

The STEM Research & Innovation Framework *Summary*



The Institute for
Research in Schools



01 Introduction

Please note, the STEM Research and Innovation Framework (R&I Framework) signposts teachers and schools to resources and organisations that can help schools to improve their STEM provision.

We reference a range of organisations that are leading the way in STEM education but their inclusion here does not infer their endorsement of the R&I Framework.

The STEM Research and Innovation Framework (R&I Framework) has been developed to improve the experience that young people in schools have in science, technology, engineering and maths.

IRIS has supported many schools and colleges across the country to transform the experiences and opportunities of young people in STEM. We've seen, first-hand, the benefits of research and innovation to young people, from improved learning and engagement in science to new STEM career aspirations. We believe every student should reap the benefits of research and innovation while at school and this is why we are proud to publish the R&I Framework.

'Research and innovation' is not a new term and is widely used to describe producing new knowledge (research) and using that knowledge to solve problems (innovation). In schools research and innovation can be used to promote STEM, to empower students to discover and apply knowledge to solve problems and to engage students in the true nature of science and research.

Research and innovation can also be a powerful tool to engage under-represented or historically excluded groups in STEM. We must do this to help address the STEM skills gap and reap wider economic benefits for the UK but, more importantly, to facilitate social mobility and 'levelling-up' – it is still the case that STEM jobs are more highly paid than comparable non-STEM jobs.

As experienced school leaders and teachers, at IRIS we understand how challenging running a school can be and how difficult it is for teachers to balance the competing demands on valuable curriculum time. In the best schools, where student experiences are exemplary, students are well supported academically to develop a strong foundation of knowledge. These students experience a wealth of opportunities which fundamentally change their relationship with, and enthusiasm for, STEM. Such experiences include regular encounters with scientists, research partnerships with universities and industry and outstanding careers advice.

The R&I Framework has been developed to highlight many of the most impactful elements of wider STEM education found in leading schools. It brings together best practice and maps it out to provide a guide to schools of actions they can take to improve their STEM provision. It should be used as a reflective tool rather than a check list of actions. While the focus of the R&I Framework is on STEM, the principles behind it can be applied to many other subject areas within a school.

Collaboration is at the heart of the framework. We have engaged with, and sought advice from, a wide range of partners and leading organisations within the STEM and education communities to ensure that this framework is as impactful as possible. Over the next few years, we will be evaluating the R&I Framework and producing supporting resources for teachers and schools. There are many organisations across the UK that provide schools, teachers and students with outstanding support and opportunities in relation to STEM. Those referenced and recommended within the R&I Framework do not represent an inclusive list and we encourage teachers and school leaders to continue to collaborate with organisations that best support them and meet the needs of their local context.

We hope that the R&I Framework will support schools and colleges to engage students in STEM and inspire many of them to take up a career in research and innovation. To achieve this, we want to hear from you. Whether you are a leader or teacher with a desire to develop research within your school, an academic or business interested in supporting the next generation of scientists or a charity with a great idea of how to support research and innovation, we would encourage you to get in touch.

The full version of the R&I Framework along with supporting documents and tools can be downloaded from our website by visiting www.researchinschools.org/framework.

IRIS is grateful to the Battcock Charitable Trust for supporting this work

Marcus Bernard
Deputy Director
The Institute for Research in Schools



Background

IRIS was founded on the belief that young people have the capacity to change the world. If their education empowers them with the right tools, school-aged students can contribute to the community of scientific research right now.

Despite the evolution of IRIS over the last few years, this founding belief continues to be central to what we do.

Our mission

IRIS aims to change the culture in UK education so that authentic research and innovation is part of every young person's experience.

We do this by:

- **Creating opportunities** for students to participate in cutting-edge STEM research and collaborate with leading universities and institutions while still at school
- **Evidencing the impact** on students of carrying out research while still at school

97%



of teachers who have led IRIS projects say students were more engaged with science and motivated to learn.

94%



of teachers say student research projects from IRIS help them put learning in context.

77%



of teachers say working with IRIS supports students to build an awareness of STEM and STEM careers.



- **Facilitating a research culture** by influencing and demonstrating best practice of STEM research and innovation in schools

As a charity, everything we do is driven by our moral purpose; to capture talent and break down barriers that impact underrepresented young people in STEM.

Our impact and reach

- Despite the challenges of COVID-19, throughout 2020 and 2021, we supported **1027 students** to carry out research in school or at home.

- In 2021/2022, we expect to work with 1500 students rising to **2500 students** by 2024.
- Since 2016, we have welcomed over **350 schools and colleges** across the UK as members of IRIS.
- We have collaborated with over **80 universities** and institutions to provide research opportunities to students.
- Over **2200 students, teachers, researchers** and members of the wider STEM community have participated in our conferences since 2018.

89%



of students plan to study STEM at university after working on an IRIS project.

77%



of students tell us that taking part in research gives them a better understanding of science.

81%



of students felt that their projects had contributed to scientific research.

