STEM

STEM Education and Training Strategy: Refresh

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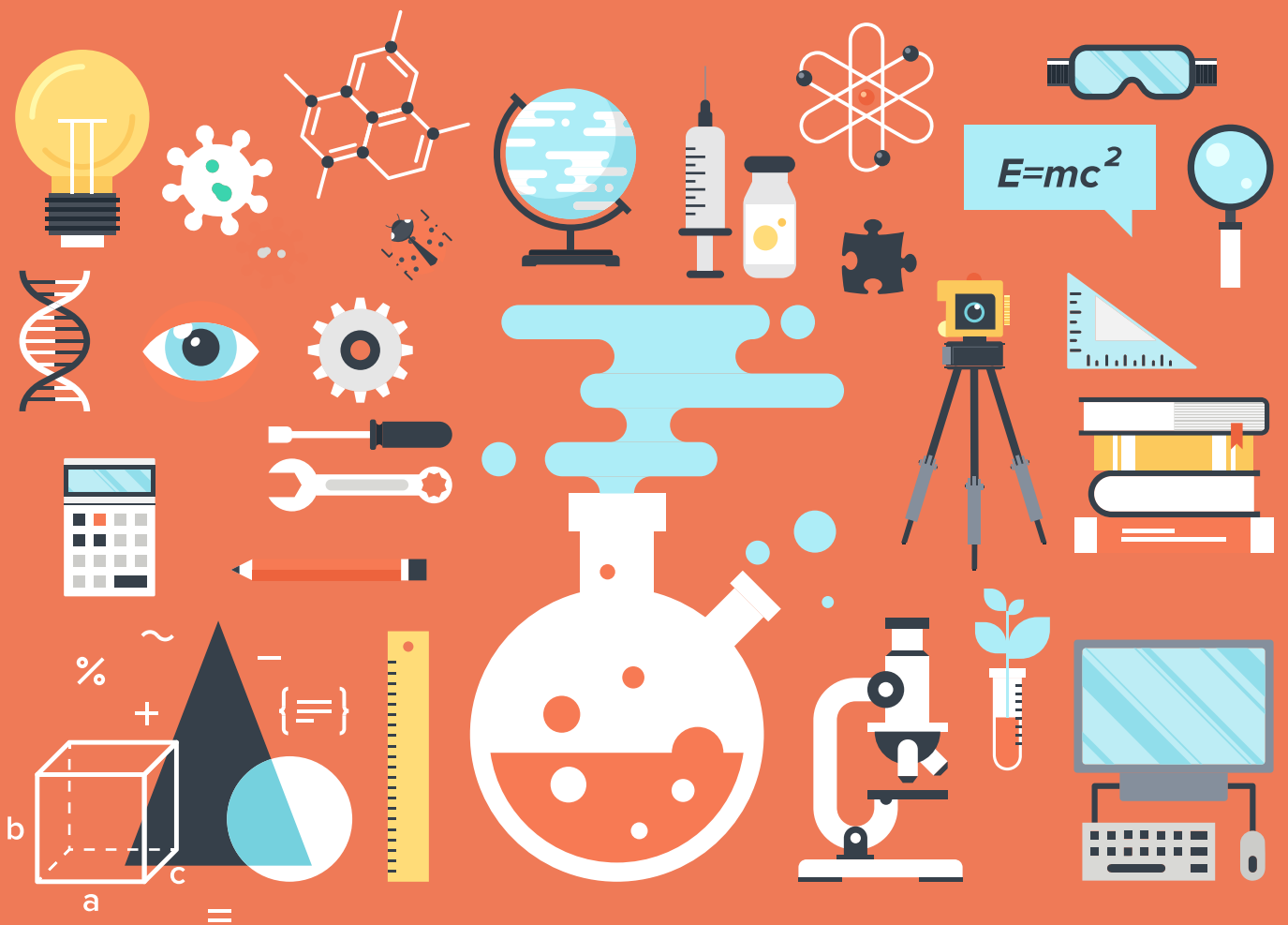
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Ministerial Foreword

In writing her foreword to the 2017 STEM Education and Training Strategy my predecessor, Shirley-Anne Somerville MSP (then Minister for Further Education, Higher Education and Science, and now Cabinet Secretary for Education and Skills) reflected on the focus of the preceding Programme for Government, and the "time of unprecedented global change" that we were facing. In both respects she concluded that it was essential for Scotland to achieve its full potential in science, technology, engineering and mathematics (STEM), both to face the challenges and the opportunities that change brings and fulfil the Scottish Government's wider ambitions.

Since 2017 global change has remained a constant, and the importance of STEM skills has been underlined again and again. We are all acutely aware of the specialist skills required to develop vaccines and treatments, and the work that has happened in schools, companies and public services to facilitate remote working and learning. To be an informed and responsible citizens in such times requires at least some comfort with the mathematical principles underpinning case statistics, and the science behind the laws and guidance that have been in place to protect us.

The context within education has not remained static either. The Cabinet Secretary for Education and Skills has announced a number of far-reaching reforms to the education system and in particular into the re-structuring of Education Scotland and the SQA, with further detail to be announced over time. This reform program is ongoing and will affect the way we support schools in how they deliver Curriculum
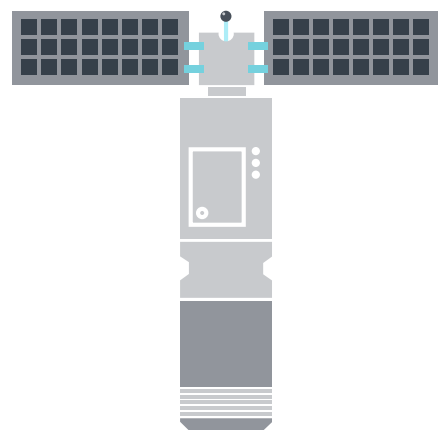
for Excellence. It will impact on the context in which STEM skills are delivered in schools, both as part of the Broad General Education and in the Senior Phase, as assessments change to reflect the lessons of the last years and as we respond to the future needs of our young people. More generally, the reform agenda has reminded us that it is essential that our approach to STEM skills stretches from early years, through school and into higher and further education and on to the world of work. Getting any single element right will not of itself be sufficient to fully leverage the potential of our young people, or maximise their opportunities.
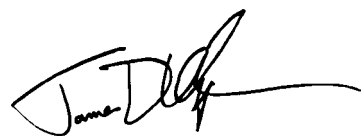
STEM skills remain key to our overall ambitions for Scotland and the Scottish economy. The Scottish Technology Ecosystem Review led by Professor Mark Logan demonstrated the importance of school Computing Science as the start of a pipeline that leads to a thriving tech sector. Scotland's just transition to a net zero economy will require an ongoing commitment to the skills supporting existing, emerging and future technologies. The National Strategy for Economic Transformation sets the overall economic context for skills development, and it too recognises the importance of core STEM skills, and other skills such as leadership and co-operation, which whilst not specific to STEM can and must be delivered alongside STEM education, for instance through our Young STEM Leader awards programme.

This is also a good juncture in which to look back at what has and has not worked over the course of the Strategy to date, and to account for where things have not gone to plan. Much work

continued during the disruption caused by the pandemic, but notable elements were stopped or postponed. Governance arrangements were put into abeyance to reduce the pressure on those participating, and a planned scheme of STEM awards to complement existing programmes were also deferred. We now have the opportunity to reboot those governance arrangements, and to re-commit to areas of work that were, by necessity, put on hold.

It is right that we are taking this opportunity to take stock of the progress we have made, and to focus our attention on the next steps. We need to be honest that in some aspects of achieving greater STEM gender equalities in higher education or in expanding STEM professional learning opportunities for Early Years practitioners for example, we have not made the progress we would have liked. On the other hand we have seen a welcome increase in STEM Apprenticeship Frameworks, the establishment and growth of STEM bursaries and increasing interest and enthusiasm for our STEM professional learning grants programme. These developments are encouraging and demonstrate that in these areas we are on the right track.

Going forward, we will continue to support the successful work we have already begun as well as delivering on new priorities.

Jamie Hepburn MSP
Minister for Higher Education and Further Education, Youth Employment and Training
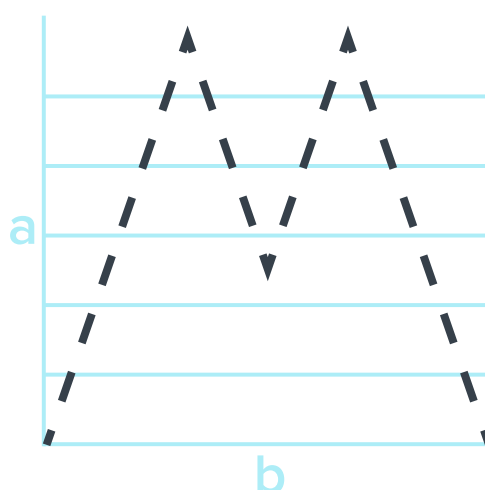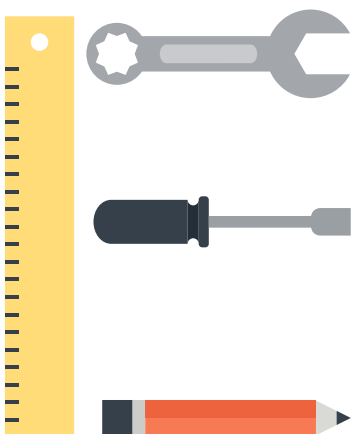
Introduction

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The challenges and opportunities facing STEM education and training, initially identified in the 2017 STEM Strategy, remain broadly similar in 2022. While the pandemic has impacted on many aspects of project and programme delivery, our core goals remain unaltered and are supported by the available academic literature;

- Efforts should continue to be made to ensure children, young people and adults are encouraged to develop an interest in, and enthusiasm for, all aspects of STEM from the early formative years and throughout their lifetime. A well-informed and STEM-literate public will be better equipped to understand the implications of rapid technological change and better prepared to participate in civic society and input to issues that may affect them and their families such as nuclear power, climate change etc. We are aware that STEM can be seen by some as a real voyage of discovery and by others as a series of dry, fact-based subjects.

- We need to ensure that our education and training system has the right number and diversity of practitioners, including educators with the necessary STEM capabilities, to be supported to continue to deliver high-quality learning and teaching.
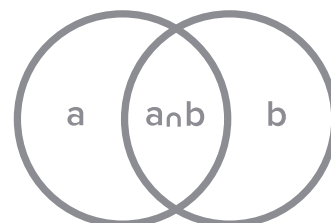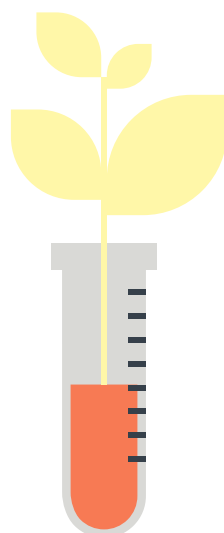
- Our education and training offer should be flexible and responsive enough to ensure that it continues to equip all of our citizens with the skills that employers are seeking and which meet our ambitions for our future economy. This includes recognising the opportunities for new green jobs and embedding green skills. Our support systems should also demonstrate a degree of agility in which to respond to changing labour market conditions and the unpredictable demands of a global economy. This is particularly apt in areas such as computing and digital skills development although it applies elsewhere across STEM.

