`

STEM: The Case for Action

The business case for investing in STEM skills in Coastal West Sussex

Final Report May 2018

Contents

Executive Summary:

This report sets out the business case for investing in science, technology, engineering and maths (STEM) skills. It proposes the steps to develop an inspiring STEM skills outreach programme that builds commitment from businesses and stakeholders, including the Local Enterprise Partnership, local authorities, universities and other education providers.

The aim of the *STEM: Making the Case* programme

Our aim is to create a strong and inspiring business case to lever further commitment, investment and engagement in targeted STEM skills activities in coastal West Sussex and across the county. The Business Case will build awareness of the need to invest in an evolving STEM programme. It is not about duplication or taking control of the agenda but about building momentum and strengthening key messages that need to be shared with stakeholders, young people, parents and education institutions

Our STEM programme will:

- Pinpoint the areas where intervention will have the most impact, recognising the extensive range of potential activities.
- Help to co-ordinate and build on the wide range of STEM activities already being delivered, nationally and locally, without duplicating them.
- Identify any gaps and learn from good practice so that investment can be targeted effectively.
- Clarify and agree with partners the criteria for investment and involvement in STEM activities.
- Develop high level messages for active communication to selected audiences by different stakeholders.

Our rationale for intervention

A greatly improved performance on STEM skills is required if we are to achieve our ambition for the coastal economy to match the performance of the wider region. The Coastal West Sussex economy has many technology-intensive businesses which need these skills but our research[1] shows that the local workforce is less highly skilled than that of surrounding areas. This affects our area's economic performance as well as our ability to support expanding businesses and compete for inward investment with other more highly skilled areas. Lack of STEM skills also means many of our residents miss out on the proven economic rewards that high-skills, high-value STEM jobs bring.

What the evidence tells us

We have analysed a wide range of international, national and local data and secondary sources and we have found that

- The UK produces a similar percentage of STEM graduates compared to the leading European nations, apart from Germany. However, our graduate supply is weighted in favour of more academic STEM subjects, such as science and maths, rather than more commercially-orientated subjects such as engineering and construction.
- A major issue is one of STEM skills mismatch: e.g. too many bioscientists and not enough technicians as well as graduates without the right technical knowledge and practical skills.
- Although mismatches are the primary issue, there are also STEM skills shortages, particularly in engineering, the medical professions and IT.
- At the local level, we are well-served for STEM HE provision, although low HE participation rates in many localities are a cause for concern.
- STEM graduate retention is rising locally but employers still report STEM skills shortages.
- Intermediate and technical STEM skills are also in short supply in many occupations and industries in coastal West Sussex. As STEM workers are less likely to receive training than workers in general, this indicates that intervention will be needed.
- STEM apprenticeships are rising in our area but numbers are still probably insufficient, either to meet demand for new entrants to the labour market or to upskill the existing workforce.
- STEM A Level participation is declining and gender differences are particularly marked: males outnumber females significantly in West Sussex in all subjects except biological sciences.

[1] **N.B. The full data and references to sources are contained in the main report**

What influences STEM take-up?

Although most young people have high career aspirations, only 15% aspire to become a scientist and aspirations are often set by the age of ten. This is not to do with how much they like science – most young people report enjoying it. The most important factor is the amount of "science capital" a family has, for example, understanding of, and interest in, science or family members in STEM occupations.

Awareness of the breadth of STEM careers is low among young people and science is seen as leading only to a job as a scientist, science teacher or doctor. The prevalent view is that scientists are "brainy" and that, unless they are high performers, they are not clever enough. Students are most likely to continue with STEM subjects if they are encouraged to do so by family member or teacher, they are well-taught and they understand that science is a springboard to a rewarding career.

Our 10-point agenda for change

1. Aspirations are formed early **so intervention at age ten or earlier is likely to be crucial** and should include key messages such as:
   a) the breadth of career opportunities in STEM: studying science does not automatically equal becoming a scientist – it keeps options open.
   b) there is a substantial payback in terms of earnings and job satisfaction.
   c) STEM is not just the preserve of the super intelligent; middle achievers can have successful careers in STEM.

2. **Building "science capital" in families** is as important as awareness and inspiring interest in students. Parents and families are a key audience and particularly those with low science capital. Activities to reach out to them and build science capital will be a key part of the strategy.

3. **Gender, socio-economic and ethnic inequalities** are deep seated and should be challenged. Girls' aspirations are particularly low and need to be addressed with specific activities, particular those girls who aspire to traditional gender roles. Their lack of confidence is exacerbated by what they see as masculine subjects.

4. Young people need opportunities to understand **the breadth of STEM careers** available. Whilst we are unable to change the curriculum to embed STEM careers advice from an early stage, real-life careers activities and meaningful work experience can help.

5. Actions to increase **STEM participation in Higher Education** should be targeted on local communities with low HE participation rates – there are too many of these in West Sussex.

6. **Skills mismatches** e.g. graduates without the right skills and knowledge, could be reduced by greater local employer and HE/FE engagement. Graduate and undergraduate placement schemes could help to decrease skills mismatches and increase STEM graduate retention.

7. Action to address **skills shortages** should focus on occupations where they are most acute. Local anecdotal evidence supports national research that these are many of the engineering professions and some IT occupations. Research into the local job market would help to pinpoint areas and target activities. Helping employers to forecast skills needs better could help to pre-empt future skills shortages arising.

8. **Intermediate and technical STEM skills** are also reported as being in short supply yet STEM workers receive less training. Supporting employers to encourage upskilling and progression will be vital.

9. Although **STEM apprenticeships** are on the rise in West Sussex, numbers are still relatively small, particularly in relation to the size of manufacturing and other STEM-intensive industries in West Sussex. Helping employers to take-on apprentices is a top priority.

10. The decline in **STEM A-level** participation is of concern. West Sussex underperforms nationally in terms of STEM A Level take-up. Activities should focus on the schools that would benefit most from more engagement.

What can we do about it?

Although there are a lot of national STEM-related initiatives our research indicates that much of them are aimed at CPD for teachers while local activity, including well known events such as local STEMfest and Big Bang, are aimed largely at general student audiences. Important though these are, the evidence suggests that they are not addressing all parts of the STEM pipeline.

Our research indicates that that there is room for targeted initiatives to fill gaps and this is where we intend to focus our efforts. Partners agree that better co-ordination across activities will enable us to build on what works well and avoid duplication.

Our areas of focus

The range of possible areas of intervention is very broad, ranging from pre-school to adults in the workforce and across a range of STEM skills levels, subjects and occupations. A targeted, co-ordinated and evidence-based approach will deliver greater success. As a result of our analysis and work with partners, our areas of focus have been agreed as:

- **Parents and families:** the research confirms that parents have a major influence on young people's aspirations and career choices. We should target activities on families that have lower levels of "science capital".

- **Young people:** targeting young people from primary school through to A level and into further and higher education while supporting them with well-informed career choices will encourage take-up of STEM subjects and STEM careers. We will focus on the "middle 30%" who are the more average performers at school and less likely to see themselves as scientists.

- **Girls**: gender inequalities are stark in our area and there seems to be a gap in provision tailored to their needs.

- **Schools**: Focusing on those schools which would benefit most from more engagement, extending proven activities and supporting more school - industry links to supplement STEM CPD for teachers.

- **Signposting and co-ordination**: there is a confusing array of activities being delivered nationally and locally. Helping employers, parents, teachers and young people to navigate what is available could be highly effective.

- **Communicating and messaging**: developing clear and succinct messages for the different audiences e.g. parents, employers, teachers, young people, and encouraging a shared partner communications strategy will maximise impact in a crowded marketplace.

