The Sector Skills Council for Science, Engineering and Manufacturing Technologies

Bioscience Sector Skills Agreement

Stage 2: EXECUTIVE SUMMARY

Assessment of Current Provision

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EXECUTIVE SUMMARY

This report analyses in considerable detail all aspects of learning provision relating to the skills of importance for the Bioscience sector. In particular, the report documents:

- The Scope of learning provider use and quality;
- Higher Education provision;
- Vocational Education and Training;
- Relevant Learning Provision in Schools (Secondary and Primary Education);
- Learning provision for the Bioscience Clusters around the United Kingdom;

and concludes with an overall assessment of provision.

In a sector where Skills shortages and gaps are higher than in other sectors:

- The number of universities offering Bioscience-related subjects is declining;
- The number of first degrees gained in Bioscience-related subjects has declined over the last six years: by 27% in Biological Sciences and by 23% in Chemistry;
- Only a small minority of the graduates in these relevant subjects enter the Bioscience industry or go onto higher degrees in the subject;
- Only 5% of all the higher educational qualifications achieved in 2006 were in the sciences relevant to the Bioscience sector; and
- The take up of Foundations Degrees, HNC/Ds and BTEC National Certificates is low and there may be opportunities to expand capacity in this area to increase the number of technicians coming into the industry by this route.

Section 1: The Bioscience Sector and SSA Methodology

The Bioscience Sector Skills Agreement covers the following elements:

- Research based pharmaceutical companies that discover, develop, market and distribute medication and drugs;
- Research and development in pharmaceutical manufacturing companies;
- Bioscience companies that are a spin-off from universities;
- The application of bioscience to produce innovative medicines, therapeutics and devices;
- The application of bioscience for the processing and production of materials i.e. the use of bioscience in engineering industries. This currently *excludes* agricultural bio-technology and bioscience that is for the processing and production of chemicals and energy; and
- Research and experimental development in bioscience.

The Bioscience sector is estimated to have some 50,000-55,000 employees.

The Sector's profile can be seen from analysis of the Semta Labour Market Survey sample:

Sites by region/nation and sub-sector

	Sector					Total
Region/nation	Pharma-ceutical R&D	Contract Research Organisation	Medical Devices or Diagnostics	Biopharmaceutical R&D/medical biotechnology	All other sectors	
East of England	9	6	5	9	7	36
London	2	2	0	1	2	7
Midlands	1	2	0	1	2	6
North East	1	0	0	0	5	6
North West	2	4	5	1	6	18
South East	8	3	1	2	11	25
South West	2	1	1	0	2	6
Yorkshire and Humber	2	4	5	2	3	16
Northern Ireland	4	2	0	1	3	10
Scotland	5	6	7	2	19	39
Wales	0	0	2	1	6	9
Total	**36**	**30**	**26**	**20**	**66**	**178**

The Survey sampling was developed in a two-stage process, in consultation with the Bioscience SSG given a certain complexity of the scope, and the sample structure is viewed as being broadly representative of the Sector as a whole, with 20-25% of enterprises in Scotland, some 5% each in Wales and Northern Irelands and about two thirds in England.

Methodology

A substantial amount of desk and primary research has been used to establish a comprehensive assessment of current provision. This included accessing a wide range of statistical sources, using the findings of the Skills Needs Assessment (SNA), as well as carrying out primary research with employers and training providers.

Core sources of statistical data include:

- the Department for Education and Skills (DfES)[1]
- the Higher Education Statistics Agency (HESA),
- the Higher Education Funding Council for England (HEFCE),
- the Scottish Qualifications Authority (SQA),
- the Department for Education and Learning Northern Ireland (DELNI),
- the Universities and Colleges Admissions Service (UCAS),
- the Joint Council for Qualifications (JCQ),
- the Welsh Assembly, and
- the Learning Skills Council (LSC)

In addition, in order to strengthen this assessment of the current supply provision of skills for the Bioscience sector Semta has:

- conducted a labour market survey (of 178 employers in 2006);
- supplemented the findings with a smaller survey of employers and training providers;

[1] now the Department for Children, Schools and Families (DCSF) and the Department for Innovation, Universities and Skills (DIUS)