- The long-term goal of promoting efforts to tackle gender imbalances and other inequalities that exist across STEM education and training should continue at pace. Limiting access due to factors such as gender, race, disability, deprivation and geographical location are inherently unfair and continue to undermine our ability to deliver inclusive economic growth for Scotland. The full benefits of STEM education and training will not be realised until this goal is achieved.

This report, covering activity over the four years that have elapsed since the start of Strategy implementation, is divided into the actions, grouped under each of the four Strategy themes. Where appropriate, reference is made to actions and plans that are likely to be taken forward over the coming two years. In addition, progress on meeting a set of key performance indicators is included as a series of data tables published alongside this report.
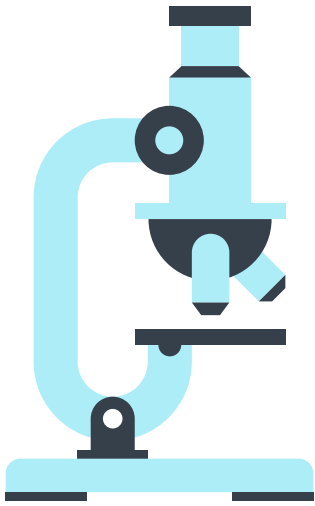
Key Aims

The aims of the Strategy are:

- to build the **capacity** of the education and training system to deliver excellent STEM learning so that employers have access to the workforce they need;

- to **inspire** children, young people and adults to study STEM and to continue their studies to obtain more specialist skills; and

- to **close equity gaps** in participation and attainment in STEM so that everyone has the opportunity to fulfil their potential and contribute to Scotland's economic prosperity;

- to **connect** the STEM education and training offer with labour market need – both now and in the future – to support improved productivity and inclusive economic growth.

In meeting these aims in the Broad General Education and beyond, the STEM Strategy helps deliver successful learners and confident individuals, able to pursue their interest and career ambitions, to learn new skills as those interests and ambitions dictate. Learners will also be supported to become responsible citizens, empowered to understand the big issues facing our society and communities such as climate change, and as such to become effective contributors in society, higher and further education, and the workplace.

Meeting these aims supports our wider aims and ambitions, in particular they support the National Strategy for Economic Transformation (NSET).[1] By inspiring learners we lay the foundations for them to develop the skills they need throughout their lives, to allow them to access rewarding careers. By building capacity to deliver excellent STEM learning we build the workforce to support Scotland's position in new markets and industries, and support the transition to net zero. We also ensure, both through a commitment to fundamental STEM skills, and to the wider skills of leadership and co-operation that can be developed through STEM learning, that the conditions are in place for the learners of today to be the entrepreneurs of tomorrow. This supports the NSET vision for Scotland as a world-class entrepreneurial nation in general, just as in relation to Computing Science and related skills in particular it supports the foundations of the pipeline described in the Scottish Technology Ecosystem Review. Finally by closing equity gaps in STEM education we can play our role in reducing the wider structural inequalities that impact on poverty and on health, participation, cultural and social outcomes.

In this way the STEM Strategy helps meet our ambition to fulfil the potential of learners, and to support a thriving net zero future economy.

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1 Scotland's National Strategy for Economic Transformation - gov.scot (www.gov.scot)

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Excellence

We will promote **excellence** by:

- improving the supply of STEM talent into the teaching profession.
- improving STEM learning and teaching, and delivering enhanced professional learning.
- prioritising STEM in the expansion of apprenticeships.
- maintaining our research excellence in our universities.

Apprenticeships

Modern Apprenticeships (MA) offer individuals in paid employment the opportunity to develop and learn new skills from SCQF Level 5 to up to Level 12 which includes technical, professional levels and training to support up-skilling new and existing staff. STEM is included in the MA funding priorities.

Skills Development Scotland continues to work with partners at local and national level to promote uptake in STEM-related apprenticeships. During the past six years, **Foundation Apprenticeships** at SCQF Level 6 have been developed and expanded. Starts for STEM Apprenticeship frameworks accounted for 45% of Modern Apprenticeship starts in 2020/21. This represents an increase from 41% in 2019/20.

There are now nine FA STEM-related apprenticeship frameworks. Statistics published by Skills Development Scotland for 2020/21 show that 61% of all MA starts on STEM frameworks were aged 16-24. For MAs, female representation in STEM frameworks was 11% in 2020/21, reflecting a small increase from 10% at the same point in the previous year.

Foundation Apprenticeships in 2020/21 for males represented 75% of participants in STEM frameworks at SCQF Level 6 and females 24% – up over sixteen percentage points since 2016. In SCQF Levels 4/5, males represent 95% of participants in STEM frameworks. Foundation Apprenticeship uptake at Pilot SCQF Levels 4/5 is dominated by male pupils. This is likely to be due to the scope of the available subject areas, where two represent sectors that have long engrained gender segregation issues. There has been an increase of six percentage points in the number of female participants in 2020.

In March 2022, Education Scotland published a review of Foundation Apprenticeship provision in Scotland. The aim was to identify what was working well and where further development and improvement was necessary. The report noted that almost all FA delivery providers have developed open and inclusive recruitment strategies to support equity of access to FA programmes. It stated that some colleges and universities acknowledge the positive impact of undertaking an FA on a young person's skills development. It also recorded that across Scotland there was now a greater need for partnership approaches to evaluating FA programmes in order to support continuous improvement.

Graduate Apprenticeships (GA) are now in their fourth year of delivery and are co-designed with employers to offer bespoke learning and fresh thinking. They are designed to develop higher-order skills in individuals, including resilience and adaptability, that provide the building blocks for lifelong great learners to better cope in a fast-changing world of work. In the academic year 2020/21, 13 of the GA frameworks are in STEM-related subjects. In 2020 21% of Graduate Apprentices studying a STEM-related framework were female – up three percentage points since 2017. Females apprenticeships were most prominent in the following GA STEM frameworks:

- **Data Science (36%)**
- **IT: Management for Business (32%)**
- **Construction and the Built Environment (28%)**

Although work is underway to promote equal access, this data highlights the barriers that continue to exist and reinforces the need to identify and understand the underlying reasons. Systemic change will be required along with a major cultural shift in course choice processes and career pathways that people choose, as well as the recruitment and employment practices of businesses.

To support the cultural shift required, the Scottish Apprenticeship Advisory Board created the Gender Commission to develop recommendations that offer practical solutions to help address the gender imbalance across the whole Apprenticeship family and to advise the Scottish Government on how it can better support all businesses in this area. The Commission is due to report in the coming months.

Early Learning and Childcare – ELC

STEM already forms a key part of the learning taking place with Early Years and Childcare and the expansion of funded ELC means that children will be entitled to more hours of high-quality, flexible learning at those critical early stages. This will support the development of skills, including STEM skills such as creativity and confidence, prior to moving on to primary learning.

Working with Education Scotland, a refreshed ELC national practice resource Realising the Ambition was published in 2020. This explains how to support children's development, including early STEM skills. This resource is available to ELC practitioners and primary teachers to ensure consistency in approach. We are continuing to support early years practitioners with training and good practice in STEM. We have launched a free online module in STEM for early learning and childcare practitioners, developed by the University of the West of Scotland. This module aims to help build staff confidence, knowledge and skills and covers play-led approaches, supporting scientific enquiry, delivering STEM outdoors as well as indoors and tackling gender bias. The latest data shows that around 3,500 participants have completed their certificate and there are considerably more who are progressing with the training. Feedback has been very positive; with 98% of participants saying they would recommend this module to fellow practitioners.

RAiSE – Raising Aspirations in Science Education

The RAiSE programme is a partnership between the Wood Foundation, Scottish Government, Education Scotland and participating local authorities. Twenty local authorities have been engaged in RAiSE since its inception in 2016.

The Primary Science Development Officers who deliver the programme have been critical to its success. Half of local authorities engaged since its launch have now exited their formal funding period. However, all remain engaged with the collaborative national network, connected to a growing cohort of regions committed to the development of primary STEM. In the last academic year, the programme has provided 500 professional learning opportunities, engaged more than 4,000 primary practitioners and delivered over 3,500 hours of professional learning.

RAiSE aims to establish high-quality experiences of STEM education at primary school in order to support the election of STEM subjects at further or higher education level. It seeks to build capacity at local authority level to deliver a co-ordinated approach to STEM education. Objectives include to:

- Build the confidence, skills, knowledge and enthusiasm of primary school practitioners;

- Create opportunities for education practitioners to consider weaving STEM as a context into other areas of the curriculum for the development of literacy and numeracy skills;

- Promote joint curriculum planning from early years to secondary schools to ensure effective progression in STEM learning;

- Contribute to curriculum developments that supports high-quality, relevant and contextualised STEM learning, teaching and assessment;

- Establish and grow STEM education partnerships through connection with a wide range of agencies and industry at local, national and international level;

- Develop and promote opportunities for all learners to increase their experiences, engagement, enthusiasm and achievement in STEM; and

- Support the development of skills progression in STEM through real life, contextualised learning and opportunities linked to STEM careers.
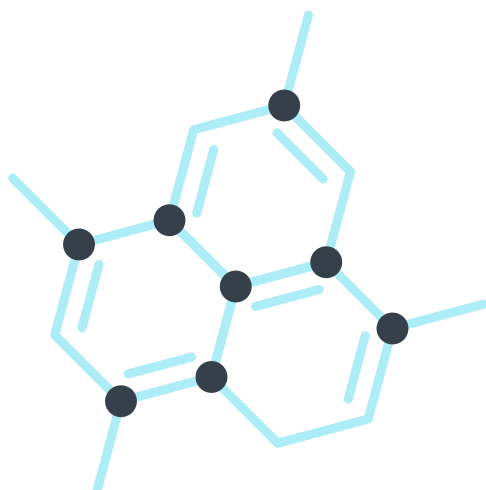
Easter Bush Science Outreach Centre (EBSOC) developed a microbiology toolkit and professional learning session, working alongside RAiSE to ensure these were delivered to school communities throughout Scotland. The initiative was made possible thanks to a successful funding bid by Dr Laura Glendinning to the Microbiology Society. Primary Science Development Officers (PSDOs), Science, Technology, Engineering and Maths (STEM) leads, and teachers took part in a two hour-long professional learning session with members of the EBSOC team to understand how to deploy the resources. This learning is now being cascaded throughout the country with different learning opportunities evolving to suit context.