- **Future focussed**: Working with employers and sector organisations on foresighting the STEM skills of tomorrow so that STEM education and training provision is future-proofed.

- **Active partnership**: Coastal West Sussex Partnership is prepared to take an active role in putting the STEM message across and encouraging other partners to engage and collaborate e.g. West Sussex County Council, Coast to Capital, the Careers and Enterprise Company, the Enterprise Advisers Network, Colleges, Universities, employers and business organisations.

Our investment criteria

To avoid duplication, maximise investment and get the best value for money we will apply the following criteria to any action before it is agreed:

- Does it fall within our areas of focus?
- Is there a demonstrable gap or market failure?
- Are we confident that it will not duplicate what is already taking place?
- Have we consulted our partners and worked with them to co-design the best solutions?
- Additionality: will it happen anyway? What will happen if we don't do it? Can it be achieved in other ways?
- Will it have an impact on what we are trying to achieve and will that impact be low, medium or high?
- How much will it cost and will it provide value for money?
- Has it proved to be effective previously or elsewhere?

1. Introduction

1.1. Coastal West Sussex Partnership brings together businesses and public sector leaders to work on issues that affect the local economy. A leading priority is raising the educational aspiration of young people and improving the skills of the current and future workforce.

1.2. In the knowledge-based economy, the demand for science, technology, engineering and maths (STEM) skills continues to rise. The Coastal West Sussex economy has many technology-intensive businesses which need these skills but our research2 shows that the local workforce is less highly skilled than that of surrounding areas. This affects our area's economic performance and our ability to compete for inward investment with other areas. We also need to prepare for a possible increase in STEM skills shortages when we leave the European Union, for example, in technology-intensive horticulture, a major industry along the coast, which is highly dependent on migrant labour.

1.3. Ambitions require translation into action and this report contains the business case for investing in STEM skills. It sets out the steps we will take to develop an inspiring STEM skills outreach programme that builds commitment from businesses and stakeholders, including the Local Enterprise Partnership, local authorities, universities and other education providers.

2. The aim of the STEM: The Case for Action report

2.1. The aim of the *STEM: The Case for Action* report is to create a strong and inspiringbusiness case to lever further investment and engagement in targeted STEM skills projects in coastal West Sussex and across West Sussex as a whole. The business case will raise the profile and build awareness of the need to invest an evolving STEM programme that responds to the changing needs of the workplace. It is not about duplication or taking control of the agenda but about building momentum and strengthening key messages to be shared with stakeholders, young people, parents and education institutions.

2.2. Our inspirational STEM programme will:

- Pinpoint the areas where our intervention will have the most impact, recognising the extensive range of potential activities.
- Help to co-ordinate and build on the wide range of STEM activities already being delivered, nationally and locally, without duplicating them.
- Identify any gaps and learn from good practice so that investment can be targeted effectively.
- Clarify and agree with partners the criteria for investment and involvement in STEM activities.
- Develop high level messages for active communication to selected audiences by different stakeholders.

[22] Coastal West Sussex Economic Profile February 2018 TBC

3. Our rationale for intervention

3.1. A greatly improved performance on STEM skills is required if we are to achieve our ambition for the coastal economy to match the performance of the wider region. The Coastal West Sussex economy has many technology-intensive businesses which need these skills but our research shows that the local workforce is less highly skilled than that of surrounding areas. There are both mismatches and shortages in the supply of STEM skills, young people are not following STEM subjects and careers in sufficient numbers, STEM graduates may not have the right skills and employers may need additional support to upskill their STEM workforces.

3.2. Although there is a high level of commitment and effort by local partners as well as a wide range of activities aimed at increasing STEM skills take-up and supply locally, the scale of the task is such that there is still much more to be done. The evidence suggests that there are market failures in both STEM skills learning and skills supply due to:

- The messages not getting across to young people about the value of STEM subjects, the breadth of careers and the scale of rewards of following STEM subjects at school and into further and higher education.
- The lack of information that parents have about STEM opportunities for their children, particularly in low science capital families.
- The attractiveness of incentives to employers to train their current workforces; although the new apprenticeships subsidies may help, they may not be taken up by SMEs in sufficient numbers for a variety of reasons.
- There may be weak demand for STEM graduates among employers, though STEM graduate retention seems to have been improving locally.
- There are skills mismatches in the supply of STEM graduates; the problem is not insufficient graduates but graduates with the wrong sort of skills.
- At national level, government tend to focus on CPD for teachers and enriching the learner experience which are important, but do not address all the failures in the STEM skills supply chain. There may also be a need to link teachers with industry to supplement the STEM CPD available.
- There is a lack of co-ordination of STEM promotional activity, nationally and locally.
- Anecdotal evidence suggests there is an acute shortage of STEM teachers in Coastal West Sussex.

3.3. Our aims are realistic; although we cannot solve all of these issues, we can influence some of them. At the local level, we can have an impact on the quality and effectiveness of STEM skills communications to address market failures; the co-ordination of initiatives, filling of gaps and the engagement of employers, drawing on the good practice of our partners. If we can communicate clearly where we think the market failures lie, and encourage more joint working among partners, we can help to increase the effectiveness and reach of current activities.

4. STEM skills: the national picture

The national picture: key points

- The UK appears to be producing a similar percentage of STEM graduates compared to the leading European nations, apart from Germany.
- The UK's STEM graduate supply is weighted towards more academic STEM subjects such as science and maths rather than more practically-based subjects such as engineering and construction.
- At least 40% of STEM graduates are not in a STEM job six months after graduating.
- There is a difference between skills shortages and skills mismatches. The main problem appears to be skills mismatches;(e.g. too many biological scientists, not enough technicians) and problems of quality, e.g. graduates do not have the right technical knowledge and/or skills.
- There are, however, some actual skills shortages, for example, across a range of engineering occupations and specialisms and in the medical professions.
- Demand for intermediate STEM skills is also rising rapidly. At the intermediate skills level, (Levels 2 and 3) are declining in the workforce.
- Apprenticeships in STEM subjects are rising and make up just over 22% of total apprenticeships but there is some evidence that the rises are in subjects where there is already oversupply.
- 44% of apprenticeship starts are over 25 years of age which indicates that apprenticeships are being used by employers to upskill their workforces,
- STEM A Level take up is falling nationally and the most significant loss is in those taking at least one maths or science A Level.
- The number of STEM teachers has stagnated since 2010 while pupil numbers have continued to grow.

4.1. The National Audit Office (NAO) has recently produced a report[3] on the Government's approach to STEM skills which notes the need to achieve higher productivity in a time of rapid technological change, to which STEM skills are seen to hold a large part of the answer. The NAO also draws attention to: "*the widely held belief that one of the UK's key economic problems is a shortage of STEM skills in the workforce*." However, it concludes that many of these problems are likely to be due to skills mismatches and problems of quality rather than quantity.

4.2. The NAO report points out that Government does not gather information on STEM skills in a robust and systematic way, particularly since the demise of the UK Commission for Employment and Skills in 2017. It also says that STEM initiatives are not sufficiently co-ordinated and that Government has no consistent definition of STEM skills and STEM jobs, hampering its ability to develop effective, targeted solutions.

[3] "Delivering STEM (science, technology, engineering and mathematics) skills for the economy" National Audit Office 17 January 2018

How does the UK perform on the supply of STEM graduates?