04 The Framework

Overview

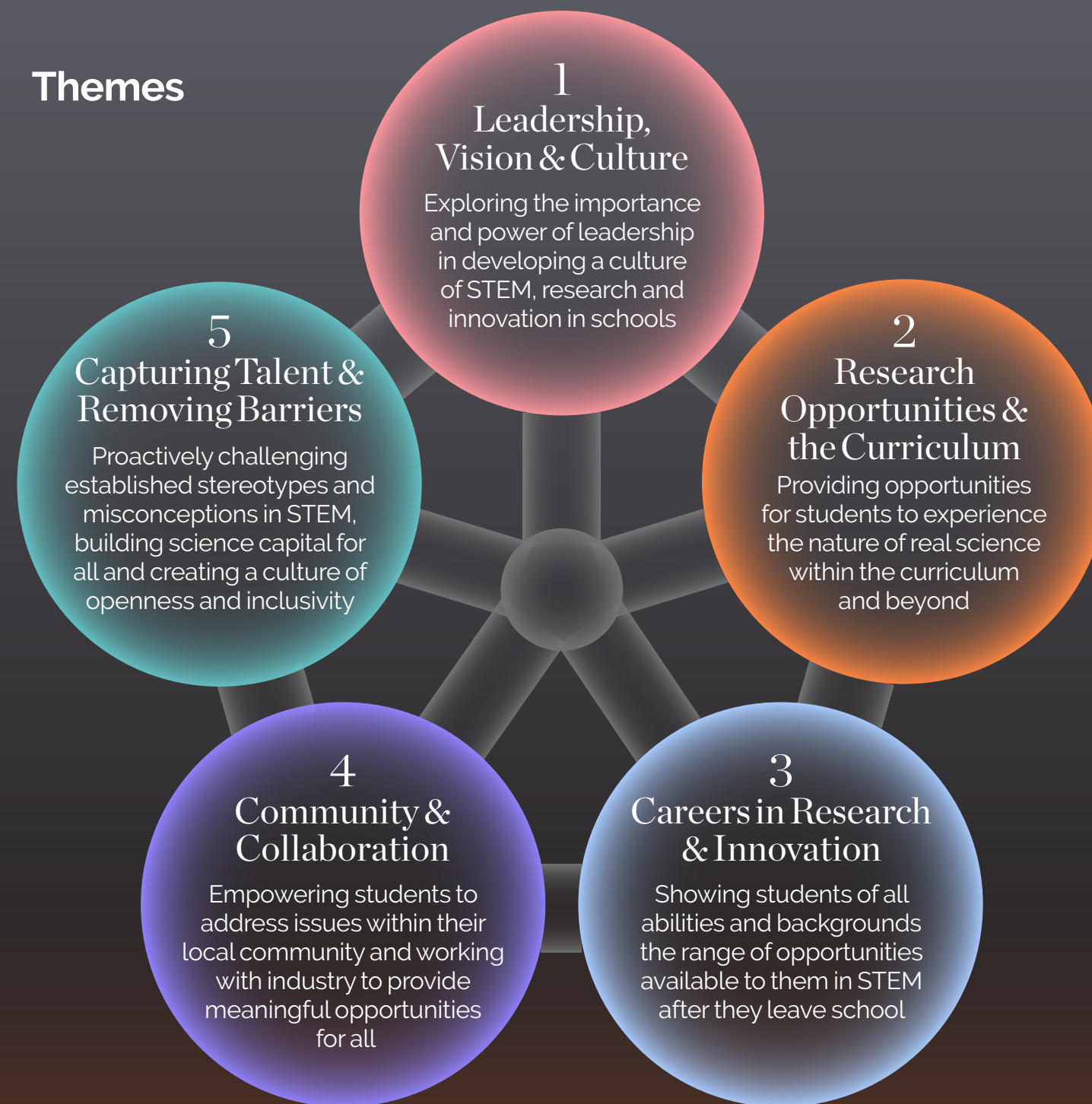
Designed for teachers and school leaders by teachers and school leaders, the STEM Research and Innovation Framework brings together best practice from across the STEM education sector and forms a toolkit to help evaluate and improve a school's wider STEM provision.

Throughout this document we have provided guidance and various tools to help you implement the framework. This includes resources and links to a range of different organisations who do fantastic work in the STEM education sector.



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Themes





Leadership, Vision & Culture

Exploring the importance and power of leadership in developing a culture of STEM, research and innovation in schools



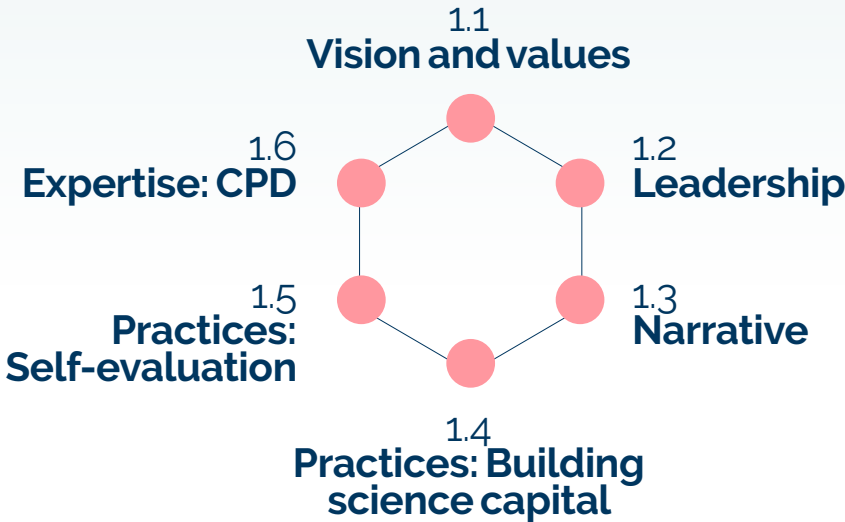
Leadership within a school is crucial as it influences every aspect of school life from day-to-day operations to the overall culture of the school.

Any type of innovation in a school requires careful consideration and planning. While class teachers and middle leaders can be the change makers and drivers, senior leaders and headteachers have a bigger reach, with the influence and resources to drive motivation.

A good STEM education is more than just preparing a few students to become the scientists of tomorrow. Schools must be proactive in ensuring that all young people can access science and feel that STEM is important and relevant to their lives. To achieve these goals, leaders must create or buy into such a vision and take an active role in building a set of beliefs that drive forward a culture of research and innovation.

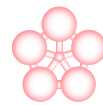
Theme 1 strand map

Leadership, Vision & Culture has been designed to encourage teachers and school leaders to reflect on their vision for STEM and consider the systems and values that the school uses to develop a culture of research and innovation, whether they be implicit or explicit.



Every school is different and unique, this framework should be used as a reflective tool rather than a checklist. We encourage you to adapt it in a way that works best for your school.

Strands	Starting out	Embedding	Established
1.1 Vision and values	There is a vision for STEM although this is limited to a departmental or class level. This vision is beginning to inform practice, which is changing the profile and perception of STEM.	The school has a clear vision for STEM which is supported by senior leaders and staff across the school. This vision shapes STEM, research and innovation activities across the school.	The school has a strong vision for STEM, Research and Innovation, including a set of values which guide practices. The school's vision and values are supported and promoted by senior leaders and understood by almost all staff and students.
1.2 Leadership	STEM, Research and Innovation is coordinated by a dedicated member of staff, although this could be on a volunteer or informal basis.	STEM, Research and Innovation is primarily driven and coordinated by middle leaders or a dedicated member of staff who has been given responsibility for this area. It has a wide reach across the school.	STEM, Research and Innovation are driven and supported by senior leaders and the governing body, with a named member of staff having overall responsibility for leadership in this area, coordinating the activities of others. It has a whole-schools' reach.
1.3 Narrative	There is a narrative within the school around the general importance of STEM at the national level.	There is an understanding of the importance of STEM at a national level as well as within a local context. This understanding starts to shape the schools' activities in relation to STEM, Research and Innovation.	The schools' STEM provision and opportunities provided to students are shaped from a strong understanding of the importance of STEM at a national and local level.
1.4 Practices: Building science capital	There is a recognition of the importance of building science capital, with some strategies in place to do so. The impact of this work is not yet reaching a significant number of students.	The school recognises the importance of building science capital and there are several effective strategies in place to do so at departmental level impacting a significant number of students.	The school is dedicated to building science capital for all students and it is well integrated into the schools' culture. The school has strong systems, strategies and routines in place in order to achieve this, impacting almost all students.
1.5 Practices: Self-evaluation	Through self-evaluation the school has an awareness of the reach and impact of its STEM provision.	The school's self-evaluation on the impact of its STEM provision is evidence based. This information is used to drive improvement and increase engagement in STEM.	The school's self-evaluation of its STEM provision is robust and incorporates clear measures of impact. Clear future actions are identified which will move the school towards its overall vision for STEM. The school collaborates with external partners to help with the evaluation and improvement process.
1.6 Expertise: CPD	STEM teachers and staff are supported to take part in CPD to develop their own substantive and disciplinary knowledge in addition to subject-specific pedagogy.	The school recognises and values the importance of subject specific CPD. This includes developing teacher substantive knowledge, disciplinary knowledge and subject-specific pedagogy. CPD for STEM teachers also focuses on building science capital while removing barriers to students engaging in STEM. This includes a focus of students becoming scientifically literate citizens.	The school is committed to empowering STEM teachers to become experts by providing effective and sustained CPD opportunities to improve their substantive and disciplinary knowledge alongside their subject-specific pedagogy. CPD for STEM teachers also focuses on building science capital and removing barriers to students engaging in STEM and becoming scientifically literate citizens. Where appropriate, senior leaders, teachers, technicians and other school staff actively promote or engage in opportunities to continue their own research including through CPD and partnerships.