In the Western Isles, students connected the lessons to the world of work and learned more about microorganisms' role in the local fish farming industry. They captured samples in a loch by the school. The resources were translated into Gaelic.

Primary 7 pupils in Clackmannanshire designed their own investigations, developing skills in scientific inquiry. The kits given to the authority have become a central resource and particularly beneficial to schools who have access to ponds to better understand their local habitat. These have been loaned out already.

STEM Bursaries

In relation to teacher recruitment, we continue to offer 150 bursaries of £20,000 for career changers to undertake teacher training in the STEM subjects where the demand is greatest. The STEM Bursaries programme is administered by Skills Development Scotland and to date 505 bursaries have been awarded.

| Year	Bursaries Awarded
18/19	107
19/20	111
20/21	150
21/22	137

Teacher Numbers

Latest data, published in December 2021, shows that teacher numbers have risen for the sixth year in a row, rising to 54,285 in 2021 and representing an increase of 885 on the previous year. In addition, we continue to support teachers in dealing with the pandemic; including through funding of £240 million to ensure additional teachers and support staff are available. More broadly, we are committed to funding 3,500 additional teachers and 500 support staff over this parliamentary term.
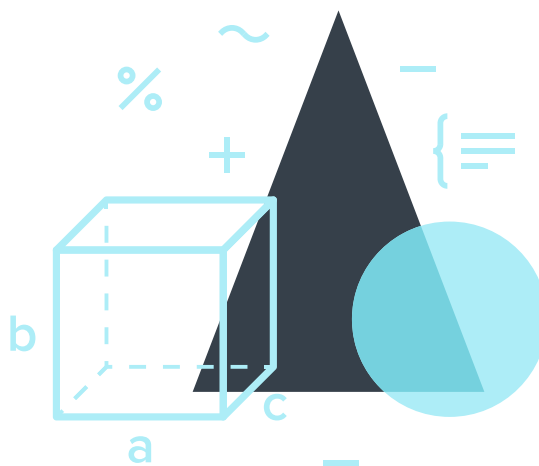
Secondary School Teachers by Main (STEM) Subject Taught – 2016 to 2021

	2016	2017	2018	2019	2020	2021
Mathematics	2,331	2,361	2,364	2,362	2,412	2,464
Biology	1,183	1,153	1,213	1,256	1,312	1,343
Chemistry	942	982	948	967	999	1,019
General Science	131	136	144	149	151	165
Physics	814	826	806	806	824	836
Computing Studies	594	582	595	579	595	595
	5,995	6,040	6,070	6,120	6,292	6,422
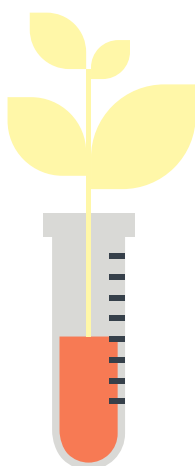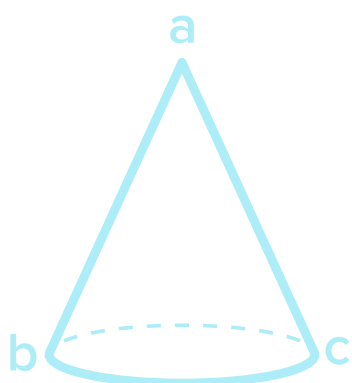
STEM Entries – SCQF Level 6 (August data)

Subject	2018	2019	2020	2021	% change 2020-21
Biology	7,305	7,685	7,428	7,388	-0.5%
Chemistry	9,990	10,047	10,038	9,833	-2.0%
Human Biology	5,937	6,259	6,968	7,549	8.3%
Physics	8,280	8,325	8,392	8,481	1.1%
Other Science	423	392	360	515	43.1%
Computing Science	4,099	3,228	3,166	3,377	6.7%
Mathematics	18,753	18,626	19,182	19,419	1.2%
Technology	12,694	11,506	10,798	11,974	10.9%
Total	**67,481**	**66,068**	**66,332**	**68,536**	**3.3%**

Scottish Funding Council – Initial Teacher Education intake targets for STEM subjects

Subject	2017	2018	2019	2020	2021
Mathematics	237	163	225	230	224
Biology	111	110	134	142	142
Chemistry	86	98	150	150	144
Physics	77	81	122	120	117
Computing Studies	60	55	53	47	47
Technical Education	124	50	82	82	85
Totals	**695**	**557**	**766**	**771**	**759**

SSERC

SSERC (Scottish Schools Education Research Centre) continues to enthusiastically deliver programmes of hands-on experiential professional learning to a broad range of educators in Scotland, with the ongoing focus on curriculum, including digital skills and computing science, but with an ever-increasing offer of wider STEM engagement programmes and activities.

The SSERC Early Years and Primary team provide professional learning courses for **Early Years** practitioners, childminders and primary teachers. Despite the pandemic and the associated restrictions, by the end of March 2020 SSERC were able to deliver a full year of professional learning support. By April 2021, 1,803 training days had been delivered, exceeding the target by 18%. More recently, for financial year 2021/22, the Early Years and Primary Team has delivered over 2,000 training days. It is particularly noteworthy that there is a strong desire from early years and primary school practitioners to use STEM as a context for learning through interdisciplinary activities.

The **Primary Cluster Programme (PCP)** continues to be the main focus of SSERC professional learning support for early years and primary schools. Data highlights the programme had engaged with more than 7,000 teachers and early years practitioners, 840 schools comprising more than 19,000 attendees. The pandemic necessitated a creative approach to continued delivery including the use of digital platforms combined with resource kits being sent directly to course delegates.

The **Secondary Professional Learning Programme** delivered 1,073 training days during 20/21 with the vast majority being online due to the pandemic. A return to more normal delivery methods has seen a significant increase in face-to-face professional learning carried out at SSERC with over 1,200 training days delivered to secondary educators and technicians during 2021/22. The programme includes secondary school teachers, PGDE students, those who are newly qualified and school technical support staff. By necessity, the programme was delivered by website resources, experiments presented on video and "cook along" sessions using pre-delivered kits.

SSERC is continuing to work in partnership with Apple, Education Scotland, the Cyber Skills and Internet Safety programme among others to support **digital and computing skills** development. A digital manager supports delivery and has devised new and innovative approaches to professional learning in this important area forming part of the wider work of SSERC.

The **Young STEM Leader Programme**, as referenced later, is continuing to grow, with many new schools and community organisations joining. The programme is delivered in 624 centres across all local authority areas and includes 214 secondary schools, 302 primary schools and 108 other organisations. These include youth groups and community settings.
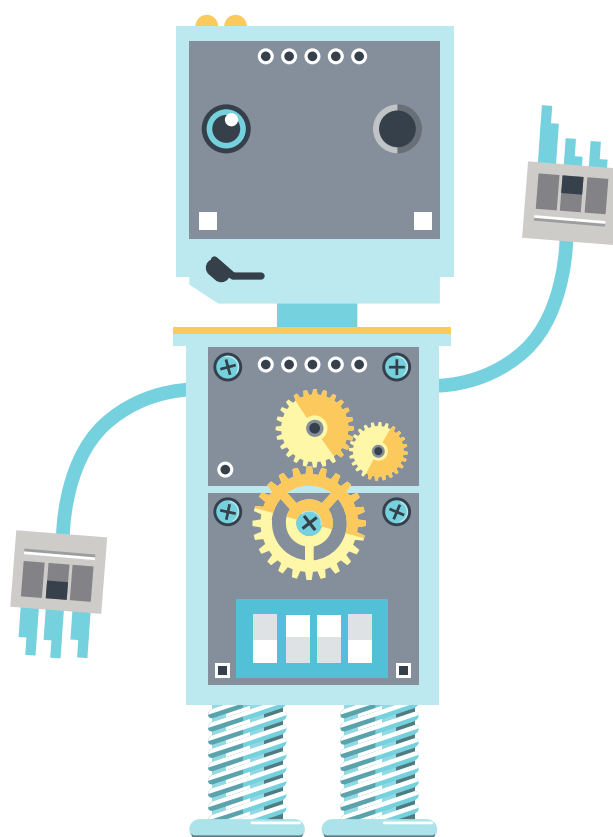
Learning for Sustainability

The links between STEM subjects and the cross-curricular theme of Learning for Sustainability (LfS) are vitally important. In response to COP26, the Scottish Government is taking further steps to refresh and strengthen our approach to Learning for Sustainability and climate education in educational settings. In the meantime, the Government and partners across the sector and other organisations such as the General Teaching Council Scotland and the SCQF partnership continue to work together to implement our Learning for Sustainability action plan. Much of this work reaches into STEM subjects in both the Broad General Education and the Senior Phase of learning, where the study of environmental science, the living environment, the Earth's resources and sustainability is so crucial to delivering on learners' entitlement to LfS.

Strong links between STEM and Learning for Sustainability exist in engineering and technologies, in particular when looking at energy production and distribution. There has been a noticeable increase in taking STEM outdoors, demonstrated by the Education Scotland professional learning in STEM grants referred to elsewhere in this report.

The Royal Highland Education Trust has also been delivering sessions on STEM in farming and food production across Scotland, as have Kemnay Academy in Aberdeenshire. Projects such as Aviemore Early Learning and Childcare Service in Highland, and Inverkip Primary in Inverclyde have focussed on looking at STEM in their local environment in early and first levels. In addition, the Field Studies Council and the John Muir Trust have been supporting practitioners in developing the "STEM by Nature" project in Tayside.

The Climate Emergency Skills Action Plan (CESAP) published in December 2020, sets out the Government's plan to maximise the transition to net zero for Scotland, ensuring that Scotland's workforce has the skills required to make the transition to net zero a just transition, fair and inclusive to all. STEM-related activity plays a significant role within the action plan. CESAP implementation is supported by a cross sector Industry Steering Group whose membership has a strong STEM footprint.

STEM Grants Programme

Building the capacity and skills of education practitioners is key to improving any education system. Enabling education staff to access high-quality professional learning opportunities involves overcoming many practical and logistical challenges. These include releasing staff from school to attend professional learning sessions, accessing funding for training, finding replacement cover, identifying appropriate training and travelling from remote island communities to attend courses and conferences. We know that practitioners are also seeking more professional learning that is locally owned, led and delivered and there is an appetite for online and recorded learning support; accessible at a time and place that meets their needs.