4.3. Figure 1 shows the distribution of STEM versus non-STEM graduates in the best performing ten countries of the 28 countries in the European Union. The UK comes 9th on this measure, above the EU average

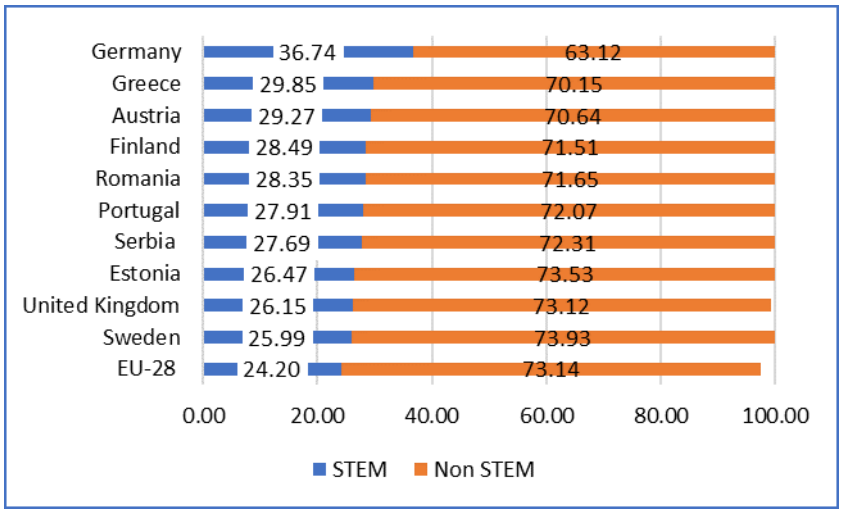

Figure 1. Distribution of STEM and non-STEM graduates in the top ten performing nations for STEM graduates in the EU 28 in 2015
Source: Eurostat/CWSP

4.4. Out of the top four largest economies in the EU28, the UK comes second (Figure 2).At headline level, the UK appears to be doing reasonably well in the proportion of STEM graduates it produces, though nowhere near as well as Germany.

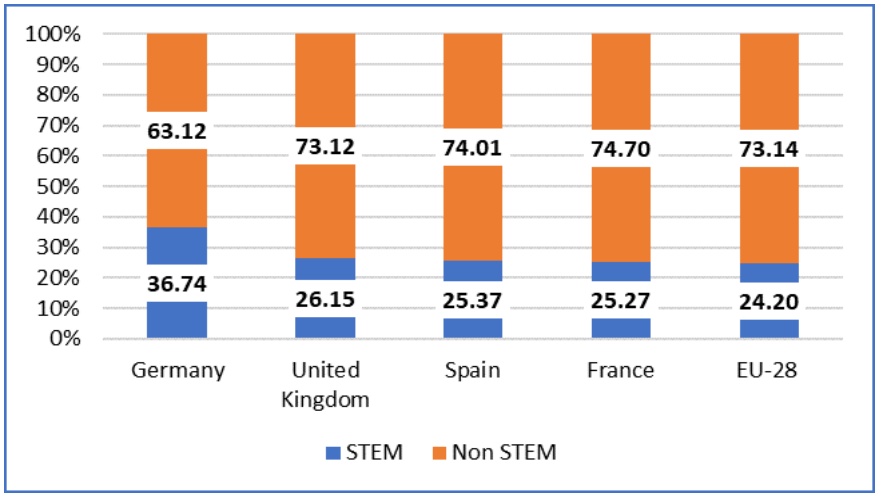

Figure 2. Distribution of STEM and non-STEM graduates in the four largest economies in the EU 28 in 2015.
Source: Eurostat/CWSP

.

4.5. When broken down to broad subject level, the UK produces the highest percentage of Science, Maths and ICT graduates but one of the lowest percentages of Engineering, Manufacturing and Construction graduates in the EU 28 (Figure 3). It appears that the UK, is very good at producing graduates at the more academic end of the STEM spectrum, at least in terms of quantity, but perhaps less good at the more commercially-orientated subjects. By contrast, Germany is exceptionally good at both.

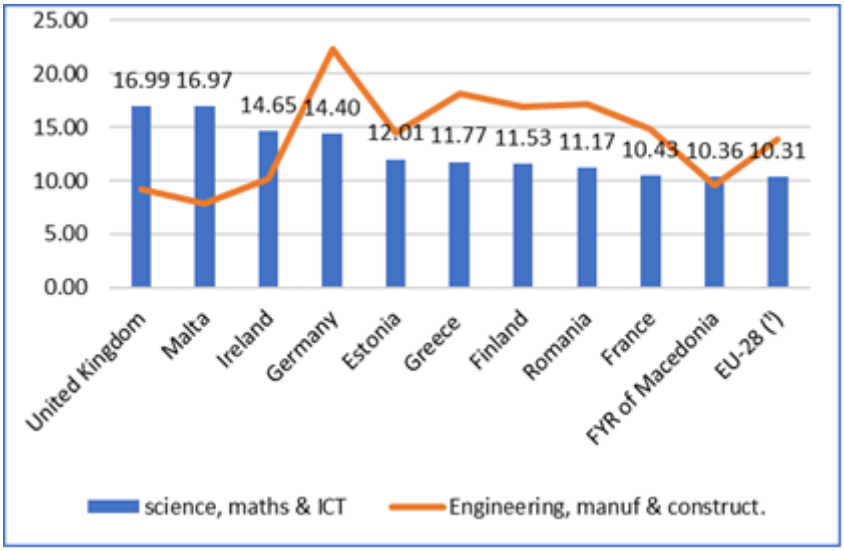

Figure 3 Top 10 countries for %age of graduates in Science, Maths, Statistics and ICT overlaid with % age of graduates in Engineering, Manufacturing and Construction in 2015.

UK STEM skills: mismatches or shortages?

4.6. This may be one of the reasons that UK skills mismatches occur between what degrees graduates have and what employers are looking for and why vacancies are hard-to-fill. Again, data is not plentiful or consistently collected but:

- 43% of vacancies for professionals working in science, research, engineering and technology were hard to fill (UK Commission for Employment and Skills (UKCES) 2013)[4]. 76% of skills shortages were due to lack of technical, practical, job specific or advanced IT skills.
- Of those firms seeking to recruit technology specialists, 42% stated that some or all of these positions had been hard-to-fill. Of the businesses identifying skills gaps within their technology workforce, 96% stated that missing key technical skills was a problem (the Tech Partnership[5]).
- The Engineering Employers' Federation estimates that a third of manufacturers cannot find the skill they need within the UK labour market[6].

[4] Source. *"Employer Skills Survey 2013"* UKCES. Later data is not available. UKCES was closed down in 2017 and its responsibilities transferred to DFE. DfE have yet to produce any new reports.

[5] "Employer Skills Survey 2015" The Tech Partnership

[6] "EEF response to MAC call for evidence on EEA workers in the UK labour market" EEF

4.7. The evidence would seem to suggest that it is not a shortage of graduates *per se* but a shortage of graduates in the right subjects and with the right skills. UKCES research concludes that[7]:

- STEM skills issues are not the same across the economy; there are pockets of STEM skills shortages in certain occupational areas and some industries.
- Degrees may not have the right technical content or enough hands-on laboratory experience with up-to-date equipment.
- There are insufficient well-rounded candidates with broader competencies such as team work.
- There is a lot of leakage: only 24% of 75,000 people who graduated in 2016 with a STEM degree were known to be working in a STEM occupation within six months. Although 20% of the cohort's destinations are unknown and 18% go on to further study, this still leaves 38% known to be not employed in STEM occupations[8].