- held a series of employers' meetings around the UK;
- held face to face interviews with a number of University heads of department.
- visited and consulted in depth with individual companies;
- worked with our Bioscience Sector Strategy Group, which comprises employer representatives and other stakeholders;
- drawn on the large body of recent research on science education, including the main relevant public policy reports as well as papers and reports from the Biosciences Federation, the Royal Society of Chemistry, the Scottish Science Advisory Committee, the Association of the British Pharmaceutical Industry (ABPI), the Association for Science Education (ASE), the DfES and others to assess the effectiveness of provision of education and training for this sector. The full list of reports drawn on is given in the bibliography.
- participated in meetings and conferences within the sector, including the Bioscience Industry Association (BIA) Scotland, the Royal Society, and Bio Business Northern Ireland, and held meetings with stakeholders including round table discussion with members of the Scottish Science Advisory Board, and the Royal Society of Chemistry.

Section 2: UK Education and Training Infrastructure

Section 2 sets the scene by introducing the UK's Education and Training infrastructure of relevance to Bioscience, and showing how, in the light of the Skill Needs Analysis presented, the different elements of Learning provision contribute to the different knowledge and skills needed by Bioscience employers, for the different sub-sectors and occupations of most importance. It summarises the key elements of variations in the learning infrastructure in different parts of the United Kingdom, and presents the flows from relevant Higher Education courses into employment into Bioscience. The importance of sound Science education within School provision is introduced, as well as some of the key factors identified by Bioscience employers as characterising 'good provision'. Based on the Skills Needs Assessment, it is evident that good provision prepares potential employees for work in industry by providing:

a) Depth of scientific knowledge and skills

b) Chemistry Skills

c) Practical skills

d) Ability to work to regulatory standards

e) Mathematical skills

f) Interdisciplinary awareness

g) Experience in industry is regarded as valuable

h) Communication

These 'targets' for quality of learning provision articulated by Bioscience employers will inform – in a cross-cutting way – the action priorities of the Sector Skills Agreement developed in Stages 3-5 of the process. They are picked up in different ways, depending on the learning provision context. They will also feed into the existing Quality Assurance processes for public learning provision. The Stage 3 reports for each 'nation' provide more information on the SSA action priorities.

Overall, the over-riding importance of effective and appropriate *Higher Education* of adequate quality is identified, and the section concludes with a summary of employer training activity and the realities of the labour market from which employers recruit.

Section 3: Higher Education provision

Section 3 provides an in-depth analysis of Higher Education provision of relevance to Bioscience employers. The analysis provides a wide range of quantitative and qualitative data covering:

- First Degree provision in relevant subjects
- Postgraduate (taught) courses in relevant subjects
- Research degree achievement in relevant subjects
- Recent trends in flows of graduate at all three levels into Bioscience sub-Sectors
- Quality Aspects of HE provision, and
- Some international Comparisons of relevant HE provision

A considerable amount of quantitative evidence is provided, drawing very largely on the valuable data from the Higher Education Statistics Agency.