With these challenges in mind, Education Scotland launched the Enhancing Professional Learning in STEM Grants Programme in 2018. The fund allows for a range of support; from small practitioner-led bids benefitting two nurseries to projects reaching thousands of teachers across Scotland. Funds are available through two funding streams –

- the Leadership and Collegiate Professional Learning Fund;

- and the Regional and National Partner Fund

Since the inception of the grants programme over £4 million has been awarded to 248 projects. An estimated 58,161 practitioners have benefitted from the three funding rounds which have run to date. A new round of funding, Round 4, has recently been launched and will provide a further £400,000 of investment in STEM. In Rounds 2, 3 and 4, ring-fenced funding for Numeracy and Mathematics has been made available, amounting to 50% of the totals in Rounds 3 and 4.

The process also allows for successful approaches to be scaled up to benefit greater numbers of practitioners. For example, a small project benefitting one school cluster in Round 2 Phase 1 could be extended in Round 2 Phase 2 to benefit more clusters. A subsequent bid for Round 3 funding could allow for it to be extended across a local authority.

An external evaluation has been commissioned by Education Scotland to support the grants and to guide the development of the programme in the context of this Strategy.

Fraserburgh Academy – Promoting a "STEM for All" approach

This STEM grant project enabled successful collaboration between Fraserburgh Academy and North East Scotland College (NESCOL), bringing the SCQF Level 5 Craft Mathematics course from the college to the school. Training was provided to maths teachers alongside skill-share sessions with the college. The project targeted school students who have an interest in STEM careers but who lacked the SCQF Level 5 Mathematics qualifications that would allow them entry to further education (FE) engineering courses. This pathway was further supported by offering National 5 Engineering Science and the Foundation Apprenticeship in Mechanical Engineering. This reflected the increased opportunities in the local area for engineering skills, including in offshore renewables. The digital learning strand of the project involved upskilling of science practitioners using new instrumentation technologies. This supported progression into new FE STEM courses in automation and renewables. Both the Craft Mathematics and the new in-school engineering provision have increased the number of learners progressing into FE STEM provision and STEM jobs.

Computing Education

The economic potential of Scotland's tech sector is high. The sector contributed £5.1 billion Gross Value Added (GVA) to Scotland's economy in 2020. Our digital world is changing the way we work, do business, entertain, shop and keep in touch with family and friends. Digital education and skills must continue to be supported to meet these challenges and opportunities. Our Digital Strategy aims to ensure that digital skills and knowledge have a place in education, that we build a skilled digital workforce, support up-skilling and re-skilling opportunities and increase diversity in the digital skills pool.

The Skills Development Scotland Tech Industry in the classroom project focuses on the co-delivery of computing science lessons with schools and industry working together and lessons being aligned to real-life working scenarios. An employer toolkit has been created in order to facilitate ease of engagement with schools.

In May 2020 Mark Logan, former Skyscanner COO, was commissioned by Kate Forbes MSP, Cabinet Secretary for Finance, to undertake a review into how Scotland's technology sector can contribute to our economic recovery following the pandemic. The Review's recommendations are primarily concerned with accelerating the maturity of Scotland's "Technology Ecosystem"; the environment that supports and nurtures technology businesses in Scotland, from early stage start-up through to fully scaled maturity.

The Scottish Technology Ecosystem Review put forward a series of recommendations related to education and a programme has since been set up to take forward their implementation. A core recommendation of the Review is for all pupils to be taught computing science from the first year of secondary school, raising the profile of computing science as a subject to the same status as maths and science. We are continuing to develop a successful and effective strategic approach via a series of interventions across the education system and at university level. The aim is to promote the study of computer science and equip the next generation with the digital skills required for the future world of work.
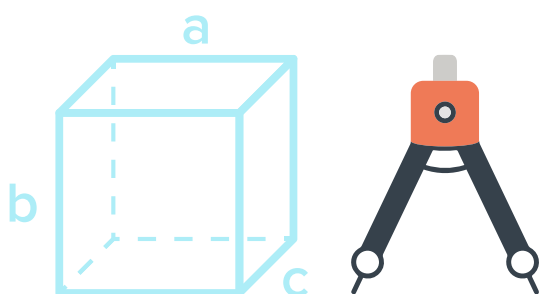
In addition, we are investing in upgrading the devices and software available to Scottish teachers; ensuring that lessons are stimulating, fun and reflective of the latest available technologies. We are also working to support teachers to enable pupils to engage and interact with digital technologies in a fun and stimulating environment.

Further, and in line with our broader ambitions around equality as noted earlier, we are working to encourage more girls and young women to engage with computing science with a view to strengthening Scotland's future tech sector. By supporting school-stage extra-curricular programming clubs offering exciting extracurricular activities, we aim to expand and diversify the talent pipeline of young people who study technology-related disciplines and ultimately pursue a career in digital technologies.

Closing the future skills gap remains a real challenge. Recent evidence has demonstrated that labour market demand in the rapidly growing fields of Cyber Security and Data Science significantly exceeds supply. Furthermore, demand shows no sign of slowing down. In addition, employment trends indicate that the current shortage will become more acute, resulting in a significant deficit in the coming years.

The Skills Development Scotland **Discover Cyber Skills** programme was launched in 2017 to provide young people with the opportunity to explore careers in this sector through classroom-based and online lessons and challenges. The programme has now evolved into the Discover Tech Skills programme. Between January 2021 and December 2021 80% of Scottish schools engaged in the programme with 69,764 learners taking part through a mix of live online sessions and "meet the expert" sessions.

At the strategic level, work to improve computing science provision in schools is being informed by a Computing Science in Schools senior steering group led by the Cabinet Secretary for Education and Skills and a newly formed Scottish Teachers Advancing Computer Science (STACs) organisation run by and for computing science teachers.
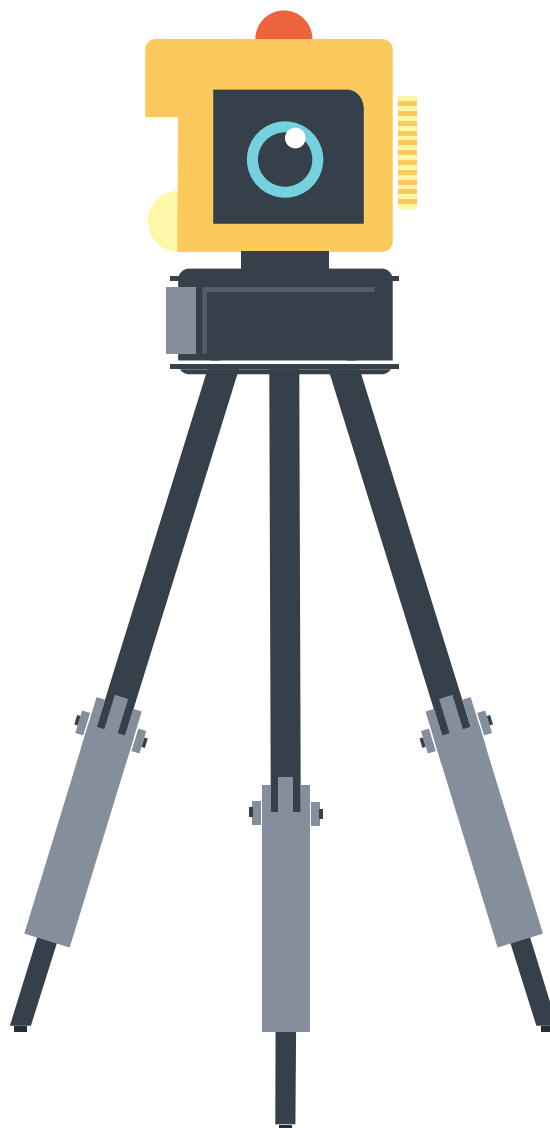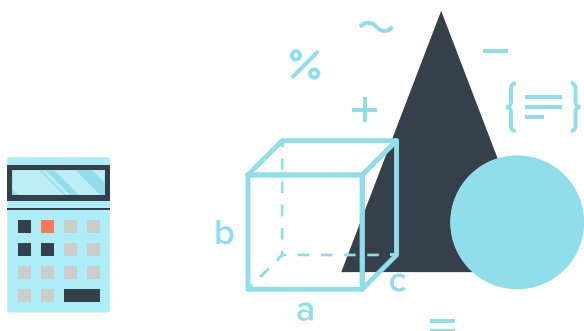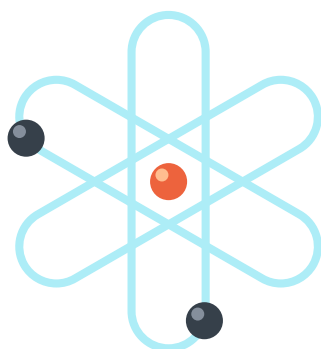
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Equity

We will promote **equity** by:

- tackling inequity in STEM learning and careers.

- improving participation in STEM further and higher education courses and apprenticeships.

- increasing access to public science engagement events.

Improving gender balance and equalities – IGBE

The challenge of STEM education is varied and impacted by many diverse socio-economic factors. Teacher competence, personal interest, academic achievement, gender, peer interests and the influence of the media all impact on the interests, career choices and motivations of young people.

There continues to be a pressing need for a greater diversity of people taking STEM subjects, courses and training to tackle the long-standing under-representation of certain groups in STEM jobs and sectors. This includes a strong focus on improving female uptake in subjects such as physics, engineering and computing science, as well as encouraging more males to take subjects like biology and life sciences. Disparities also need to be tackled in relation to race and disability and to encourage greater numbers of young people from our most deprived communities to pursue STEM learning opportunities.

The impact of the pandemic reveals that social inequalities are more present than ever and that specialist support for schools and settings to address inequality is imperative. At the same time, the move to working from home and increase in digital connection will bring new opportunities to those who had previously found it difficult to access the physical workplace.

At a policy level, there has been an increased focus on equality through a number of new developments including the *Gender Equality Taskforce in Education* and *Learning and the Fairer Scotland for Women* strategy that is taking action to close the national gender pay gap.

These developments provide the backdrop for Education Scotland's **Improving Gender Balance and Equalities (IGBE) Team** which was formed in 2019 to put equity and equality at the heart of this Strategy. The team has built on the successful Improving Gender Balance pilot programme which had been supported through a partnership involving Skills Development Scotland, the Institute of Physics and Education Scotland.

A range of measures to promote equality within STEM and tackle stereotypes and unconscious bias have been adopted. A strong focus of engagement has been to support early learning and childcare settings adopting whole establishment approaches to equality to achieve sustainable and long-term change. This approach is fundamental in promoting the deep cultural change that is necessary to change ingrained traditions and norms.