4.8. It seems that the higher education system may not be producing enough of the right types of candidates to meet STEM demand and, at the same time, demand is rapidly evolving requiring more complex skills due to:

- Converging technologies, blurring of sector boundaries and rising demand for cross-disciplinary skills e.g. natural sciences, informatics and creative technologies.
- Digitalisation of production digital manufacturing requires design, simulation, data analytics, materials technology, etc.
- Disruptive technologies such as AI, big data and, potentially, quantum computing require new and multifaceted skills.
- New business paradigms such as "networks of orchestrators", are leading to slimmed down core businesses plus outsourcing and flexible employment models. These require team working across organisations and often, geographies.

UK STEM graduate skills shortages

4.9. Although skills mismatches appear to be the major issue, the evidence suggests there are also actual shortages of some graduates, e.g. engineers, possibly as a result of the bias towards maths and science in our supply of graduates. The Engineering Employment Federation highlights skills shortages and this is borne out by the Home Office skills shortage list which lists the following skills shortage occupations:[9]

- Civil, mechanical, electronics and electrical engineers.
- Design and development engineers.
- Production and process engineers.
- Quality control and planning engineers.

[7] "Employer Skills Survey 2015" UKCES

[8] This may not be true across all STEM subjects. For example, an Engineering UK report "*The State of Engineering 2017*" states that 70% of engineering graduates enter engineering occupations, dispelling previous concerns that most graduates are being lost to other sectors.

[9] "Immigration rules: skills shortage occupations list" Home Office updated January 2018

- Engineering geologists.
- Engineering technicians.
- Aircraft certifying engineers and technicians.

4.10. Engineering related skills shortage occupations make up the majority of the Home Office list. Other STEM occupations on the list are:

- IT specialist managers, business analysts, systems designers, programme and software development professionals.
- Medical practitioners including radiographers and paramedics.
- Artists and graphic designers are required but only those with skills in 2D and 3D animation.

UK STEM intermediate and lower level skills

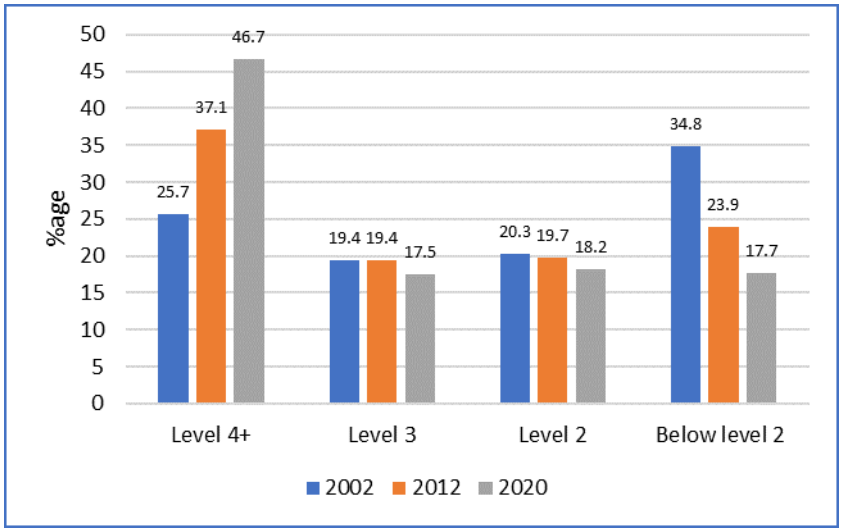

Figure 4: Percentage of UK Qualifications at Levels 4, 3, 2 and below
Source: Labour Force Survey/CWSP

4.11. The trends shaping demand for more complex STEM skills sets at higher level are also driving up demand at intermediate and lower levels and this is increasingly evident across all sectors including services. Large proportions of workers in some STEM occupations do not hold a degree. For example, less than a third of electrical engineers, quality control and planning engineers are graduates[10] and fewer than half of electronics engineers and mechanical engineers hold a degree level qualification or higher. At the intermediate occupational level, associate professional and technical workers are even less likely to hold a degree. Although this is not a static situation and skills levels are rising across the workforce, they are increasing less quickly at NVQ Levels 2 and 3, the intermediate and technical skills levels (Figure 4) which is where demand is growing for technicians and associate professionals.

[10] "Reviewing the requirements for high level STEM skills" UKCES 2015

National STEM apprenticeship performance

4.12. Apprenticeships are the Government's flagship training programme and the recently introduced apprenticeship levy on large firms with a payroll of over £3m per annum together with up to 90% grant funding for SMEs is expected to significantly boost take-up. The National Employer Skills Survey 2016 found that the number of organisations offering apprenticeships was expected to rise from 31% to 59% in next two years. However, STEM starts in England were down 25% in quarter 1 of 2017/18 compared to the same quarter the previous year, following a decline of 2.3% in the previous year as a whole.

4.13. The level of many apprenticeships may be too low to meet rising STEM skills demand. The majority of starts (57%) were at Level 2, 38% were advanced or Level 3 (equivalent to A Level) and the remaining 5% were higher level, degree and above and there may not be sufficient starts in STEM subject areas. Of the 509,400 apprenticeship starts in 2015/16, 22.6% were in STEM subjects made up as follows[11]:

- Engineering and Manufacturing Technology: 77,000 (15.3%)
- Construction, Planning and Built Environment: 21,000 (4.1%)
- Information and Communication Technology: 16,000 (3.2%)

National STEM A Level performance

4.14. In England, the number of students taking A levels has risen by 22% since 2009 to 326,687 in 2016 /17. However, the percentage taking one or more maths or science subjects has fallen from 39% to 36.2% over the period[12]. (Figure 5). The most significant loss has been in those taking at least one maths or science A level which is concerning when the requirement for STEM skills is permeating the majority of sectors and occupations.

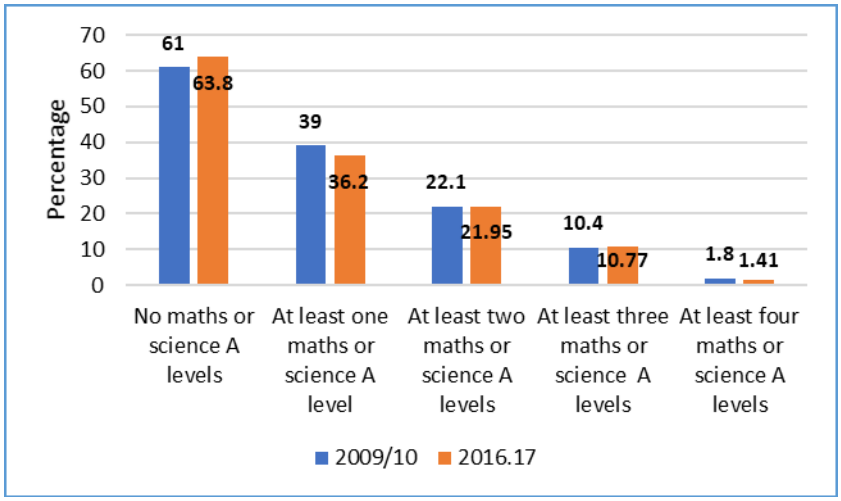

Figure 5: Percentage of pupils taking maths and science A Levels in England in 2009/10 and 2016/17
Source: DFE A Level Statistics

[11] FE data library- apprenticeships
[12] DfE statistics A level and other 16-18 results: 2016/17 (provisional) Maths and Science Tables SFR59 2017

5. STEM Skills: the local picture

- The local picture: key points:
- There is a wide variety of STEM HE provision available from local universities.
- There is some evidence that STEM graduate retention rates are rising, particularly in Brighton & Hove and West Sussex which have outperformed London.
- Local HE participation rates are poor in parts of Coastal West Sussex with many areas in the bottom quintile nationally.
- West Sussex Apprenticeship STEM starts have fallen recently. STEM subjects make up just 20% of all apprenticeships and may not be sufficient.
- A Levels: the number of students taking STEM A levels in West Sussex has declined across all subjects between 2012/13 and 2015/16, particularly those taking maths.
- There is a mixed performance across our educational institutions when it comes to STEM A Levels. The national rankings show 40% of our schools and colleges were in the top 40% based on the proportion of grades A*-B, whilst a third of institutions were in the bottom 20%.
- Gender differences in A Level subjects studied in West Sussex are quite marked with females outnumbering males only in biological sciences, while males outnumber females in mathematics, chemistry and physics.