10 Recommended resources and reading

Here are some recommended organisations, resources and reading materials to help you get started. We encourage you to explore the many other STEM organisations offering support and opportunities to schools.

ASPIRES

Whether you are a specialist STEM teacher or a school leader without a STEM background, we highly recommend reading the ASPIRES study. For over ten years ASPIRES, a mixed-methods study at UCL, has been investigating how young people form ideas around STEM. The project has led to key observations on what shapes young people's science identities, aspirations and their level of engagement in STEM. ASPIRES provides a strong evidence base to help teachers and education leaders to gain a clear understanding of the problem in order to address it.

For more information, visit:

www.bit.ly/IRIS_1

Click here to download the phase one ASPIRES project summary report:

www.bit.ly/IRIS_2

Click here to download the phase two ASPIRES project summary report:

www.bit.ly/IRIS_3

Science capital

We know that having a good teacher is one of the leading reasons, along with practical work, that students enjoy science. There are, however, many students who do not see science as important or accessible to them. Historically, we have focused on making STEM fun but evidence is now clear that we need to make it more relevant. The Enterprising Science project has looked at how teachers and schools can develop the science capital of young people and therefore change their perception that science is for them.

We've added science capital and the science capital teaching approach to theme 1 as we believe that it can be most effective when embraced and supported by school leadership and incorporated into the school's culture.

Click here to download the resources and teacher pack for the science capital teaching approach:

www.bit.ly/IRIS_4

Project STEM - Book of Insights

This research looks at the attitudes, motivations and mindsets of young people and how these affect the decisions they make on subject and career choices, particularly in relation to science, technology, engineering and maths. We've added this resource to theme 1 as it helps to understand the need to develop a culture of research and innovation in schools.

Click here to download Project STEM:

www.bit.ly/IRIS_5



11 Continued Professional Development (CPD)

Collaboration and sharing good practice amongst teachers and schools can have a positive impact on students and staff, but sometimes we need to look further afield.

External CPD opportunities are a crucial component of an effective development programme for teachers. External CPD can build skills and knowledge in an area where an existing learning community lacks expertise or needs additional support to drive improvement, including alternative perspectives or challenge. These recommended organisations have a proven track record of high quality STEM CPD which includes some aspects of research and innovation in schools.

STEM Learning

STEM Learning offers well-established and successful CPD in many areas of STEM and STEM Leadership. National residential CPD courses and local/online CPD events are complimented by thousands of educational resources covering all aspects of STEM.

For more information, visit:

www.stem.org.uk

Institute of Physics (IOP)

The Institute of Physics works to promote, develop and support excellent physics teaching through networks, CPD events or proven resources. Regardless of what stage you are at in your career, or whether you are a specialist or non-specialist physics teacher, we highly recommend the IOP to help develop and improve physics teaching.

For more information, visit:

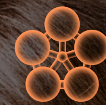
www.iop.org/education

Royal Society of Chemistry (RSC)

The Royal Society of Chemistry (RSC) offers a well-rounded programme of training and learning that aims to support every aspect of chemistry teaching. In addition, the RSC offers teachers support through their regional teams of Education Coordinators and Programme Managers, alongside a wealth of resources to support chemistry teaching.

For more information, visit:

www.edu.rsc.org



Research Opportunities & the Curriculum

Providing opportunities for students to experience the nature of real science within the curriculum and beyond



13 Research Opportunities & the Curriculum

Student-led research describes activities that enable young people to experience STEM in the way that researchers do through scientific research.

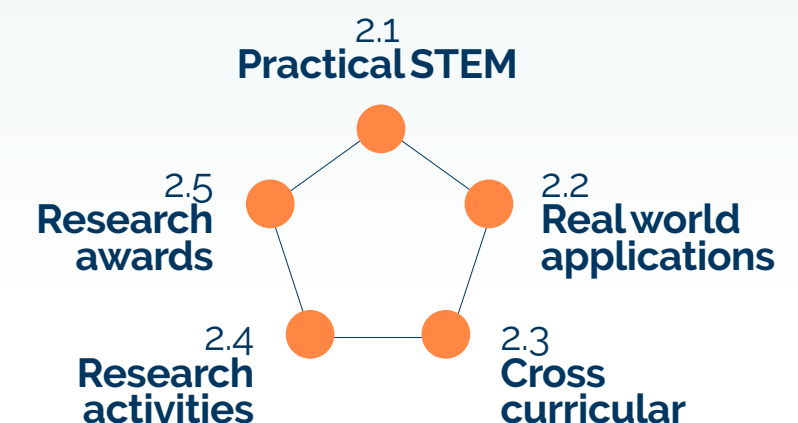
Far too many students see STEM as a static body of knowledge, something that has already been done and a domain in which they are often passive participants. A strong knowledge-based curriculum is incredibly important to ensure that students know the products of science and can explain the natural

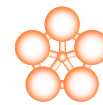
world around them. It is also important that students learn about the practices and nature of science. From procedural knowledge which develops into practical skills overtime, to understanding how knowledge is established through enquiry and research.

Evidence shows that there are many benefits of student-led research, including a positive impact on learning, improved attitudes to science and increased awareness and uptake of STEM careers. Student-led research can also be effective in building science capital and engaging historically excluded groups in STEM.

Theme 2 strand map

This theme focuses on enhancing the curriculum and providing wider opportunities in STEM. Using student-led research and setting learning in a real-world-problem-solving context shows students that they can be active participants in science.





14 Research Opportunities & the Curriculum

Every school is different and unique, this framework should be used as a reflective tool rather than a checklist. We encourage you to adapt it in a way that works best for your school.