Since the IGBE team was recruited it has undertaken 866 engagements reaching 9,422 attendees in 1,156 education establishments. A rich blend of professional learning has been offered that includes face-to-face sessions, online webinars, enquiry-based research approaches along with gender-aware leadership training for those looking to take on whole-establishment responsibilities for equality.
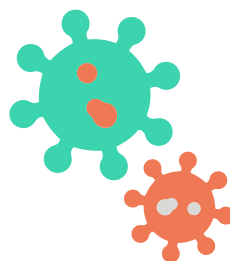
Evaluation of the IGBE team from 405 respondents show that:

- 96% of participants rate the session they have attended as very good or good;
- 88% agreed or strongly agreed that the session had made them more knowledgeable about the impact of gender imbalance;

- 99% said they would be very likely or likely to consider the issues in their own practice;
- 96% said they would be very likely or likely to share what they learned.

Similarly, the expertise and skills of the IGBE Team have enhanced and supported a wide range of activity led by Education Scotland. This includes the development of the Promoting Race Equality and Anti-Racist Education website, and collaboration with Education Scotland's Attainment Adviser Team to co-develop professional learning sessions on equality, equity and attainment. During the first lockdown, the IGBE team identified the need for more support and information on domestic abuse for educators. Collaboration with Scottish Women's Aid and Mentors in Violence Prevention (MVP) colleagues resulted in the development of the domestic abuse information for educators resource.

An extensive bank of IGBE resources is now available for practitioners, settings and organisations to access on Education Scotland's National Improvement Hub. As we move forward into the next phase of the STEM Strategy, the ambition of the team is to further develop the Improving Gender Balance Self-Evaluation Framework as a focal point for their activity to help establishments adopt whole setting approaches. This would include the addition of case study exemplification and good practice.

Women into STEM pipeline project

The Skills Development Scotland two-year Women into STEM project commenced in 2021 and will run to 2023. It aims to work with stakeholders and partners to review and understand the journey individuals may experience, identifying areas of good practice and exploring areas where the pipeline fails. It will develop awareness, access, and participation for young females to become involved in STEM activities and pathways and by developing a sustainable Apprenticeship Pathways model the project aims to recruit, prepare, and progress females aged 16 to 24 into STEM careers.

## Gender Balance – Further and Higher Education

The Scottish Funding Council Report on Widening Access 2018/19 provides an overview of progress in tackling gender imbalances within the most gender imbalanced subjects. Limited progress has been made by all universities in tackling this challenging issue. Three of the eight subjects of focus for the Scottish Funding Council's Gender Action Plan are in STEM: Engineering, Computer Science and Technologies. The gender gap has reduced in Engineering since 2011-12 although it has increased in the two other subjects.

At colleges, progress has varied. Improvements in reducing the gender imbalance were seen in four subjects. The biggest improvement was seen in Engineering/Technology which saw a 2 percentage point increase in female students from its 2011/12 baseline of 10.9% to 12.9% in 2018/19. Two of these subjects saw reductions in the gender imbalance of only 0.6 percentage points since 2011/12. The biggest increase in the gender gap was seen in Building Maintenance Services as well as Computer Science which both saw a 1.6 percentage point decrease in the percentage of female students.

To better address these issues, a decision was taken to develop a more streamlined and targeted approach. This involved working in partnership with the Equality and Human Rights Commission (EHRC) through a Memo of Understanding to support Scotland's colleges and universities to meet the requirements and achieve the aspirations of the Public Sector Equality Duty. The Scottish Funding Council continues to work with the EHRC to progress their shared ambition of tackling inequality across Further and Higher Education in Scotland.

Equality and Diversity Mainstreaming

The Skills Development Scotland Equality & Diversity Mainstreaming Report was published in May last year. As well as outlining new equality outcomes for 2021-25 the report highlights the progress achieved against the four-year equality outcomes set in 2017. It sets out examples of the ways in which they have worked, and continue to act, to promote and increase equality of opportunity for people in Scotland who face disadvantage because of their protected characteristics or lived experience.
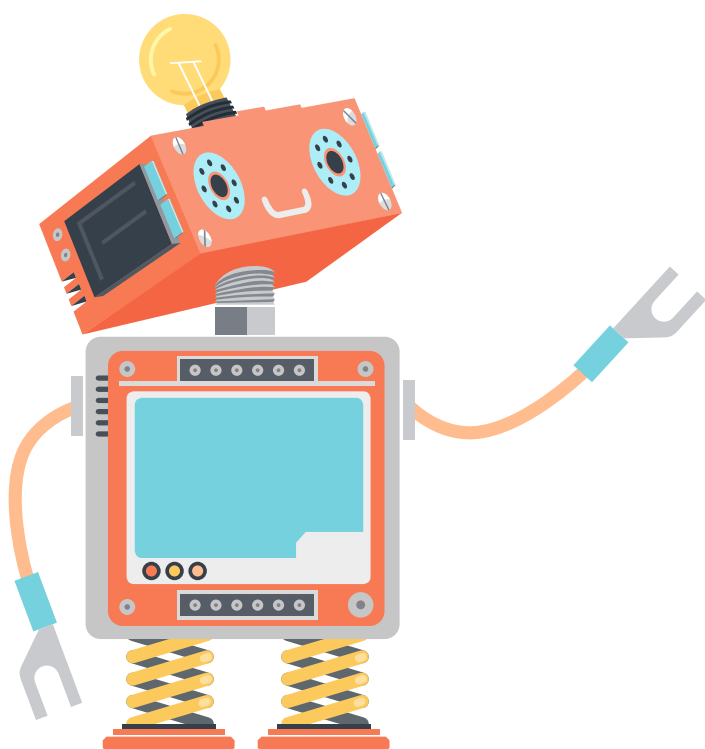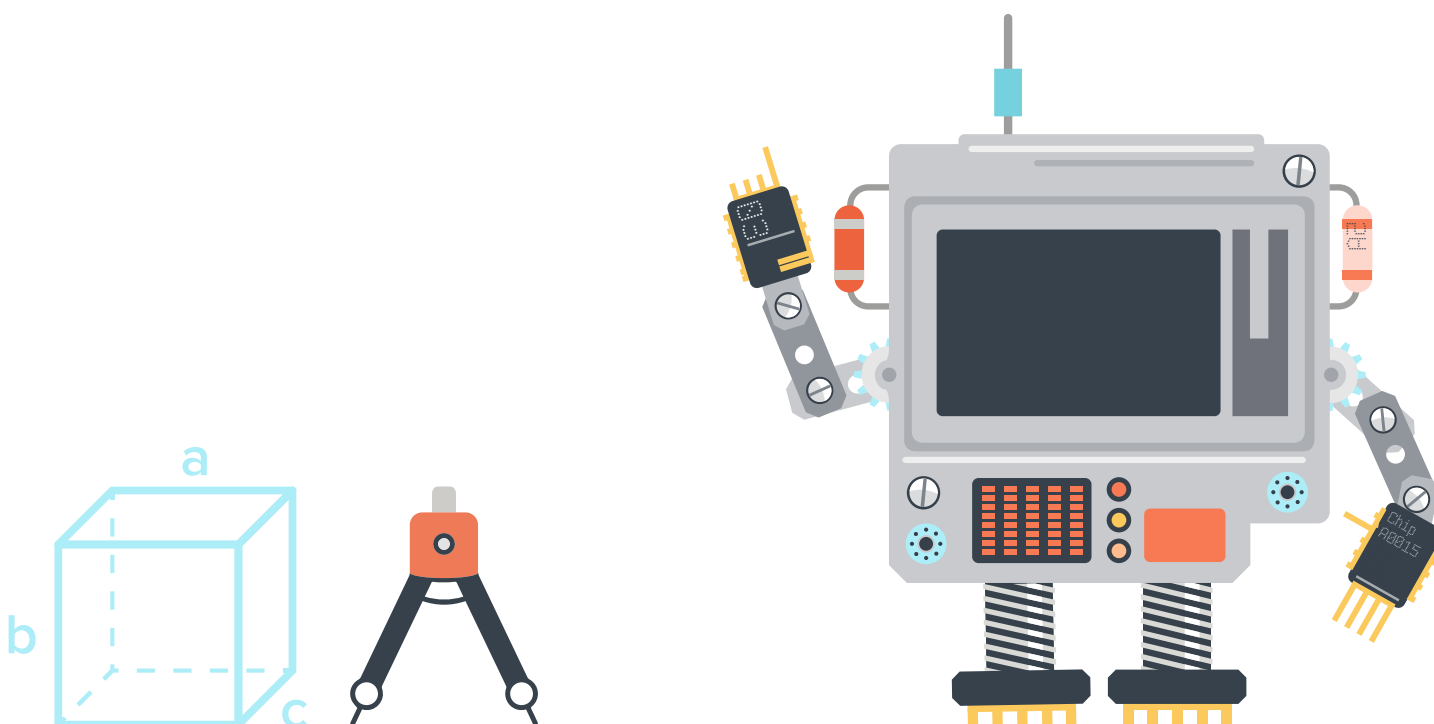
STEM – College Enrolments by Gender

	Male	Female	Other	Prefer not to say	Total	% Female	% Male
2016-17	67,853	26,975	9	30	94,867	28.4%	71.5%
2017-18	69,670	29,961	50	136	99,817	30.0%	69.8%
2018-19	76,592	31,340	87	318	108,337	28.9%	70.7%
2019-20	69,814	30,731	117	308	100,970	30.4%	69.1%
2020-21	68,626	26,496	173	431	95,726	27.7%	71.7%

Source: SFC FES Student Data

Innovative, accessible student pathways; targeting STEM employability gaps

A tripartite partnership between University of the West of Scotland, North Lanarkshire Council and New College Lanarkshire focuses on creating new pathways for previously hard-to-reach candidates by targeting future projected STEM employability gaps in the region with an innovative, fast-track qualification route. Participating S6 pupils complete an HNC in school, an HND in first year at college and enter the third year of study at UWS to complete their degree; with the opportunity of achieving an Honours degree only three years after leaving school. All participating students have employer placement opportunities and are guaranteed an employer interview at the end of the programme. A pilot programme was agreed for initial implementation in August 2021.
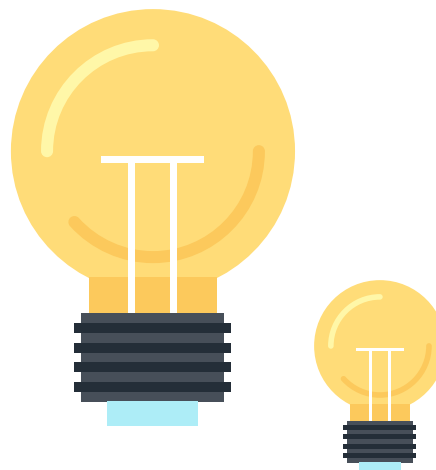
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Inspiration

To help create a strong pipeline of STEM talent into the labour market and ensure that everyone develops STEM skills and knowledge we will **promote inspiration** for STEM by:

- creating positive STEM role models, mentors and coaches.

- promoting the opportunities and benefits of STEM learning and careers.

- recognising and celebrating success.