5.1. Graduate data is not easy to come by at local level so we do not know how many STEM graduates our local universities are producing and precisely how many of them are being retained in the area. However, Coast to Capital's analysis of HESA data[13], although somewhat out of date, since it refers to graduates from 2012/13, found an increasing number of graduates were finding work locally, particularly those from STEM subjects, with a retention rate of 51.6% in 2012/13 compared to 43% for all graduates. Both Brighton and Hove and West Sussex were ahead of Greater London.

Local HE participation rates

5.2. However, local participation rates in HE in Coastal West Sussex are poor in many areas. Figure 6 shows how likely 15 year olds are to have entered higher education by the age of 19 and many areas in Coastal West Sussex are in the bottom quintile shown by the red areas in spite of the presence of three local universities, the Universities of Brighton, Sussex and Chichester.

[13] "Economic Assessment 2016" Coast to Capital

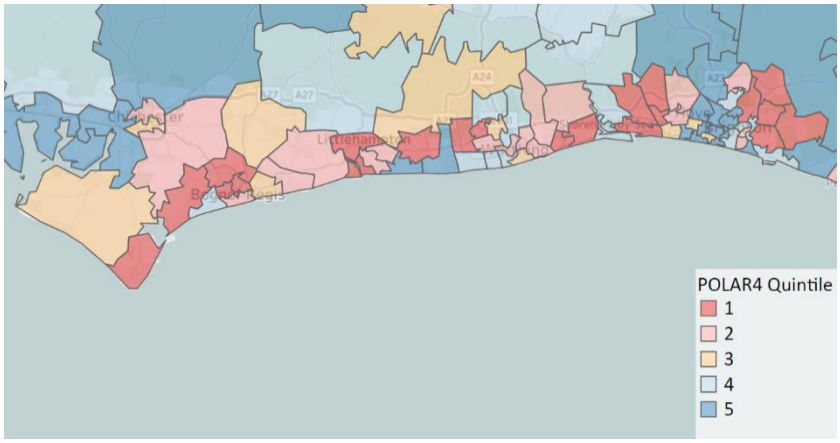

Figure 6: Proportion of young people (15 year olds) who entered HE by the age of 19 during the 2009-10 to 2014-15 academic years
Source: Higher Education Funding Council for England

STEM Apprenticeships in West Sussex

5.3. In terms of apprenticeships, there is reasonably good data available on starts by subject at county level. Table 1 shows the starts by subject in West Sussex by subject level. The number of starts stayed the same in 2016/17 (5,790)(compared to the previous year[14]. In STEM subject starts: *Construction, Planning & Built Environment* and *Engineering & Manufacturing Technologies,* have increased by 38.46% and 25.71% respectively while ICT has increased by 9%.

Subject Sector Area	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	%age +/-
Agriculture, Horticulture	80	70	100	100	130	110	37.50
Arts, Media and Publishing	10	20	10	20	30	20	100.0
Business, Administration & Law	1660	1450	1160	1520	1260	1410	-15.06
Construction, Planning, Built Environment	130	150	150	160	190	180	38.46
Education and Training	50	30	30	20	30	30	-40.00
Engineering & Manufacturing Technologies	700	810	740	630	1070	880	25.71
Health, Public Services &Care	1290	1540	1230	1580	1710	1890	46.51
ICT	110	100	110	110	140	120	9.09
Leisure, Travel, Tourism	300	230	190	220	240	180	-40.00
Retail & Commercial Enterprise	1180	1210	1100	1030	1000	970	-17.80
Science & Maths	0	10	0	10	0	0	0.00

Table 1: Apprenticeship starts by subject in West Sussex between 2011 and 2017 Source; Department for Education

5.4. However, the STEM subjects make up just under 20% of total apprenticeship starts locally, lower than their percentage nationally of 22.6%.Figure 7 shows the numerical starts in 2011/12 and 2016/17 in West Sussex. The largest growth has been in *Health, Public Services & Care* (46.51%). Figure 8 shows the percentage share of starts by subject in West Sussex in 2016/17.

[14] Source ESFA 2018

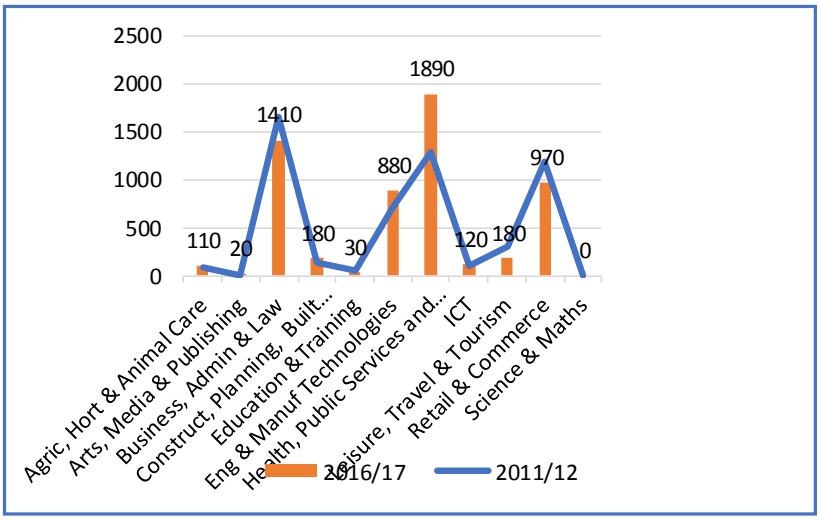

Figure 7: No.s of Apprenticeship starts in West Sussex in 2016/17 and 2011/12.
Source: Department for Education

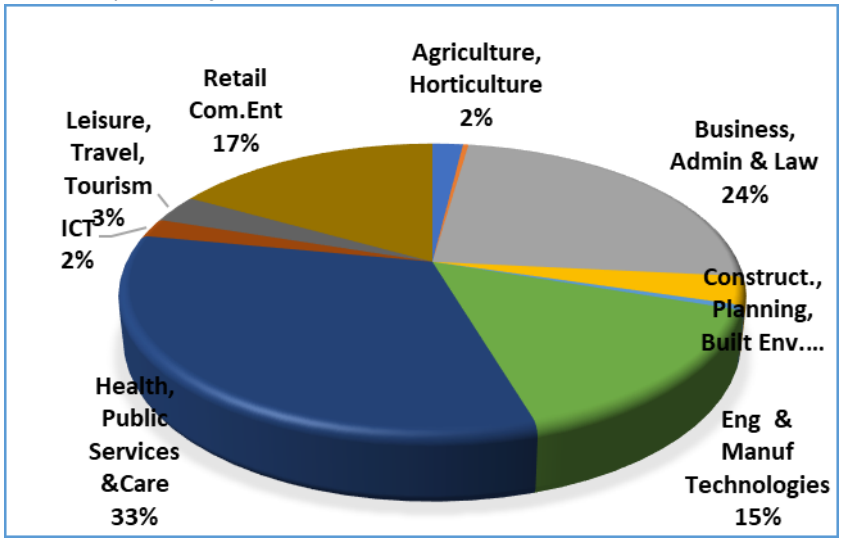

Figure 8: Percentage share of apprenticeship starts by subject in West Sussex 2016/17
Source: Department for Education

STEM A Levels in West Sussex

5.5. Educational Institutions are ranked nationally by STEM A level performance based on the proportion of all A Level grades achieved which are grades A* - B in STEM subjects. The data shows that of the 35 institutions for which data is available in our area, 7 (20%) were in top quintile, 7 (20%) in the second quintile and 9 were in the third quintile of the 2,500 schools and colleges in the rankings. It is a variable position across the county although much will depend on type of institution, intake, catchment areas and other factors.