Strands

2.1 Practical STEM	In STEM subjects procedural knowledge (how to do things i.e. use a thermometer or tri-square) is explicitly taught.
2.2 Real world applications	The curriculum in STEM subjects is occasionally linked to real world scenarios or issues.
2.3 Cross curricular	Students are given the opportunity to connect and apply their learning across STEM subjects. This usually happens through specific projects or events such as STEM cross-curricular days.
2.4 Research activities	Students have the opportunity take part in activities which are rooted in the principles of research.
2.5 Research awards	Where appropriate, the school supports some students to complete a project-based award or qualification in addition to the normal curriculum offer.

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Embedding

In STEM subjects procedural knowledge is valued and taught with ever more complexity over time leading to the development of skills.
Students have regular opportunities to use these skills.
The curriculum in STEM subjects is regularly linked to real world scenarios or issues highlighting the importance of STEM in our lives.
Cross-curricular work is common, and students are often given the opportunity to connect and apply their learning across STEM subjects through the curriculum.
The school provides opportunities for students to take part in longer term research activities, where the answer is not known to them.
Students can use their research, if they wish, to complete a project-based qualification or award as part of the school's standard offer.

Established

In STEM subjects procedural knowledge is valued and taught with ever more complexity overtime leading to the development of skills.
Students have the opportunity to use these skills in innovative ways, not only enhancing and enforcing curriculum learning but also the nature of STEM and research.
Where appropriate the curriculum in STEM subjects is set in a real-world context addressing key issues or highlighting the importance of STEM in our lives.
Students understand how STEM not only enables active citizenship but also empowers us all to directly address global and local issues.
Every opportunity is taken to work collaboratively across the curriculum to allow students to connect and apply their learning across STEM subjects.
The school's leadership team supports STEM leaders to work together and the curricula of different STEM subjects complement each other in terms of both intent and implementation.
There are opportunities for students to take part in long-term authentic research (where the answer is not known to them) at least once per year. The school is involved in external schemes or collaborates with partners to support student-led research.
Where long-term authentic research opportunities are not appropriate, the school provides students with an innovative, wide range of opportunities and activities related to research.
Students see themselves as producers of science rather than just consumers.
At different points in their schooling students can use their research to complete a range of project-based qualifications or awards at different levels.

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Ideas for developing
IRIS student-led research
in your school

1st year	2nd year	3rd year	4th year
Create a research club targeted at one of the following groups: • 11- to 14-year-olds • 14- to 16-year-olds • 16- to 18-year-olds Run an IRIS beginner project for younger students or IRIS intermediate project for older students. Tip: If looking for a beginner project, check out Carbon Researchers: www.researchinschools.org/projects Celebrate your students' research by presenting at an IRIS conference. Evaluate the impact of student-led research on participating students. Tip: Many schools find that partnering with a local university, business or STEM charity provides additional support and acts as a catalyst for student-led research.	Expand the number of research clubs on offer – adding one club for each age group. Ask returning students to expand their previous year's research, focusing on a particular element or question of interest. Tip: Once you've set up the research group, encourage older students to work together independently. They can use the school's login details to access project resources from IRIS without the need of a teacher or member of staff. Select one or two students who are interested in studying STEM after they leave school. Introduce them to original research and support them in carrying out an IRIS Original Research project. Check out IRIS' comprehensive Original Research Guide for students. As well as attending an IRIS conference, consider hosting an internal conference or getting students to present their artefacts at school events such as parents' evenings. Evaluate the impact of student-led research on participating students.	Continue running research clubs. Returning students will be experienced in research, so look at original research or more advanced projects. This could include partnering with a local university or business. Run a small-scale trial to encourage students to use their research as a basis for an extended project qualification (EPQ) or an accreditation scheme. Attend an IRIS conference, but also host your own. Invite members of the local STEM community to encourage students and staff to expand their research network. Evaluate the impact of student-led research on students. Tip: After three years of research, speak to your school leadership team about your ambitions for next year. It is important that you get buy-in and support at this stage.	Continue running research clubs. Where possible offer research opportunities to all students in sixth form, encouraging them to complete an extended project qualification (EPQ) or an accreditation scheme. Tip: Consider encouraging some students to apply for IRIS' Young Researcher High Potential Programme. Introduce student-led research projects as part of the curriculum. Create a staff research board by inviting staff from across STEM subjects to get involved in shaping the school's research offer. Evaluate the impact of student-led research on students.



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Recommended
resources and reading

Here are some recommended organisations, resources and reading materials to help you get started. We encourage you to explore the many other STEM organisations offering support and opportunities to schools.

The Institute for
Research in Schools

The Institute for Research in Schools (IRIS) develops opportunities for students aged 11 to 18 from all backgrounds to participate in authentic research while in school and make valuable contributions to the scientific community. IRIS offers a range of projects to schools, free of charge, as well as support for teachers and students, including meaningful encounters with STEM professionals.

For more information, visit:

www.researchinschools.org

Good Practical Science

Good Practical Science provides a framework for practical science in schools. Originally published in 2017 by the Gatsby Charitable Foundation, the report established ten good practical science benchmarks that schools can use to guide how they plan and deliver practical work. Benchmark 8 recommends that "students should have the opportunity to do open-ended and extended investigative projects".

For more information, visit:

www.bit.ly/IRIS_6

CREST Awards

CREST is a scheme that inspires young people aged 5 to 19 to think and behave like scientists and engineers by giving them the chance to take part in a student-led project. Students can embark on a project of their choice and receive a widely recognised award upon its completion. To support teachers, parents and students, CREST provides a wealth of resources on their website along with funding opportunities and grants open to a number of community settings and schools.

For more information, visit:

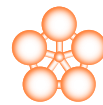
www.crestawards.org

Investigating Practical
Science in the Curriculum

The British Science Association (BSA), which manages the CREST Awards, has recently produced a free curriculum-based teaching resource called *Investigating Practical Science in the Curriculum: Making it Happen*. This resource has been developed to help re-engage students with practical learning and includes top tips, ideas and guidance for teachers to embed open-ended, extended investigative practical work into the secondary science curriculum.

For more information, visit:

www.bit.ly/IRIS_7



18 Recommended resources and reading continued

The Royal Society Partnership Grants

The Partnership Grants Scheme from the Royal Society offers schools up to £3,000 to run investigative STEM projects in partnership with STEM professionals from academia or industry. The scheme has been designed to provide opportunities for students to develop key skills, highlight the range of STEM careers available, foster long-term relationships between schools and STEM professionals, and addresses Benchmark 8 of the Gatsby Good Practical Science Benchmarks.

For more information, visit:

www.bit.ly/IRIS_8

Neon

Neon brings together engineering experiences and resources to help teachers inspire students and bring STEM to life with real-world examples of engineering. From inspiring case studies to helping schools, business, academia and industry to connect.

