, others may have little idea or change their expectations frequently or later in their school career.

Research on STEM identity suggests that a robust sense of self as a STEM learner begins to form in childhood and early adolescence through feelings of competence, performance and recognition[6]. But these are foundations, rather than static beliefs that cannot be changed. Longitudinal work such as the ASPIRES project shows that science and career aspirations change from age 10 into young adulthood. Reflecting a complex interaction between family, schooling, social identities, and structural inequalities.[7]

6 A paper by Carlone and Johnson (2007) is widely cited in STEM education research as it introduced the concept of science identity, emphasising the role of competence, performance, and recognition in the development of a STEM identity, particularly during childhood and adolescence.

7 The ASPIRES project tracked young people's career aspirations and the factors influencing these across 7 timepoints from year 6 to the end of their first year of further/higher education or work. The most recent report looks at changes in STEM trajectories from age 10 to 22.

As a result, some of the experiences described in the framework may be achieved by some students very quickly and others much later. For example, some young people may have had plenty of opportunity to imagine themselves in different STEM jobs during the association phase in early childhood because they have living role models in these jobs in their day-to-day lives. The sequence phase for these young people then consists mainly of them matching their skills, interests, values and strengths to careers they already know about. In contrast, young people who do not know someone working in STEM may only start to explore these pathways in the sequence stage of career aspiration development.

Activities at this stage must meet multiple needs, including teaching young people what people working in STEM do. They must also help them develop key STEM skills so they can link their interests and abilities to suitable career choices.

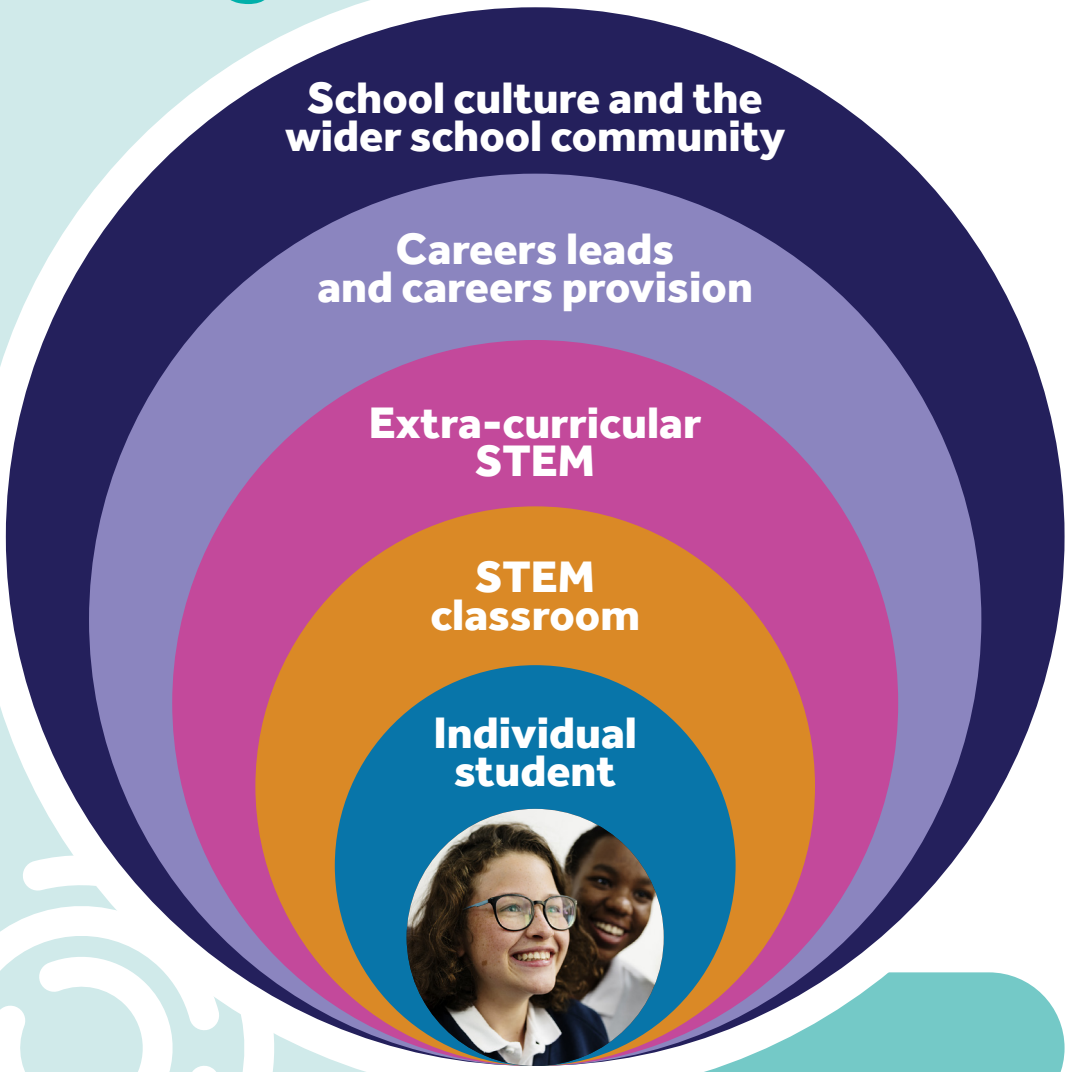
Therefore, this approach not only enables us to tailor meaningful activities to each developmental stage. It also highlights the ongoing need to provide young people with opportunities to engage with STEM throughout their educational journey.

8 As described in the ASPIRES3 report, as well as case studies derived from this longitudinal project that explores the role of science capital in career destinations in more detail (for example, Archer & Mendick, 2024).