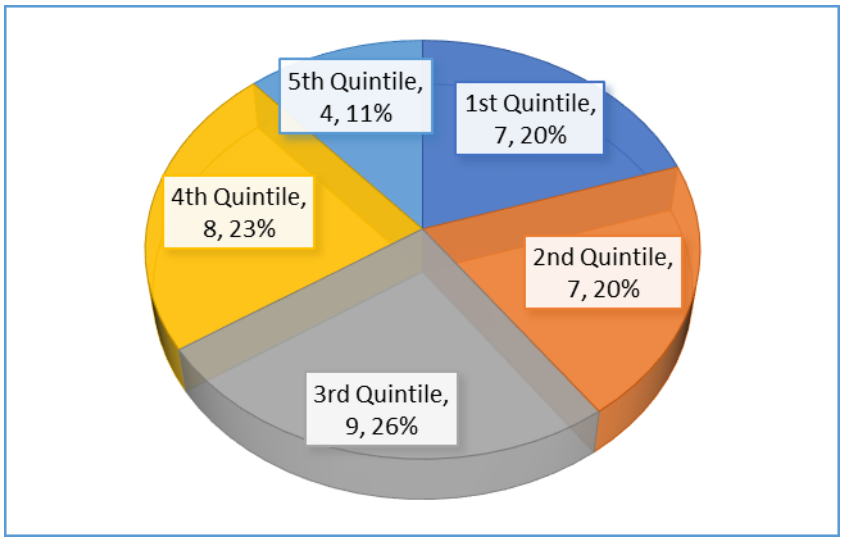

Figure 9: West Sussex secondary schools and colleges in West Sussex positions in the national STEM rankings.
Source Your Life – the Department for Education

5.6. There are some clear gender differences in our area in STEM A level subjects studied. Figure 10 shows the median percentage for males and females entering STEM A Levels by subject in West Sussex. Males are more heavily represented than females in all subjects except biological sciences.

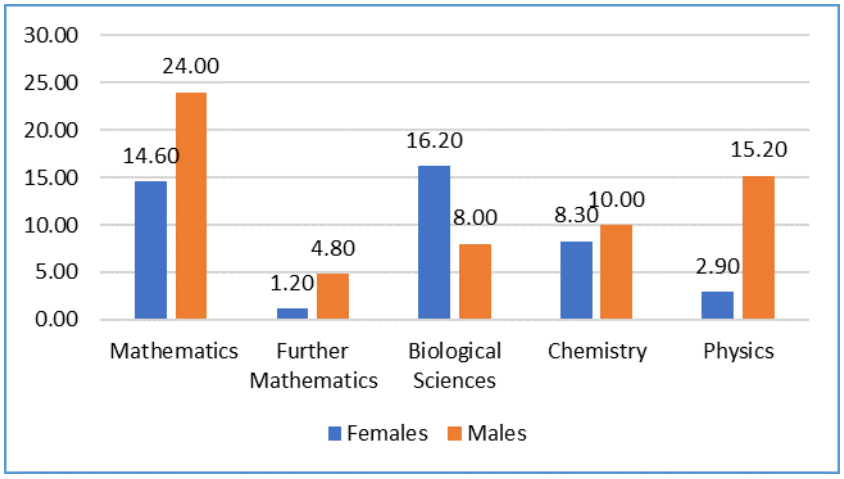

Figure10: Median percentage of students entered for STEM A levels by subject and gender in West Sussex in 2015/16
Source DfE Maths and science data 2017 table 13b/CWSP

6. What influences young people's STEM take-up?

What influences STEM take-up: key points

- Young people's aspirations are generally high but very few aspire to a career in science.
- In spite of liking science, most (60%) would prefer a career in business.
- Decisions are heavily influenced by families and the level of "science capital" in a family.
- Young people also think scientists are "brainy" and that they are not clever enough.
- Good teaching has a key role to play in building confidence, shaping aspirations and continuing with STEM studies at 16 plus.

6.1. If we want to make a difference to the take up of STEM subjects and STEM careers in West Sussex we need to understand what influences young people's decisions. The ASPIRES study[15] looked at how children aged 10 to 14 and their parents develop science and careers aspirations. This large scale longitudinal study found:

- Although most young people aged 10 to 14 hold high aspirations for professional, managerial and technical careers, very few – 15% - aspire to become a scientist.
- The aspiration to become a scientist is consistently low across the age range and is disproportionate to their interest in science. Most students report liking science from year 6 to year 9 and 42% would like to study more science.
- Of the STEM careers, medicine is a more popular aspiration (35%) but most students (nearly 60%) would prefer a career in business. (Figure 11).

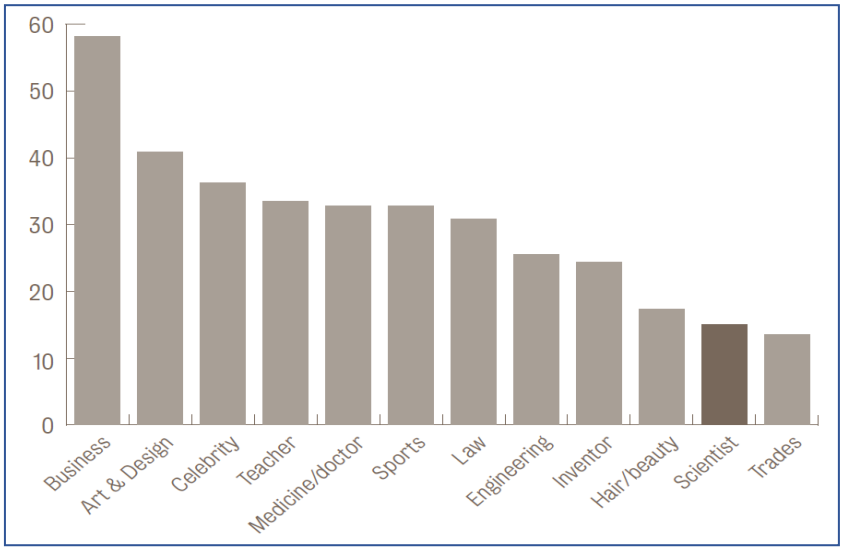

Figure 11. Percentage of year 9 students agreeing they would like this job
Source: Aspires: Young people's science and careers aspirations age 10-14" King's College London

[15] "Aspires: Young people's science and careers aspirations age 10-14" King's College London

Families and science-capital

6.2. Families exert considerable influence on students' aspirations. The most significant factor affecting the likelihood of a student aspiring to a science related career is the amount of science capital a family has, including: science qualifications in the family, understanding and knowledge about science, and social contacts with people in a science related job.

6.3. Science capital is unevenly spread across social groups and is more prevalent in middle class homes. Those students with low science capital backgrounds who do not have science related aspirations at 10 are unlikely to develop them by 14.

6.4. Because of the widespread lack of science capital in families, awareness of the breadth of opportunities for science in career terms is low. Science jobs are typically seen as only leading to jobs as a scientist, science teacher or doctor. They are also unaware of the payback on STEM subjects, for example that an A level in mathematics can enhance lifetime earnings by 10% or more.