For more information, visit:

www.neonfutures.org.uk

STEM Crew

STEM Crew offers a range of resources to bring science to life and help make science teaching more engaging and exciting.

For more information, visit:

www.stemcrew.org

(Extended) Project qualifications

An EPQ (Extended Project Qualification) is a project-based qualification which is usually completed alongside A-levels and is worth between 8 and 28 UCAS points. It allows students to delve into a topic that they have an interest in and carry out a focused piece of research. Universities and apprenticeship providers view the EPQ as a great way for students to get ready for higher study and develop many of the skills that they will need at university.

The EPQ is offered by several examination boards, some of which also offer project qualifications at various levels to suite the age and ability of learners. Take a look at the following websites to find out more information about project qualifications:

Pearson – Project Qualifications:
www.bit.ly/IRIS_9

AQA – Project Qualifications:
www.bit.ly/IRIS_10

ASDAN – Extended Project Qualification:
www.bit.ly/IRIS_11

OCR – Project Qualifications:
www.bit.ly/IRIS_12

WJEC – Extended Project Qualification:
www.bit.ly/IRIS_13

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Museums

Museums are a great place to illustrate the nature of science. They highlight not only what we know but also what we don't know. They show first-hand that many of the innovations that were hailed as the next big thing were soon superseded or shown to be ineffective but still helped to contribute to our collective understanding of science.

Many museums have programmes and resources that help bring STEM to life and support teachers to make links between scientific knowledge and the real world.

Real World Science – this is a network of museums across the UK that use their collections to engage students with science. The network puts experts, role models, and scientists in contact with schools to support teacher training and CPD.

For more information, visit:

www.bit.ly/IRIS_14

Science Museum Group – The Science Museum Group's learning vision is to enrich lives by igniting curiosity in science. To do this they provide teachers, schools and community groups with a wealth of resources, from ideas of how to build science capital to learning resources including being able to explore museum collections in 3D.

The Science Museum Group also runs *The Academy* which delivers research-informed training and resources for teachers and STEM professionals.

For more information, visit:

www.learning.sciencemuseumgroup.org.uk



In2ScienceUK

In2scienceUK provides young people from disadvantaged backgrounds with the opportunity to take part in STEM placements, working alongside researchers and industry professionals to get hands-on STEM experience.

For more information, visit:

www.in2scienceuk.org

Skills Builder

Although not directly linked to student-led research, the Skills Builder Universal Framework is a great resource for teaching essential skills. The framework breaks each skill into steps supporting progress for students. Student-led research is a fantastic way to support students to develop and grow essential skills and Skills Builder allows that journey to be planned and monitored effectively.

For more information, visit:

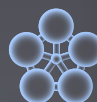
www.skillsbuilder.org

Nuffield Research Placements

Nuffield Research Placements are real-life research or development projects where Year 12 (or equivalent) students carry out a well-supervised but independent research project in STEM. This includes a placement at a host organisation.

For more information, visit:

www.stem.org.uk/nuffield-research-placements



Careers in Research & Innovation

Showing students, regardless of ability or background, the range of opportunities available to them in STEM after they leave school



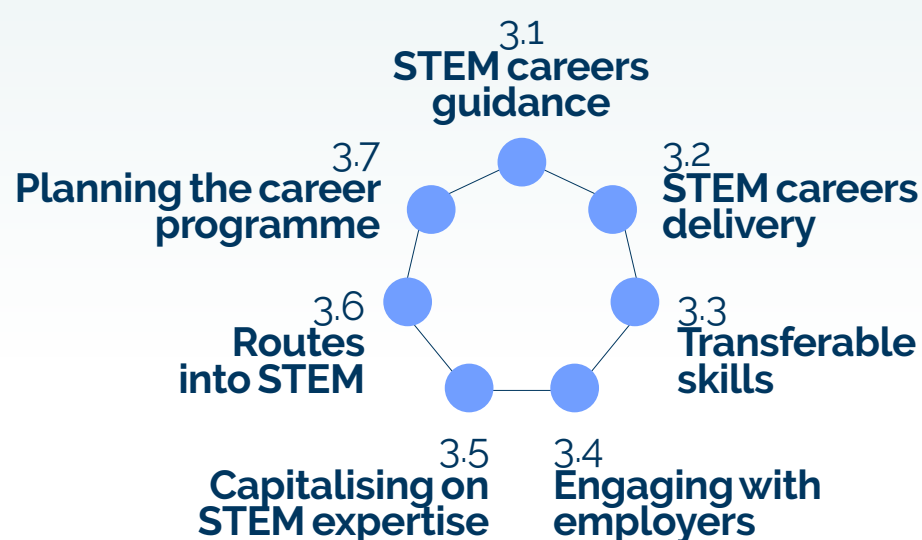
Good career guidance can be transformational for young people, particularly when it comes to raising awareness about careers in science, technology, engineering and maths.

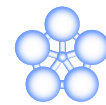
The Government has an ambitious vision to establish the UK as a 'science superpower' and the role of science and technology is becoming ever more prominent in the economy. This represents real opportunity for young people, particularly those from disadvantaged backgrounds or individuals from under-represented groups in STEM.

It is vital that, through an effective careers programme, all students are exposed to the opportunities available to them in STEM. Part of this work must be focused on breaking down the dominant societal representations of science as being hard or reserved for certain types of people. Good career guidance must illustrate the vast array of STEM careers while also ensuring that all students understand the different routes into STEM.

Theme 3 strand map

Careers in Research & Innovation provides a framework to help build an effective STEM careers programme and embed careers education into the curriculum and school life.





22 Careers in Research & Innovation

Every school is different and unique, this framework should be used as a reflective tool rather than a checklist. We encourage you to adapt it in a way that works best for your school.

Strands

Starting out

3.1 STEM careers guidance	The school's career education and guidance programme includes STEM-specific information.
3.2 STEM careers delivery	STEM career information and learning opportunities generally take the form of specific events such as themed days or assemblies.
3.3 Transferable skills	
3.4 Engaging with employers	Students have some opportunities to engage with employees and employers from the STEM community.
3.5 Capitalising on STEM expertise	The school is aware of what internal STEM careers expertise they have and staff collaborate to ensure STEM career information is accurate and appropriate.
3.6 Routes into STEM	Students and teachers are aware of some routes into STEM once they leave school.
3.7 Planning the career programme	STEM career opportunities in the local area are mentioned to students as part of the school's career events.