Maths Week Scotland

Maths Week Scotland 2021 ran from 27 September to 3 October with a mix of digital and in-person events with the theme "Our World". There were approximately 65 different activities, events and downloadable resources delivered by 25 organisations, many supported by project funding schemes. 75,448 pupils from 289 schools registered from all corners of Scotland. Public activity included virtual talks, family open days and maths trails at visitor attractions including National Museum of Scotland, Aberdeen Science Centre, Dumfries and Galloway towns and a range of local museums across Scotland. Workplaces got involved with the #ShowYourWorking social media campaign sharing how they use maths in their industries.

A new Large Grants Funding scheme expanded the reach of Maths Week Scotland, working with eight organisations to deliver large-scale projects to school, adult, family and community audiences. This included CPD training, virtual apps, workshops, videos and community activity days. Funding was awarded to: Aberdeen Science Centre, Scottish Schools Education Research Centre, Dynamic Earth, Dumfries and Galloway Council, University of Glasgow, University of Edinburgh, Learning Link Scotland and Open University.

Great British Bake Off Winner and National Numeracy Ambassador Peter Sawkins hosted a virtual session for 750 primary pupils. Pupils helped him plan a Maths Week Scotland cake and heard how vital maths has been in his baking career. According to evaluation 92% of educators felt that Maths Week Scotland had given them new ideas for how to cover maths topics and 75% said it gave them more confidence covering maths topic. This was particularly the case among primary and early years teachers.

Parental Engagement

Parents continue to play a vital role in supporting their children's learning. We are aware that the pandemic has created a number of challenges for parents. Parents' involvement in school and communication between school and home has continued to be vitally important at this time. In relation to STEM, Education Scotland continues to promote and support a range of family learning resources associated with STEM and the National Parent Forum's "STEM in a Nutshell" guide provides information to parents about STEM careers and subject choices.

My World of Work

My World of Work Live is a set of fun, interactive activities to help young people understand future careers. Aimed at P5 to S6 pupils across Scotland, activities are designed and delivered by experts with a passion for education and learning. Delivered virtually or face-to-face in schools, activities use the latest technology to engage and inspire, bringing school subjects to life. Activities are designed to support the delivery of experience and outcomes in Curriculum for Excellence and are aligned to the Career Management Skills framework and support the realisation of self, strengths, horizons and networks. In 2021/22, My World of Work Live has delivered interactive, hands-on sessions to over 12,500 young people across Scotland.

STEM Nation Award Programme

The STEM Nation Award programme has been developed to promote and celebrate whole-setting approaches to STEM. Education Scotland's STEM self-evaluation framework provides the foundations for the new award, helping to guide settings to highly effective practice, whatever their starting point.

Practitioners are encouraged to engage in professional dialogue and evaluation to support improvements to STEM learning in their setting. The aim of the award is to promote transformative and sustained change at setting and community level to support Scotland's journey to be a leading STEM nation. Early learning and childcare, schools and community learning and development settings can all participate in the award programme.

The award consists of five elements that settings can work towards over a three-year period. The five STEM Nation Award elements are:

- *leadership in STEM* – supporting effective leadership at all levels including children and young people leading STEM learning.

- *STEM family learning / STEM learning in the community* – recognising commitment to family and community learning which is helping to build the STEM capital of learners, their families and the wider community.

- *Employability and STEM partnership working* – encouraging sustained collaboration between settings and their STEM partners to develop learners' STEM and employability skills.

- STEM *curriculum and learner pathways* – recognising the work of settings in developing an inspiring STEM curriculum and associated learner pathways.

- *equity and equality in STEM* – celebrating the work settings are undertaking to address the issues of equity and equality in STEM.

Education Scotland and SSERC have collaborated to support the development of children and young peoples' leadership in STEM. The two awards have been designed to be complementary. For example, evidence referencing SSERC's Young STEM Leader Programme can be used in support of different elements of the STEM Nation Award.

Hazeldene Family Centre, East Renfrewshire

The team at Hazeldene have been awarded all five elements of the STEM Nation Award. They have successfully embedded STEM in their curriculum with all staff confident in leading STEM learning.

They are an excellent example of collaboration, working with primary schools at key transitions as well as providing professional learning for ELC and Primary colleagues. The enthusiasm of the staff and passion with which they describe their STEM Nation Award experience including overcoming barriers, embracing digital learning and supporting family learning demonstrates their continuing commitment to their STEM journey.

$$E=mc^2$$

Young STEM Leader (YSLP)

Six levels of the programme are currently available, divided into a non-formal and formal programmes:

Non-formal programme - linked to CfE Second, Third and Fourth levels			Formal programme - linked to SCQF Levels 4, 5 and 6		
YSL2	**YSL3**	**YSL4 - NF**	**YSL4 F**	**YSL5**	**YSL6**
25%	20%	10%	10%	15%	20%

As of March 2022, more than 7,000 young people have engaged with YSLP. Flexibility and ease of delivery are key in ensuring that the programme is available to all young people in any setting. Interventions have included establishing a Community Learning and Development group and supporting ASN centres to participate in the award. Education Scotland's Improving Gender Balance and Equalities Team has collaborated with SSERC to develop a new gender equality module for the YSLP.

SSERC operates Enthuse Partnerships and Education Industry Partnerships in Scotland with the aim of linking educators, schools, colleges and industry together to benefit young people and inspire them in STEM. In 2021/22 this partnership has generated 150 training days for teachers and will lead to Young STEM Leader Awards for the learners. In addition, Nuffield Research Placements are now being led by SSERC and work is underway to create 90 fully funded summer placements in industry or university for young people in deprived, underserved and underrepresented groups in Scotland.

YSLP Tutor Assessor: "This experience has changed my perception of what STEM is. Before, I just thought of it as 'school science' but as I got into it, it opened my eyes to the practical nature of the STEM stuff – and having our own makerspace has meant we've been able to keep expanding our knowledge and confidence about what's possible. I see STEM everywhere now – I'm always thinking about how we can integrate it into our work. I want to get other youth workers engaged too."
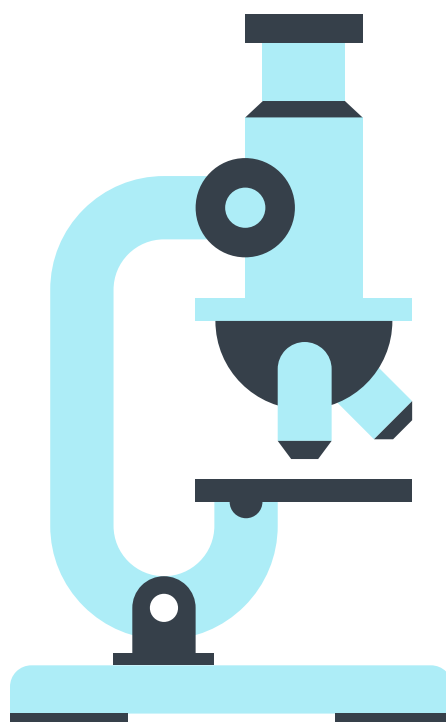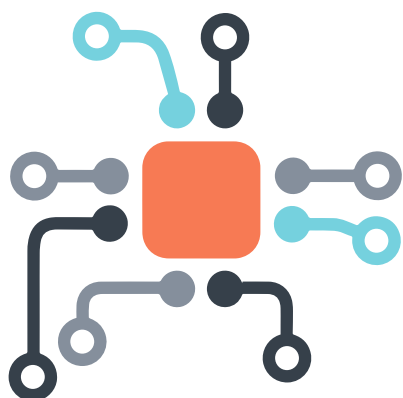
Science Centres

Since 2017, Scotland's science centres and science festivals have played a key role in progress towards the goals and outcomes of the Strategy, with a specific focus around increasing the numbers of people from the most deprived and rural areas participating in quality STEM engagement.

Funding levels for the science centres for financial year 2021/22 were maintained from 2020/21, including the Community and Transport Subsidy elements, which directly fund and encourage engagements with people and communities within eligible demographics.

The pandemic had a significant impact on gauging progress in this area, particularly the effect of lockdown restrictions and health and safety protocols on face-to-face engagement with schools, community groups and others. Despite this, Scotland's science centres, science festival organisers and other partners worked with the Government to develop creative and flexible approaches. This approach maximised the technologies available in order to continue to interact and engage with target groups; particularly those in deprived and rural communities.

While, by necessity, this often meant delivering programmes virtually or in a Covid-19-secure manner to smaller audiences, this continuing engagement was crucial at a time when other learning and support services were limited.

In 2020/21, while mainly closed for lockdown, science centres alone were able to engage over 5,622 pupils across 151 schools. They also reported over 103,773 STEM engagements of all types with members of community groups across Scotland. These figures do not include engagement with online resources – conservatively estimated at over 1.5 million.

As science centres and festivals have continued to develop relationships with community groups across the country, there has been an annual increase in the number of engagements. In 2016/17, the baseline figure for engagements was 8,235 which led to the setting of an original STEM Strategy target of 10,000 engagements to be achieved by 2022. The effort and investment made in this area drove engagement figures to increase exponentially with 8,604 engagements recorded in 2017/18, and 11,505 achieved in 2018/19, exceeding the original 10,000 target. This success led to a revised target that aims for 15,000 engagements by 2022.

It is encouraging to note that in the final quarter of 2021/22, the gradual lifting of Covid-19 restrictions has resulted in schools beginning to return to in-person visits to science centres. We are confident that the excellent progress made by our partners in terms of STEM engagements in our schools and communities will continue.
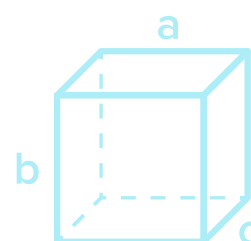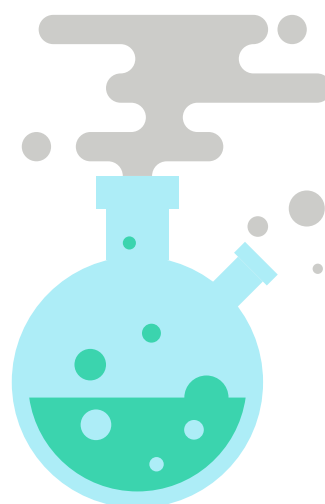
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Connection
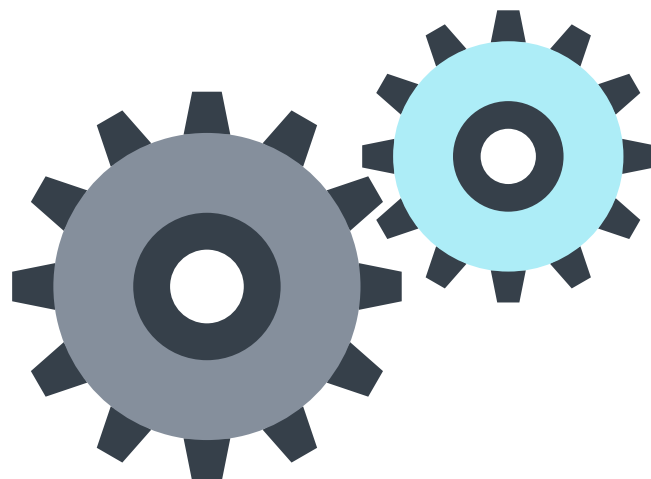
We will **promote connection** by:

- improving the support available to schools.