Image of scientists and science

6.5. The prevalent view among young people is that scientists are "brainy" and this can lead to young people thinking that they are not clever enough. It also tends to be seen as a male and/or Asian profession and a student is least likely to see science as a career if she is female. Among thirteen year olds, 18% of boys and 12% of girls aspire to science as a career. Science aspirations are particularly precarious among black students. However, the number aspiring to engineering is higher at around 28%.

16 plus aspirations and influences

6.6. The UPMAP study[16] looked at the factors that caused students to continue with mathematics or physics post 16. It found that students are more likely to continue with mathematics and/or physics if:

- They have been encouraged to do so by a key adult – either a family member who believes in the worth of these subjects, or a teacher.
- They believe they will gain from studying the subject in terms or job satisfaction or material rewards such as a good salary.
- They are good at the subject and can show they understand it in depth.
- They have been well-taught.

6.7. Inspiring teaching clearly has a role to play. As already noted, there is a wide range of STEM related CPD for teachers available from primary level upwards. However, teachers may not have sufficient industry experience to understand the breadth of STEM careers available or the payback for continuing with STEM studies.

[16] "UPMAP: understanding participation rates in post-16 mathematics and physics" University College London

7. Current STEM initiatives, activities and gaps

7.1. The National Audit Office audited STEM skills initiatives[17] and found that between 2007 and 2017, the Government spent around £990 million on improving STEM skills and has recently announced further initiatives including substantial reforms to technical education as well as changes to apprenticeships and skills funding. As previously noted, the NAO has highlighted the lack of a clear definition of STEM skills as well as of rigorous data collection and that there is not a coherent approach to initiatives across departments.

7.2. We have looked at national initiatives and found that they tend to focus on CPD for teachers and pupil enrichment activities which is commendable but may not address all the issues. These include amongst others:

- A high number of STEM schools-based initiatives and resources to help with triple science and maths and physics.
- The STEM inspiration programme which aims to increase engagement and raise aspirations from primary school to 19 years of age. It includes the STEM ambassadors scheme.
- The National STEM Learning Centre which is an online resource for teachers with a wide range of support for activities including setting up STEM clubs.
- Science Learning Partnerships which deliver CPD to schools and provide support to increase the take up of triple science.

7.3. At the local level, STEM Sussex, the outreach support department at the University of Brighton, carried out a mapping exercise covering their own activities as well as those provided by the University of Chichester and the University of Brighton. The results were subsequently interpreted in a separate report produced by Nairne[18]. It found that:

- There were over 64 events in the 15 months between October 15 and December 2016 including the Universities' own events, STEMfest and Big Bang events along with the STEM ambassadors programme.
- Some were generic STEM events while others had a specific focus across a wide range of subjects.
- Target audiences for many of the events were either not stated or were very open, although some were focused on particular stages. Only two had a gender focus.
- There was not much evidence of co-ordination across the events, with the exception of BigBang programme which is delivered locally by STEM Sussex through Engineering UK.
- Participation by schools in STEM events was high with 100% of West Sussex schools surveyed taking part. However, the numbers of individual students' participating in West Sussex was lower than in West Sussex. West Sussex students were the most likely to participate in Big Bang events.

[17] "*Delivering STEM (science, technology, engineering and mathematics) skills for the economy*" National Audit Office 17 January 2018
[18] "*Co-ordinating STEM activity in Sussex*" Nairne May 2017

- Over three quarters of schools surveyed participated in the STEM ambassadors programme. STEM clubs were also much in evidence with two thirds of schools having at least one. There was however only one STEM club aimed at girls.

7.4. Whilst the mapping data was incomplete, it seems to suggest that:
- At a local level, more co-ordination and more strategic targeting of activities at particular problem areas is indicated by our research.
- There appear to be gaps in terms of activities aimed at girls and at families to build science capital.

7.5. The University of Chichester also provided evidence for the data collection exercise. Their team of four works with up to 60 schools covering a wide area including the Isle of Wight, Portsmouth, West Sussex and Crawley. Key lessons learned:
- They find themed events are successful e.g. Space, building on Tim Peak appeal,
- They work from nursery and primary school up and also engage the parents.
- They carry out community activities and reach out to those students who would not consider university.
- They find that STEM initiatives work best when integrated into wider schools outreach programme.
- There are different target markets in each school and therefore the approach was individualised.

7.6. We conclude that what is needed is co-ordinated action that identifies and fill gaps in the STEM pathway rather than duplicate what is already being done. Our model of the STEM pathway is illustrated in Figure 12 below.

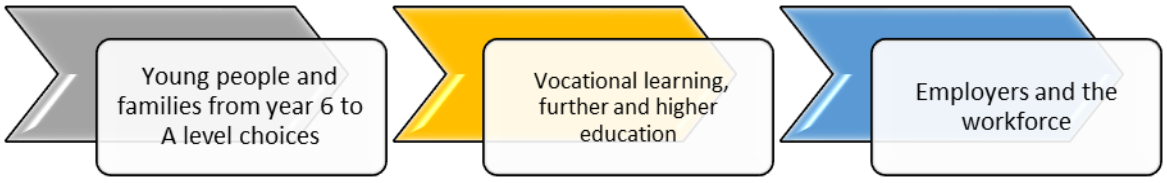

Figure 12: The STEM pathway from early education to the workforce.

8. Our ten point agenda for change

8.1. Aspirations are formed early so intervention at age ten or earlier is likely to be crucial and should include key messages such as:

a) the breadth of career opportunities in STEM: studying science does not automatically equal becoming a scientist – it keeps options open.

b) there is a substantial payback in terms of earnings and job satisfaction.

c) STEM is not just the preserve of the super intelligent; middle achievers can have successful careers in STEM.

8.2. Building "science capital" in families is as important as raising awareness and inspiring interest in students. Activities to reach out to them and build science capital will be a key part of our strategy.

8.3. Gender, socio-economic and ethnic inequalities are deep seated and have to be challenged. Many girls' aspirations are low and need to be addressed with specific activities, particular those girls who aspire to traditional gender roles. Their lack of confidence is exacerbated by what they see as masculine subjects.

8.4. Young people need opportunities to understand the breadth of STEM careers available. Whilst we are unable to change the curriculum to embed STEM careers advice from an early stage, meaningful work experience can help.

8.5. Actions to increase STEM participation in Higher Education should be targeted on local communities with low HE participation rates

8.6. Skills mismatches e.g. graduates without the right skills and knowledge, could be reduced by greater local employer and HE/FE engagement. Graduate and undergraduate placement schemes could help to decrease skills mismatches and increase STEM graduate retention.

8.7. Action to address skills shortages should focus on occupations where they are most acute. Research suggests these are many of the engineering professions and some IT occupations. Research into the local job market and helping employers to forecast skills needs better could help to pre-empt future skills shortages arising.

8.8. Intermediate and technical STEM skills are also reported as being in short supply yet current workers in STEM related occupations receive less training. Supporting employers to encourage upskilling and progression will be vital.

8.9. Although STEM apprenticeships are on the rise in West Sussex, numbers are still relatively small, particularly in relation to the size of manufacturing and other STEM-intensive industries in West Sussex. Helping employers to take-on apprentices is a top priority.

8.10 The decline in STEM A-level participation is of concern. West Sussex underperforms nationally in terms of STEM A Level take-up. Activities should focus on the underperforming schools in the bottom 40% of the national league tables for STEM A Levels.