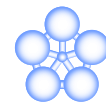
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Embedding

Established

STEM career information and guidance is well-integrated into the school's career strategy or has a separate strategy highlighting the importance of STEM.	STEM career information and guidance is well-integrated into the school's career strategy or has a separate strategy. It is supported by the school's leadership team, governors and community.
STEM career information and learning opportunities are accessed by a significant number of students and are routinely integrated into the wider school as well as specific events. For example; PSHE or careers curriculum time, assemblies, themed days, tutor time or enrichment.	STEM career information and learning opportunities are presented to all students and are well integrated into the school's STEM curriculum. Across the curriculum, teachers link learning with future opportunities in STEM and STEM careers.
STEM career information not only focuses on STEM specific jobs but also how STEM skills are important for non-STEM jobs.	The school's STEM career programmes enables all students to understand the wide range of jobs available to them in the STEM industry, including both STEM and non-STEM jobs. Students understand the importance of (and transferability of) STEM skills in their futures.
The majority of students have opportunities to engage with employees and employers from industry, academia and the wider STEM community. These meaningful encounters are with people from a diverse range of backgrounds to demonstrate that STEM is for all.	All students have multiple opportunities to engage with employees and employers from industry, academia and the wider STEM community. This includes first-hand experience of workplaces. Students are encouraged to take part in organised STEM placements. Meaningful encounters with people from a diverse range of backgrounds demonstrates that STEM is for all.
The school is aware of what internal STEM careers expertise they have and colleagues are supported in delivering STEM careers information including through use of external support.	The school continually supports teachers, through CPD and resource provision, to develop and maintain an up-to-date knowledge of STEM careers. This is often supplemented by the use of external support such as STEM career facilitators or links with local industry or academia.
Students and teachers are aware of STEM opportunities available through vocational routes such as apprenticeships and T-levels as well as A-levels and university degrees. Students are appropriately supported through all routes.	The school ensures that teachers, students, parents and carers are aware of STEM career opportunities through vocational routes such as apprenticeships and T-levels. Students are aware that they can earn a salary, gain work experience and achieve qualifications equivalent to a Bachelor's or a Master's degree through an apprenticeship.
STEM career opportunities in the local area are consistently highlighted to students through the school's career events and programme. Where possible, networks are built by introducing them to key employers in their area of interest. Students are taught the importance of networking.	The school's career programme is tailored to prepare students to take advantage of opportunities available to them within the local context. There is a series of planned events in the school year to build and develop student networks with local and regional employers in their career of choice. Students are able to apply their networking skills with future employers.



24 Reflection questions

Here we present a number of reflection questions targeted at teachers and school leaders. The questions can be asked in relation to both general career guidance as well as STEM specific guidance.

- What career guidance activities are happening, when are they happening and which students access them? Which students are not taking part in career guidance activities?
- Is career guidance centralised or are activities happening at the subject and departmental level? Is career information being incorporated into lessons?
- What CPD activities have taken place for staff to support them in delivering careers guidance? Are all staff aware of current best practice in relation to careers guidance?
- Are your current staff experienced in careers guidance? How can you draw on the experiences of existing staff, for example those who have entered teaching from industry?
- What impact has your school's career guidance had? What evidence of this is there? How has progression data (school leavers) changed?
- Has your school evaluated students' views on STEM careers? How has this changed over time?
- How many students have undertaken work experience? How does the school ensure that there is equity in the opportunities offered to students?
- How many encounters have students had with employers or employees? Which students have accessed these opportunities? Have these meaningful encounters been with individuals from a wide range of backgrounds?
- Do students have the opportunity to visit colleges, universities or other education providers such as apprenticeship centres? How many visits has each student been offered?
- Are all students taught about vocational routes such as apprenticeships? Are vocational qualifications and routes considered equal to traditional academic routes within your school?
- Do students get the opportunity to meet with a career guidance practitioner? How many opportunities do they get? Which students have accessed this opportunity? Which students have not met with a career guidance practitioner?
- Does your school exploit existing networks e.g. governors or parents, for the benefit of all students?



25 Recommended resources and reading

Here are some recommended organisations, resources and reading materials to help you get started. We encourage you to explore the many other STEM organisations offering support and opportunities to schools.

STEM Learning - STEM careers support for schools and colleges

STEM Learning have produced helpful resources for both careers and school leaders, as well as STEM teachers, to develop STEM careers guidance and information in their school.

For more information, visit:

www.bit.ly/IRIS_16

Useful resources for employers can be found here:

www.bit.ly/IRIS_17

Two resources that are particularly useful for STEM teachers are:

1. STEM Careers Toolkit for Careers Leaders:

www.bit.ly/IRIS_18

2. Teachers ' Guide – Linking Careers to the STEM Curriculum:

www.bit.ly/IRIS_19

Good Career Guidance

The Good Career Guidance report published in 2014 by the Gatsby Charitable Foundation identified 8 benchmarks of good career guidance. The benchmarks have been incorporated into the Government's Careers Strategy and form part of statutory guidance for schools and colleges.

For more information, visit:

www.bit.ly/IRIS_15



Community & Collaboration

Empowering students to address issues within their local community and working with industry to provide meaningful opportunities for all



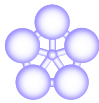
Empower students to collaborate with the community and local industry. A life changing experience, it shows them they can help us solve some of the most pressing issues at a local, national and global level.

The challenges of tomorrow can't be solved by one person alone. Collaboration is at the heart of true research and innovation, so we must instil the idea of community into our young students. We must demonstrate how, collectively, we can work together to find solutions. Research in schools is about empowering students to take informed action, giving them a voice which is recognised by their community.

Theme 4 strand map

Community & Collaboration encourages school leaders and teachers to work closely with their community, local employers, parents and caregivers to provide research and innovation opportunities for all. Through collaboration, students can help find solutions to both local and national issues.



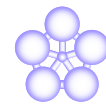


28 Community & Collaboration

Partnerships with industry, academia and the local community are a powerful tool to develop research and innovation in schools. Regardless of experience or starting points, we encourage schools and teachers to build networks and collaborate with the wider STEM community, particularly around research opportunities and social action. Remember, this framework should be used as a reflective tool rather than a checklist, adapt it in a way that works best for your school.

Strands	Starting out	Embedding	Established
4.1 Collaborating with other organisations	The school occasionally collaborates with STEM organisations including industry, academia and the charity sector to offer stand-alone events and opportunities to students.	The school regularly collaborates with STEM organisations including industry, academia and the charity sector to offer events and opportunities to students, parents and teachers.	The school has a strong history of collaboration and partnerships with STEM organisations and other schools. This network allows the school to offer a unique programme of STEM opportunities not only to students but also, on occasion, to the wider school community.
4.2 Partnering with industry and academia		Some students have the opportunity to partner with industry, academia or other individuals who can support them with a STEM project.	The school provides students with various opportunities to partner with industry, academia or other individuals who can support them with their STEM project.
4.3 Showcasing student work	Students are given the opportunity to showcase their STEM project or research findings with internal audiences at school events such as assemblies, parents' evenings and open evenings.	There is a culture of sharing STEM research or project work within the school. Students are given the opportunity to share their work with both internal and external audiences.	There is a strong culture of sharing and celebrating research. Students are encouraged to and supported in sharing their research findings with various networks and stakeholders.
4.4 Social action		Students are encouraged to use STEM research or project work to address an issue or problem within their school. This often involves an aspect of student-voice.	Students are empowered to use STEM research to take social action including to address local, real life issues within the school's community and the wider world.
4.5 Community engagement		Parents and carers are actively engaged in supporting and encouraging student research or project work.	Parents, carers and the local community are actively engaged in supporting and encouraging student research and project work. The community plays an important role in establishing networks to provide students with meaningful opportunities in STEM.