- delivering up-to-date advice and information on STEM careers.

- increasing the responsiveness of colleges, universities and the apprenticeship programmes to the needs of the economy.

Regional Support for STEM – Regional Improvement Collaboratives

The development of the STEM Strategy coincided with the publication of the *Education Governance: Next Steps* Review of Scottish education and led to the creation of six **Regional Improvement Collaboratives (RICs)** within Education Scotland. An action within the Strategy asked that Education Scotland establish a team of STEM Education Officers to provide leadership, coordination and support to help take forward implementation.

The team has collaborated extensively with practitioners and between August 2019 and March 2022 undertook 2,115 direct engagements reaching 922 distinct establishments and 10,632 attendees. This amounts to over 2,900 hours spent on engagements. Of the 922 distinct establishments that benefitted, some 152 were in remote or very remote locations. This activity represented a wide range of engagements including delivering professional learning (12%), supporting professional dialogue (25%), professional advice (24%), support for policy, strategy and networks (15%), supporting planning activities (20%), identifying highly effective practice (2%) and improvement support (2%).
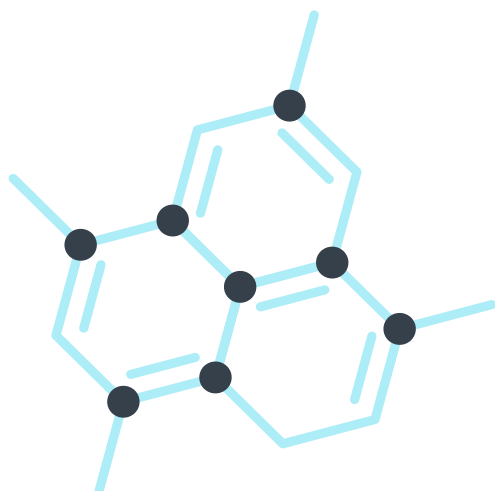
When the pandemic struck in March 2020 the team pivoted to meet the local, regional and national needs of the stakeholders, with the support moving to an online delivery format. This increased the reach and scale of delivery with positive feedback from practitioners in more remote and rural areas. In addition to the engagements noted above, 4,847 practitioners and stakeholders attended 77 online webinar sessions led by the team from the start of the pandemic lockdown. Professional learning was provided on a range of themes to support the immediate priorities of practitioners during this period. This included directing them to valuable resources to support remote learning and also subject support for the SQA Alternative Certification Model.

At the same time, Education Scotland's STEM Team provided critical support for the development of the three strands of the National e-Learning Offer – live, recorded and supported. This involved collaboration with West Online School (OS) to support development the recorded lessons and direct delivery of e-Sgoil live lessons. The STEM Team also led developments on the supported resources within NeLO, drawing inspiration from its sciences network to grow it into an extensive bank of online resources to support STEM, as well as other curriculum areas.

The professional learning offer continues to be complemented by the local, regional and national networks that Education Scotland's STEM Team leads or supports. These provide practitioners and STEM leads with the opportunity to share practice, collaborate and learn together. A national network of early learning and childcare practitioners was launched with a series of webinars focussed on interactions, experiences and spaces provided for young children, and the benefits of outdoor learning as well as sharing STEM practice. The Primary STEM Network, launched in 2022, continues this approach and a new ASN STEM Network is providing this sector with an opportunity for mutual support around their specific needs. Education Scotland's network of secondary science teachers have collectively shaped a programme of professional learning for 2022, focussing on widening STEM pathways and reimagining the BGE curriculum.

More recently Education Scotland has established a local authority STEM leads Network and STEM partners network to ensure those with a responsibility for leading STEM activities within local authorities, RICS and nationally also have the opportunity to connect, share practice, collaborate and inform national developments.

A new interactive online directory was launched on the STEM Nation Online Resource in early 2022 allowing practitioners to easily search a large range of resources and support through an interactive spreadsheet. Filters allow users to search by sector, region, local authority, theme, provider and date.

STEM Ambassadors

In April 2021 the three Scottish STEM Ambassadors hubs merged to form one national hub operating under SSERC. The hub has a network of over 5,000 STEM Ambassadors and as a national hub is now well placed to contribute to national STEM programmes.

Highlights over the past year include supporting a successful **Maths Week Scotland** campaign funded by the Maths Week Scotland Large Grants Fund. The hub funded maths- and numeracy-linked professional learning for Early and First Level practitioners as well as creating career-linked maths resources. Over 300 schools and 80 STEM Ambassadors were involved with Maths Week Scotland, resulting in 300 hours of volunteering.

The hub's second **STEM Ambassadors in Scotland Week** showcased the wide variety of STEM careers opportunities. This included a business breakfast for employers in Scotland as well as live online events covering the technology, renewable energy, construction, forestry and research sectors. Employers partnered with the hub also provided activities and resources to support the week which had over 134 schools involved along with over 100 STEM Ambassadors resulting in over 900 volunteering hours.

The hub has also supported key national campaigns such as Scottish Book Week, British Science Week and Scottish Apprenticeship week with a variety of different events, resources and opportunities including: book readings, professional learning opportunities for teachers, "Meet the STEM Ambassador" online talks and business breakfasts. A particular highlight has been launching the hub's resource library where STEM Ambassadors, schools and youth groups can borrow physical STEM resources free of charge to deliver career-linked STEM activities.

During a challenging year the hub has continued to support STEM Ambassadors to deliver engaging STEM opportunities to schools and groups resulting in over 17,800 volunteering hours from STEM Ambassadors in Scotland working with over 1,000 schools across Scotland. As with the YSLP, Education Scotland's Improving Gender Balance and Equalities Team has worked closely with SSERC to co-develop and deliver gender equality training for STEM Ambassadors.

The UK STEM Ambassador programme has firmly established itself as the leading STEM volunteer programme in the UK. With a network of 17 STEM Ambassador Hubs across the UK, STEM subjects are brought to life with the support of over 30,000 volunteers.

Life and Chemical Sciences National Transition Training Fund

The Scottish Universities Life Sciences Alliance are delivering a series of introductory courses to upskill and reskill individuals within the Life and Chemical Sciences sectors. The courses have been developed in partnership with industry and aim to develop both practical and theoretical knowledge. For academic year 2021-22, 30 individuals will be supported.
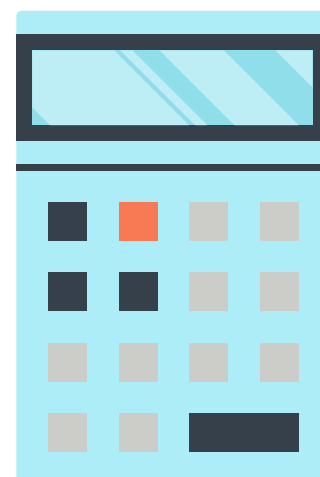
Energy Skills Partnership – ESP

The college sector plays a vital role in delivering on the objectives of this Strategy. In 2019/20 there were over 4,000 more Full-Time Equivalent students on engineering or science and maths courses at colleges than in 2006-07, an increase of 29%.

ESP is a collaboration of Scotland's colleges and industry partners that aims to increase capability and capacity to deliver the right skills for the energy, engineering and construction sectors in order to meet industry demand. As the college sector agency for energy, engineering and construction, ESP works as a cohesive partnership across Scotland's colleges.

ESP is instrumental in promoting STEM with both Scotland's colleges and its strategic partners. This has resulted in the colleges having a lead role in establishing Scotland's Regional STEM Hub Partnerships which are a collaboration of partners including the Scottish Funding Council, Skills Development Scotland, Education Scotland, Developing the Young Workforce, local authority STEM leads, the RAiSE programme, universities and key industry partners.

The Partnership has sponsored a range of events including the Greenpower electric car challenge, Bloodhound Race for the Line and Big Bang. These activities have been delivered in the Western Isles, West Highland, North Highland and within the Central Belt. During the Pandemic ESP replaced its physical STEM careers events with a virtual "Step Into" programme highlighting careers in renewables and its supply chain, science and robotics. ESP are also involved in the FIRST LEGO League in Scotland that helps develop key skills such as team work, communication, problem solving, planning and coding whilst considering a real world problem.
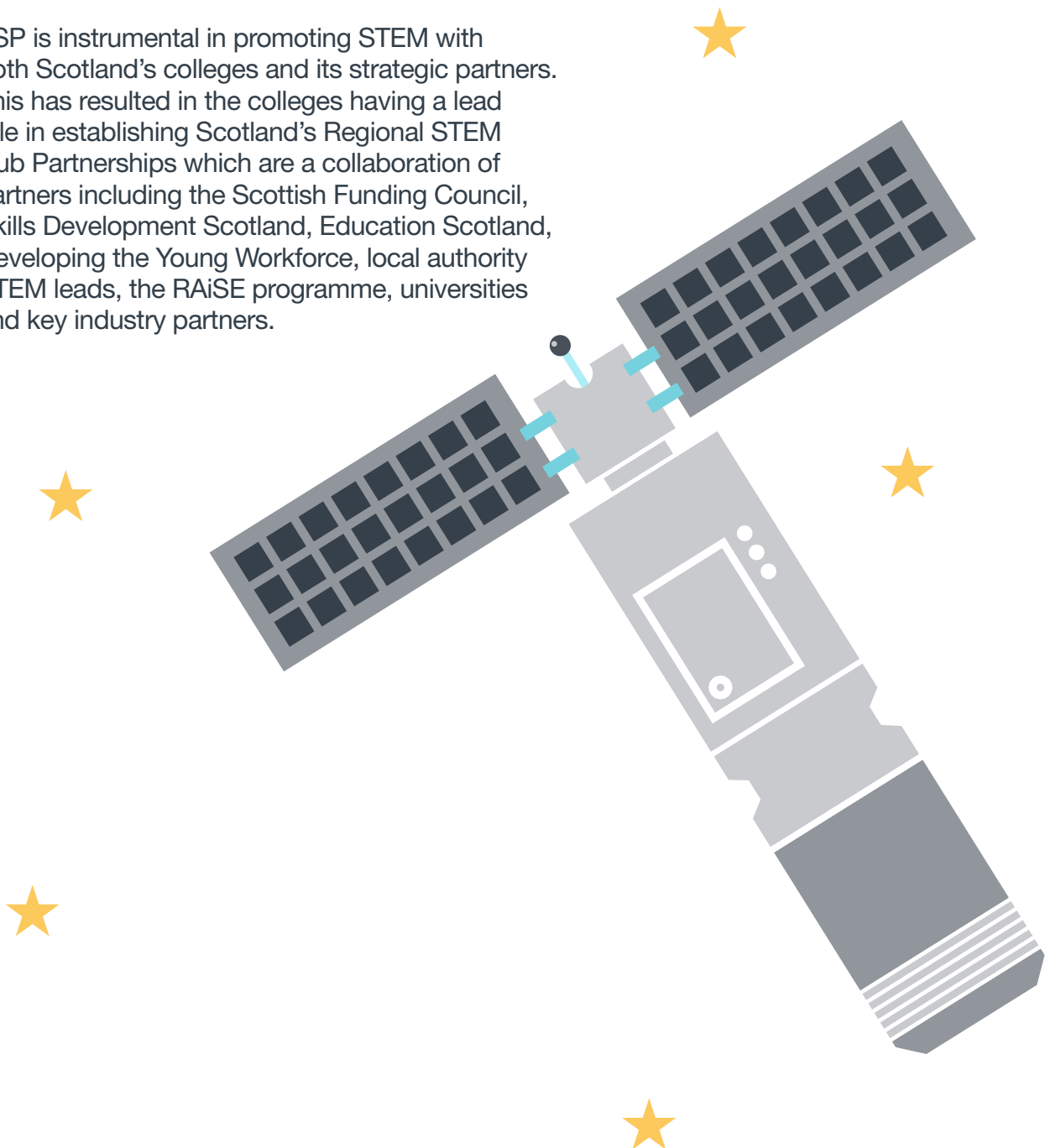
Labour Market Information (LMI)