9. Our areas of focus

9.1. The range of possible areas of intervention is very broad, ranging from pre-school to adults in the workforce and across a range of STEM skills levels, subjects and occupations. A targeted, co-ordinated and evidence-based approach will deliver greater success. As a result of the analysis, discussions with stakeholders and the consultation workshop, our areas of focus have been agreed as:

- Parents and families: the research confirms that parents have a major influence on young people's aspirations and career choices and there is scope to do more to engage them. We should target our activities on families that have lower levels of "science capital".

- Young people: targeting young people from the younger age groups through to A level and further and higher education and career choices to encourage more STEM take up. We will focus on the "middle 30%" who are the more average performers at school and less likely to see themselves as scientists. This will require "seeding the messages" all the way along the decision pathway.

- Girls: gender inequalities are stark in our area and there seems to be a gap in provision tailored to their needs.

- Schools: working with those partners already working in schools to extend activities, being sensitive to the aims of each school and their target groups as well as supporting more opportunities for teachers to gain direct experience of industry and understand STEM careers.

- Signposting and co-ordination: there is a confusing array of activities being delivered nationally and locally. Helping employers, teachers, parents and young people to navigate what is available could be highly effective.

- Communicating and messaging: developing clear and succinct messages for the different audiences e.g. parents, employers, teachers, young people and encouraging a joint approach to using them will maximise impact in a crowded marketplace.

- Future focussed: Working with employers and sector organisations on foresighting the STEM skills of tomorrow so that training is appropriate.

- Active partnership: Coastal West Sussex Partnership can take an active, coordinating role in putting the STEM message across and encouraging other partners to engage and collaborate e.g. West Sussex County Council, Coast to Capital, the Careers and Enterprise Company, Enterprise Advisors Network, Colleges, Universities, employers and business organisations.

10. Our investment criteria

10.1 To avoid duplication, maximise investment and get the best value for money we will apply the following criteria to any action before it is agreed:

- Does it fall within our areas of focus?
- Is there a demonstrable gap or market failure?
- Are we confident that it will not duplicate what is already taking place?
- Have we consulted our partners to co-design the best solutions?
- Additionality: will it happen anyway? What will happen if we don't do it?
- Will it have an impact on what we are trying to achieve and will that impact be low, medium or high?
- How much will it cost and will it provide value for money?
- Has it proved to be effective previously or elsewhere?

11. . Action plan

Children, young people and families	
Current state	**Ideal state**
• Children's attitudes towards STEM and STEM careers are set by the age of 10 and there are low levels of awareness regarding how valuable and interesting STEM careers can be and that STEM does not just lead to being a scientist. • Families are the biggest influence at this stage but low science capital families are unlikely to produce children with STEM careers aspirations. Parents lack understanding of the breadth of STEM careers and the rewards that they bring.	• Families and young children are aware of the range and breadth of STEM careers and the potential pay back in terms of job satisfaction and earnings – *it is not just being a scientist.* • Children's aspirations reflect the reality of the broad range of opportunities available in STEM.
High level priorities for action	
CYP&F 1. Develop key and consistent messages aimed specifically at low science capital families and younger children and girls. A focus group will be set up including industry representatives as well as learning providers and marketing/ PR expertise to develop the messages. These will be kept simple and locally relevant.	
CYP&F2. Develop a programme of communication activities, including case studies, family events, visits, social media etc. to put the messages across. This will require a carefully designed and externally commissioned PR campaign to get the messages across. It must be strongly linked to existing careers information to be effective.	
CYP&F 3. Gather evidence of changes in attitudes. Evaluation processes will be included in the PR campaign to measure awareness and understanding of the key messages before, during and after delivery.	

STEM higher qualifications, further and higher education	
Current state	**Ideal state**
• STEM A Level and higher qualification participation and results are variable among schools and colleges locally and girls are underrepresented in all subjects apart from biological sciences at A Level. • Teachers have a wide range of STEM CPD available to them but they may still lack real industry experience and understanding. • Education partners are focusing increasingly on STEM skills and local apprenticeship provision is increasing, for example, at the Advanced Engineering Centre at Bognor Regis. • STEM apprenticeship numbers are still small compared to the scale of local demand and workforce skills at intermediate level are low. • Although local HE STEM provision is plentiful and increasing, levels of HE participation are low in too many areas of Coastal West Sussex.	• There are no local schools in the bottom quintile of the national STEM rankings and girls equal boys in A Level and higher qualifications take up in all STEM subjects. • Teachers have opportunities to engage with industry and develop understanding of STEM in the workplace and the range of STEM careers. • The number of STEM apprenticeships is making a significant impact on workforce skills, particularly at intermediate and higher levels. • Local STEM HE participation increases in all areas across Coastal West Sussex but particularly in underperforming areas.
High level priorities for action	
HQFE&HE 1. Develop a targeted programme of work to increase STEM A Level and higher qualification participation in those schools and colleges that would most benefit from engagement, building on existing work by partners and activities that are known to work.	
HQFE&HE 2. Fully understand the range of CPD available to teachers locally through national and local research. Identify the gaps and develop interventions such as teacher industry visits/placements.	
HQFE&HE 3. Ensure apprenticeship advice is available to young people to find STEM apprenticeships locally, working with existing partners such as Sussex Learning Network to extend the help already available.	
HQFE&HE 4. Develop case studies to promote local STEM apprentice success stories to young people and use social media to promote them. Use young people who have benefited from STEM apprenticeships as ambassadors.	
HQFE&HE 5. Develop a programme to extend access to STEM education and careers opportunities through a variety of routes.	
HQFE&HE 6. Work with universities to extend outreach activities to more local communities where STEM HE access is low.	

Employers and the workforce	
Current state	**Ideal state**
• The evidence suggests there are skills shortages at local level, particularly in advanced manufacturing, engineering and IT. • There are also skills mismatches with graduates not having the right sort of skills such as technical, practical skills or softer skills such as team working. • Employers are often unsure how to go about taking on apprentices or using apprenticeships for workers and are unaware of local provision and support. • STEM graduate retention rates are rising but there is scope for further improvement. • Employer engagement can be highly effective in encouraging more STEM labour market entrants but is patchy locally. • Intermediate STEM skills gaps are a key issue locally and STEM workers are less likely to receive training than workers in general.	• Demand for STEM skills is filled, including intermediate and higher level skills, and hard-to-fill vacancies decrease significantly. • Businesses can expand using local workforce skills and reduce dependence on skills from outside the area. • Employers' have high awareness of what is on offer. Large employers use their levy and smaller employers take up subsidies, particularly for STEM apprenticeships. • Employer engagement with education and learning providers and students is encouraging more local entrants to STEM careers and there is a network of employer ambassadors. • Inward investors can get the STEM skills they need and increased numbers locate here.
High level priorities for action	
E&TW 1. Carry out further research into the local job market and STEM skills shortages and mismatches to inform activities using live vacancy data from partners and interviews with employers in key STEM sectors as well as working with sector organisations such as METTALL and WSGA.	
E&TW 2. Encourage and support more employer-engagement in STEM provision to make sure graduates are job ready, building on work by universities.	
E&TW 3. Develop more STEM-specific graduate and undergraduate placement schemes to decrease skills mismatches and increase STEM graduate retention locally.	
E&TW 4. Develop a network of employer STEM ambassadors, targeting specific companies using the Companies House data for Coastal West Sussex. Use already-engaged employers to recruit new ambassadors to work with education and learning providers and young people to raise aspirations, increase understanding and encourage take up of STEM subjects and careers.	
E&TW 5. Encourage and support more employers to use higher apprenticeships and degree apprenticeships to upskill their people and address intermediate STEM skills gaps.	
E&TW 6. Help SMEs to access the apprenticeship subsidy for STEM apprenticeships and use it effectively	