30 Recommended resources and reading

Here are some recommended organisations, resources and reading materials to help you get started. We encourage you to explore the many other STEM organisations offering support and opportunities to schools.

IRIS Conferences

Each year IRIS hosts a number of conferences across the UK, allowing students to share their research with their peers from other schools and the wider academic community.

For more information, visit:

www.researchinschools.org/conferences

Youth Social Action Toolkit

The Youth Social Action Toolkit has been designed to support young people to participate in social action. The toolkit has resources for young people and their families, employers, career coordinators, and educators. Research and evidence show that youth social action has a range of benefits to young people and can bring about real change within the community.

For more information, visit:

www.youth-social-action.careersandenterprise.co.uk

The Big Bang Fair

The Big Bang Fair is an annual celebration of STEM for young people. The event features theatre shows, hands-on activities, interactive workshops, excellent careers information and meaningful encounters with STEM professionals from a wide range of backgrounds.

The Big Bang Programmes also runs the annual Big Bang Competition and provides resources for online or in-person activities.

For more information, visit:

www.thebigbang.org.uk

Young Scientists Journal (YSJ)

The Young Scientists Journal is an international peer-reviewed science publication written, reviewed and produced by school students aged 12 to 20. The YSJ provides a place for young people to publish and share their scientific research.

For more information, visit:

www.ysjournal.com

31 Engaging your community

When families, communities, local services, businesses and schools work together to support young people, amazing things can happen.

From empowering young people to address and solve problems impacting the local community to providing opportunities for students to take part in unique work placements, here are some ideas of how to engage with your community:

1. Reach out to your school's existing stakeholders

Teachers, parents and governors have a wealth of untapped resources which exist within their personal and professional networks. Ask them to reach out to their networks and seek opportunities for the school to collaborate. From governors talking about their careers and offering work placements, to parents running masterclasses or mentoring students, there are many possibilities. It always helps to be clear on what you are looking for and to formalise the collaboration campaign with a leaflet or web page.

2. Work with your wider community

It is important to create connections within the local community. One of the best ways to do this is through community walks. With the support of students, create a campaign asking local residents to suggest ideas for how the school and students can support the wider community. Explore how the community can reconnect, collaborate and share their experience, skills and time to make a difference to your young people. Get students to write to local businesses and universities asking to work together. Go out into the community and hand deliver these leaflets and letters. It provides a great chance for the community to meet students and staff.



3. Connect the curriculum with the community

Ensuring students have a strong foundation of knowledge is incredibly important, however, it doesn't need to be learnt in isolation from the real world. Young people must understand the relevance in what they are learning. This can be done by linking knowledge to the local context. For example, by inviting community partners who are subject matter experts to speak to students.

Community collaboration can also be a powerful tool for teachers. Subject experts from industry and academia can provide CPD to teachers, ensuring that their subject knowledge is current and up-to-date.

Case study Students drive green policy

For the past few years, Ladies' College Guernsey has been taking part in Carbon Researchers. In this project, students calculate and consider their schools' carbon footprint and devise a strategy to reduce it. After a positive response from the school, they decided to organise a climate strike with young people across Guernsey to encourage other schools to develop their own carbon reduction plan. They even met with ministers from local government. They expanded their research project to work with local businesses, industry and government to reduce Guernsey's carbon footprint.

Capturing Talent & Removing Barriers

Proactively challenging established stereotypes and misconceptions in STEM, building science capital for all and creating a culture of openness and inclusivity



As practitioners, we must understand the barriers that prevent participation in STEM. Only then can we change our practice to truly reflect a vision of STEM for all.

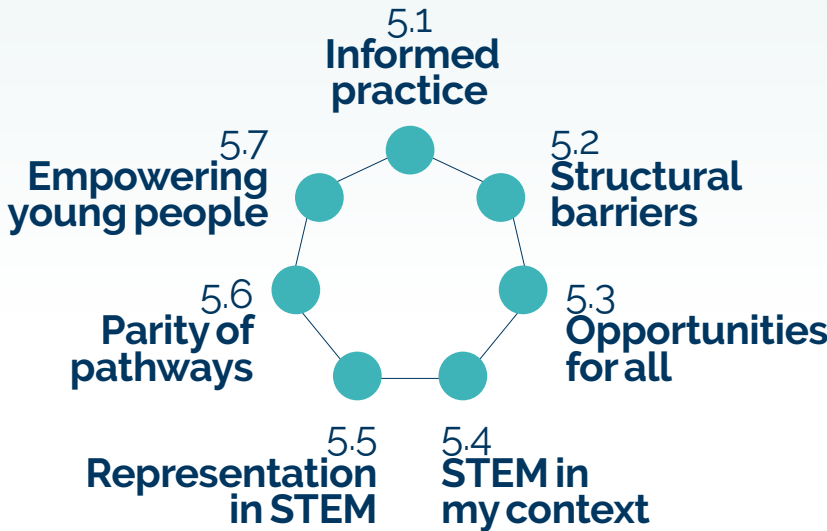


For many young people in school, there are still significant barriers to engagement in STEM, meaning that their views and attitudes towards STEM are unlikely to change without a shift in approach from educators. Thanks to research, we now have an evidence-based understanding of engagement issues along with effective tools and strategies to help breakdown barriers and capture talent.

Teachers, school leaders and the wider STEM community must accept that an effective STEM education is based on more than knowledge acquisition. Schools must build science capital, challenge the negative dominant societal representations of science, establish and promote equitable pathways into STEM and empower students to become active participants in science.

Theme 5 strand map

Capturing Talent & Removing Barriers supports educators at all levels to proactively challenge damaging stereotypes and misconceptions in STEM. The theme focuses on building science capital for all and creating a culture of openness and inclusivity in relation to science, technology, engineering and maths.



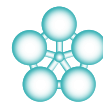


34 Capturing Talent & Removing Barriers

Every school is different and unique, this framework should be used as a reflective tool rather than a checklist. We encourage you to adapt it in a way that works best for your school.