Skills Development Scotland publish regular LMI resources to support partners with strategic skills investment planning. At a national level, the monthly COVID-19 Labour Market Insights report and dashboard provide up to date information on Scotland's economy and labour market. In addition, detailed regional and sectoral skills assessments provide analysis of skills supply and demand across Scotland's regions and key sectors of which several are STEM-related.

Developing the Young Workforce – DYW Live

We are committed to supporting all young people to achieve their potential and we have a good track record of tackling youth unemployment through Developing the Young Workforce (DYW). DYW Regional Groups and School Coordinators deliver bespoke activities in collaboration with specialist partners and employers to promote educational and career pathways available to young people through STEM subjects.

Skills Development Scotland has supported the implementation of DYW schools co-ordinators throughout 2021/22 by providing a number of professional learning sessions. These covered Labour Market Information for key sectors in the Scottish economy have attracted more than 1,200 participants.

Many Regional Groups have created annual STEM events which they tailor to reflect labour market demands, with others focussing on gender inequality in the workplace and promoting employment opportunities in Computing, Science and Technology and the Financial sector to young females. The key principles of DYW provide strong support for the implementation of this Strategy. These include a focus on reducing young unemployment, increasing partnerships working, and enhancing skills as part of learning and teaching.

DYW Live is a partnership between employers and organisations from across Scotland. It provides live sessions that supports learners' development of employability skills, career pathways and industry connections. DYW Live sessions have been organised with STEM Ambassadors, Pathway sessions with strong STEM links have been supported, and Code-Along sessions have been delivered involving more than 4,000 learner engagements.

Science Skills Academy

The Science Skills Academy (SSA) is a large-scale demonstration project testing the delivery of quality STEM activity in the Highland region. It targets around 10,000 young people aged 10 to 14 and has established five "Newton Rooms" across the region. A team of STEM Engagement Officers deliver full day inspiring hands-on STEM activities covering renewable energy, robotics, health sciences, biofuels, aquaculture and apace – specifically selected to reflect the core STEM industries active in the Highlands & Islands.

Consideration is being given to the potential of extending the project due to the impact of the pandemic, to allow further development of SSA model, expand coverage and develop a partnership with the Scottish science centres. Further development of the model could see a focus on older pupils around key industry-led immersive on-site STEM activity in regional hubs such as in aquaculture, energy and space.

The Highlands and Islands is a net exporter of young talent, with a loss of around 2,500 young people each year to higher education in the cities. More than half of those who take up STEM degrees will remain in city locations. The SSA has been set up to ensure young people, from an early age, are made aware of the significant STEM-related industries already located in the region as well as those projected to grow over the next ten years.

7

Next Steps

Actions by a range of stakeholders as set out earlier in this report have undoubtedly contributed to ensuring that the original aims of the Strategy continue to be both relevant and present a valuable focus for work programmes going forward. The annual reports published since 2017 record, in many instances, satisfactory or good progress having been made. However, the past two years have been challenging for the education sector in Scotland as a whole and, while there remains a high level of enthusiasm and commitment from stakeholders, some activities have not been possible or have been delayed or reduced.

We intend, in the coming months, to streamline the Strategy governance arrangements by replacing the multi-tier approach with a single Senior Stakeholder Group. The new group will be integrated into the wider curriculum governance structures currently being established and will take on the governance arrangements associated with the education aspects of the Logan Review of the Scottish Technology Ecosystem. Efforts will also be made to ensure that Strategy actions relating to equalities have an appropriate governance and reporting structure.

Going forward, we intend to continue the STEM Strategy in its present form for at least a further three years; making a commitment to annual reports in 2023 and 2024. While it is not possible with any degree of accuracy to predict future events, we believe that by 2025 the education reform agenda will have advanced enough to allow for a re-examination of STEM education priorities.

Annex A
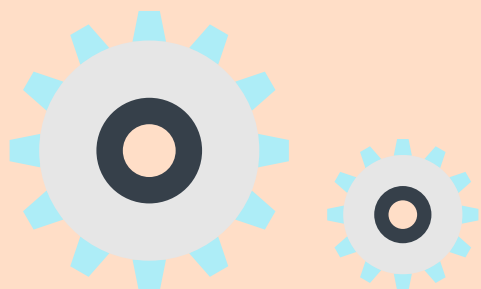
What is STEM?

In the STEM Strategy we take a broad view of what STEM is:

STEM stands for Science, Technology, Engineering and Mathematics. We include numeracy and digital skills within our definition of STEM. Both of these are vital to enable everyone to participate successfully in society as well as across all jobs, careers and occupations.

STEM education and training seeks not only to develop expertise and capability in each individual field but also to develop the ability and skills to work across disciplines through interdisciplinary learning.

All of these are increasingly important to success in a changing and technologically driven world. They are also important for helping us to develop as active citizens, making informed decisions for ourselves and for society.

We recognise, in particular, the importance of creativity and innovation for economic growth and the strong synergies that exist between STEM and creativity.
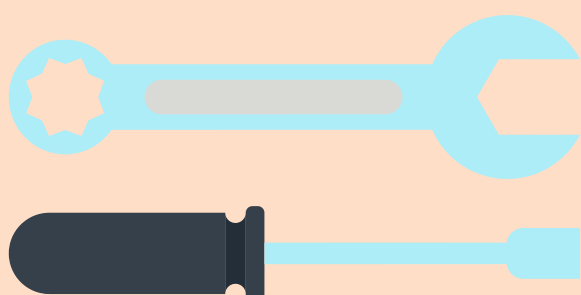
STEM education and training helps us acquire the following skills and capabilities:

- growing our understanding and appreciation of the natural and physical world and the broader universe around us;

- interpreting and analysing data and information;

- research and critical enquiry – to develop and test ideas;

- problem solving and risk assessment;

- experimentation, exploration and discovery of new knowledge, ideas and products;

- collaboration and working across fields and disciplines;

- creativity and innovation – to develop new products and approaches.

The separate parts of STEM are:

- **Science** enables us to develop our interest in, and understanding of, the living, material and physical world and develop the skills of collaboration, research, critical enquiry, experimentation, exploration and discovery.

- **Engineering** is the method of applying scientific and mathematical knowledge to human activity and **Technology** is what is produced through the application of scientific knowledge to human activity. Together these cover a wide range of fields including business, computing science, chemicals, food, textiles, craft, design, engineering, graphics and applied technologies including those relating to manufacturing, construction, transport, the built environment, biomedical, microbiological and food technology.

- All of STEM is underpinned by **Mathematics**, which includes numeracy, and equips us with the skills we need to interpret and analyse information, simplify and solve problems, assess risk and make informed decisions. Mathematics and numeracy develop essential skills and capabilities for

life, participation in society and in all jobs, careers and occupations. As well as providing the foundations for STEM, the study and application of mathematics is a vast and critical discipline in itself with far-reaching implications and value.

- **Digital skills** play a huge and growing role in society and the economy as well as enabling the other STEM disciplines. Like mathematics, digital skills and digital literacy in particular are essential for participation in society and across the labour market. Digital skills embrace a spectrum of skills in the use and creation of digital material, from basic digital literacy, through data handling and quantitative reasoning, problem solving and computational thinking, to the application of more specialist computing science knowledge and skills that are needed in data science, cyber security and coding. Within digital skills, as noted above, computing science is a separate discipline and subject.

However, it is often the interconnections between these separate parts that are important in life and in work.

This broad definition allows for different interpretations of data about STEM in education and training in what is, in practice, a complex set of inter-related disciplines and skills encompassing a very broad field of study. It is often more important to know about the differences that exist within STEM courses (for example, gender imbalances between courses) than it is to know what the total "amount" of STEM is. There are different options for defining STEM, dependent on the aspect under consideration i.e. education, the level of education or training, industry (businesses) or occupation (jobs).

For the purposes of reporting progress with the Strategy we have chosen to define STEM in different, but related, ways across the different sectors.

In summary:

- We have matched SQA qualifications and awards to the broad subject areas described above and included those qualifications and awards if at least half of the mandatory content can be related to these curricular areas and are generally organised or delivered in faculties and departments relating to these curricular areas. The teacher definition follows similar criteria. For college courses we have used the definition that was in use on the Outcome Agreements for the purposes of KPIs.

- A similar approach has been taken when determining STEM courses at universities, based on the established Higher Education Statistics Agency (HESA) definitions.

- We have established a defined list of STEM-related apprenticeship frameworks (FA, GA and MA) as set out in the definitions paper. These have been chosen because they relate to the subjects listed above and to STEM-related jobs and careers.

- There is no one accepted definition of STEM in the labour market in use in Government. The main issue is that there are some labour market sectors that are very clearly STEM-based e.g. engineering and some that are not STEM-based but include STEM-related occupations in them e.g. an accountant in a business or a clinician working in health and social work. STEM skills are increasingly important across all sectors and roles and it is very hard to rule some sectors in and some out. We have taken an approach based on work by the UK Commission for Employment and Skills that looked in detail at the proportion of people in jobs and business with degree-level qualifications.