Accounting for young people's various learning environments

To apply the framework effectively we needed to take a learning ecology approach, as the STEM experiences a young person accumulates extend far beyond the formal classroom.

A young person's sustained engagement with STEM is heavily shaped by a complex and comprehensive array of experiences and those that take place at school are only one part. Family, friends, teachers, local community and media representations all have a profound influence on how a student perceives the STEM field and develops their own sense of self-efficacy and identity[9]. As a result, the range of experiences, knowledge, attitudes and social contacts that can contribute to STEM capital go beyond the science and technology classrooms.



9 The impact of in- and out-of-school learning experiences in the development of students' stem self-efficacies and career intentions (Gossen & Ivey, 2023).

A working example of sustained STEM engagement across the student journey

We have used our EUK Education programmes and activities to show how schools can build a series of sustained, meaningful and age-appropriate STEM activities for their students.

Where applicable, we have included references to the Gatsby Benchmarks, Provider Access Legislation, and the equalex framework. This shows how the framework aligns with other national standards and statutory requirements, ensuring a comprehensive and cohesive approach to STEM engagement and careers education.

This roadmap is not intended to be a final model, but a working example intended to prompt reflection, discussion and adaptation to each school's unique context.

Framework references used:

- Gatsby benchmarks
- Work experience equalex framework
- Provider Access Legislation

STEM classroom

Primary school-aged children

Early STEM exposure and opportunities to think and act like people working in STEM through lessons, workshops and projects

Curriculum-linked careers learning using **Neon** resources to inspire and motivate students

Age 11 to 14 years

Get students thinking creatively and using their problem-solving skills with **practical activities**

Curriculum-linked STEM workshops and lesson plans connected to real-world issues, such as **Energy Quest** and the **Climate Schools Programme**

Give students the chance to think like someone working in STEM through interactive, hands-on practicals such as those in **Energy Quest** and the **Climate Schools Programme**

Explore STEM roles and responsibilities with students by integrating **talks by STEM professionals** and activities like the **Meet the future you** quiz into lesson plans

Embed careers learning supported by **careers literature** and **EUK Education resources showing STEM pathways**

14 years and over

Cross-curricular workshops and lesson plans that embed STEM careers and develop students' skills, such as those available on **Neon** and resources in the **Climate Schools Programme**

Showcasing **pathways to T Levels** and apprenticeships while embedding careers learning

Exam prep activities and revision resources contextualised with careers information, alongside personal career guidance from a trained careers advisor

School-based STEM fairs like **Big Bang at School** in partnerships with local employers for targeted, high-quality work experiences opportunities

Extra-curricular STEM

Primary school-aged children

Play-based role play activities to develop curiosity with simple careers references in stories and play themes

STEM-related school trips (for example, science museums, planetariums)

Age 11 to 14 years

Offer students the opportunity to participate in student-led projects and clubs through **The Big Bang Competition**, **The Big Bang Challenge**, or **Climate Action Club**

Use **Neon** to find experiences that build students' skills and showcase the real-world applications of STEM jobs

Host a **Big Bang at School** to give students the opportunity to develop their skills and explore the breadth of STEM careers

Plan inspiring STEM encounters like a school trip to **The Big Bang Fair**

Recommend **fun STEM activities for students** to do outside of school

14 years and over

STEM-based extra-curricular clubs that include project-based learning, for example, **The Big Bang Competition**

Highlight the **various academic and vocational routes into STEM**, including **T Levels**

Foster real-world understanding and aspiration through visits to local universities and colleges to meet students and tour STEM departments

Careers leads and careers provision

Primary school-aged children

Talks from local people working in STEM careers to showcase the breadth of opportunities available

Age 11 to 14 years

Bring STEM careers to life with careers information and experiences that emphasise **how STEM careers contribute to society**

Emphasise the relevance of different employability skills in STEM careers in your **careers talks** and **guidance**

Provide students with access to employees and employers to show students different STEM roles and the paths taken to get there

14 years and over

Provide **high-quality careers advice and guidance** that highlights **different routes into STEM**

Offer targeted, high-quality work experience, **pathways sessions** and visits to local university and college STEM departments alongside careers guidance

Opportunities to develop further technical skills through mentorships and work experience with local employers

School culture and the wider school community

Primary school-aged children

Actively challenge stereotypes through inclusive activities, assemblies, books, images and wider school communications

Engage parents and local STEM role models to visit the school and support activities

Support family-friendly conversations about everyday STEM through simple take-home activities, such as quizzes like **Meet the future you** and **STEM inspiration leaflets**

Age 11 to 14 years

Engage local businesses and employers to find STEM role models for **careers-focused enrichments talks**, supporting a culture of real-world relevance and aspiration

Use **Big Bang at School** to celebrate STEM-related successes and build a culture of appreciation for the real-world applications of STEM careers

Strengthen primary-secondary school partnerships by inviting feeder primary schools to your **Big Bang at School** event

Support family conversations about **different STEM career routes** using **take-home resources** and **webinars for parents and carers**

Promote a culture of STEM aspiration by highlighting **diverse STEM career case studies**

Showcase school leavers who have pursued STEM careers through various routes to reinforce a whole-school culture that values and champions STEM futures

14 years and over

Help parents and carers understand the different routes into STEM and next steps using **guides**, **webinars** and **other resources**

Promote a culture of STEM aspiration by highlighting **diverse STEM career case studies**

Showcase school leavers who have pursued STEM careers through various routes to reinforce a whole-school culture that values and champions STEM futures

References

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