Strands	Starting out	Embedding	Established
5.1 Informed practice	The school is aware of the major barriers that prevent young people, particularly those from historically excluded groups, from becoming engaged and involved in STEM. As a result, the school employs some strategies to overcome these barriers.	The school demonstrates a strong understanding of the barriers preventing its students from engaging in STEM, including those from historically excluded groups. The school has a robust approach to overcoming these barriers ensuring that STEM is open to all students.	The school has a strong understanding of the barriers that prevent its students from engaging in STEM and seeing STEM as a possible future career path. This is particularly true for those students from historically excluded groups in STEM. In response, the school is strategic and innovative in its approach to demonstrate that STEM is for all and to breakdown barriers to ensure that STEM is accessible and equitable. The school's approach is research-led.
5.2 Structural barriers		The school is aware of how its own systems, structure and routines, may inadvertently reduce equity of and participation in STEM e.g. extremely high entry requirements or the selective nature of triple science courses. There are some strategies to address these issues in order to show that science is for all.	The school is proactive in identifying and changing any structural inequalities in their STEM provision or practices which perpetuate dominant educational and social representations of science e.g. science being 'masculine' or reserved for those who are 'clever' or 'science-y'.
5.3 Opportunities for all	Opportunities to take part in a range of STEM extra-curricular activities or informal science learning are available to some students.	Opportunities to take part in a range of STEM extra-curricular activities or informal science learning are available to most students.	Opportunities to take part in a range of STEM extra-curricular activities or informal science learning are available to every student. Significant thought is given to the barriers that some students face in attending such activities, and steps are taken to mitigate or remove these barriers.
5.4 STEM in my context		The school works with students to help them recognise how their existing skills, knowledge and experiences are related to STEM.	The school works with students to help them recognise how their existing skills, knowledge and experiences are related to, and useful in, STEM.
5.5 Representation in STEM	The school understands the importance of representation and some efforts are made to organise meaningful encounters that expose students to individuals from a range different backgrounds who work in STEM.	Positive STEM role models from a diverse range of backgrounds are often shared with students. This happens both in curriculum time as well as extra-curricular activities and may include meaningful encounters as well as case studies or video profiles.	Significant efforts are made to share role models from a diverse range of backgrounds with students. Extensive use is made of opportunities to engage with a range of STEM professionals, in addition to case studies or video profiles of those working in STEM. The school makes every effort to also show role models who took a range of routes into STEM.
5.6 Parity of pathways	Teachers and Senior Leaders are aware of both vocational and academic pathways. There is an awareness of the opportunities offered by vocational pathways, for example degree level apprenticeships, and these are discussed with some students.	Students have a strong understanding of vocational and academic pathways. The opportunities offered by vocational pathways, for example degree level apprenticeships, are discussed with most students. There is recognition that vocational pathways may be suitable for students of all abilities.	Where appropriate, parity is given by teachers and leaders to vocational and academic pathways. The opportunities offered by vocational pathways (for example degree level apprenticeships) are discussed with all students; there is recognition that such pathways may be suitable for a wide range of students. The school engages with organisations to provide students with knowledge and opportunities linked to vocational pathways.
5.7 Empowering young people	There are systems in place to allow students to express their views about the school's STEM provision.	Student voice is highly valued within the school and carefully considered when evaluating and planning its STEM provision.	The school empowers students to take ownership and become decision makers in relation to the school's STEM provision.

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36 Recommended resources and reading

Here are some recommended organisations, resources and reading materials to help you get started. We encourage you to explore the many other STEM organisations offering support and opportunities to schools.

The YESTEM Project & Equity Compass Tool

Youth Equity + STEM (YESTEM) brings together researchers and practitioners to develop practices and tools that support equitable youth pathways into STEM.

For more information, visit:

www.yestem.org

As part of this project, the YESTEM team have developed the Equity Compass: a tool for supporting socially just practice. The Equity Compass has been designed to help practitioners ensure that STEM provision is equitable and socially just. It is a fantastic reflective tool which ensures that any action is with participants rather than being done to or for them.

For more information about the Equity Compass or to download the tool click here:

www.yestem.org/tools

STEM Ambassador Programme

The STEM Ambassador Programme from STEM Learning has over 37,000 volunteers across the UK. These volunteers come into school either virtually or face to face, free of charge and help to bring STEM to life. STEM Ambassadors make an impact by supporting learning, illuminating careers and raising aspirations.

More information about the STEM Ambassador Programme can be found here:

www.stem.org.uk/stem-ambassadors

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ASPIRES

Whether you are a specialist STEM teacher or a school leader without a STEM background, we highly recommend reading the ASPIRES study. For over ten years ASPIRES, a mixed-methods study at UCL, has been investigating how young people form ideas around STEM. The project has led to key observations on what shapes young people's science identities, aspirations and their level of engagement in STEM. ASPIRES provides a strong evidence base to help teachers and education leaders to gain a clear understanding of the problem in order to address it.

Read more about the ASPIRES Research Study here:

www.bit.ly/IRIS_1

Click here to download the phase one ASPIRES project summary report:

www.bit.ly/IRIS_2

Click here to download the phase two ASPIRES project summary report:

www.bit.ly/IRIS_3

Science capital

We know that having a good teacher is one of the leading reasons, along with practical work, that students enjoy science. There are, however, many students who do not see science as important or accessible to them. Historically, we have focused on making STEM fun but evidence is now clear that we need to make it more relevant. The Enterprising Science project has looked at how teachers and schools can develop the science capital of young people and therefore change their perception of science.

For more information, visit:

www.bit.ly/IRIS_4



The Institute for
Research in Schools



Chemistry for All

The Royal Society of Chemistry carried out a five-year research and outreach study to investigate the barriers to participation in post-16 UK chemistry education. The report identified barriers across 4 main themes and found that such barriers could be overcome through purposeful and carefully planned intervention.

Chemistry for all also recommends a number of steps that outreach providers, policymakers, educators and parents can all take to overcome the barriers that prevent young people from pursuing a career and further study in chemistry.

Click here to access Chemistry for All from the Royal Society of Chemistry:

www.rsc.li/3566fha

Stemettes

Stemettes is a social enterprise working to inspire the next generation of young women and young non-binary people to enter STEM. Through a range of programmes, Stemettes demonstrates the diversity of people already in STEM, showing the next generation that girls do STEM too.

Click here to find out more:

www.stemettes.org



The Institute for
Research in Schools

39 Notes

Top tip

When developing a culture of research and innovation, it is important to get the buy-in and support of school leadership. This could involve sharing the benefits of an improved STEM culture with governors or members of the school leadership team, as well as demonstrating the need for change based on the evaluation of your schools' current STEM ethos and provision.

VISION

Prioritise & Plan

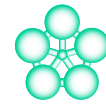
Implement

Monitor & Measure

Evaluate

Alongside the publication of the R&I Framework, IRIS has produced a range of tools to support with self-evaluation, improvement planning, and impact evaluation. These tools and guides include a self-assessment toolkit, student and teacher questionnaires, action plans and much more. For more information or to download these resources visit:

www.researchinschools.org/framework

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