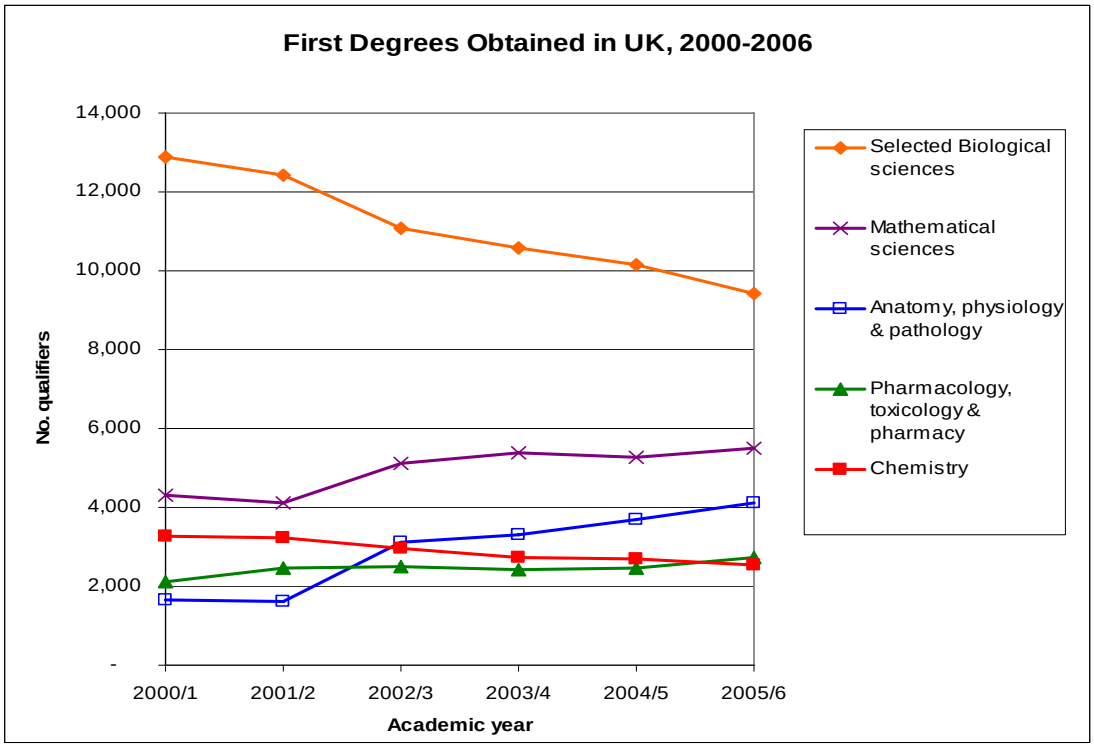
The key findings are that:

- The most relevant HE subjects are *Biological Sciences (with the exception of Sports Science and Psychology)*, *Chemistry*, and selected disciplines within *Subjects Allied to Medicine*;

- Numbers of First-year Students and Graduations in Bioscience-relevant subjects have generally increased between academic years 2002/3 and 2005/6. However, there are notable exceptions, including ***reductions in First Year numbers*** for *Genetics* (-7% over the three years), *Botany*, *Zoology* and *Genetics* (-25%, -10% and -7%) and '*Others in Biological Sciences*' (-55% - probably arising partly from re-classifications). Over the same three years, ***graduations have fallen*** by 13% in *Genetics*, *8% in Microbiology*, 8% in *Molecular Biology, Biophysics and Biochemistry* (as well as 69% in '*Others in Biological Sciences*' - again, arising partly from re-classifications) and 14% in *Chemistry*.

- Since 2004, the number of universities offering courses in biological sciences has gone down. There are 20 fewer HEIs offering for Biology-related subjects; 13 fewer offering Microbiology. There are 19 fewer universities offering Chemistry. The decline in provision of Chemistry has triggered action but the situation for biological sciences has not received great attention.

- Over the last *six* years, the number of first degrees gained by all students in Biological Sciences has declined by 27% if Sports science and Psychology are excluded from the figures. In Molecular Biology, Biophysics & Biochemistry there is a 6% decline and in Chemistry a 23% decline.



- About 5% of all the first degrees achieved in 2006 were in the sciences relevant to the bioscience sector. Overall, 9,400 students gained first degrees in relevant Biological sciences, with a further 4,100 in Anatomy Physiology & Pathology; 2,500 in Chemistry and around 600 in Pharmacology or Toxicology (if the numbers doing Pharmacy are excluded).
- Even where there has been an increase in the numbers graduating as in mathematics, this has not kept up with the increase in overall student numbers in all subjects.
- At the level of *Postgraduate* courses, successful achievement in courses of relevance to Bioscience has grown from 2002/3 till 2005-6 with very few exceptions.
- There are significant Quality Assurance processes built into the delivery of Higher Education in the UK. As well as standards being set for publicly-funded HE through the QAA for both generic and subject-specific learning outcomes from First Degree courses (including the QAA subject benchmarks), there is substantial Quality Assurance through course accreditation by a number of Professional Bodies. Both these processes include an element of industry input, but this could probably be strengthened. However, in general the strong growth of student numbers over recent years has posed challenges for maintaining the quality of delivery standards in most – if not all – HEIs. Anecdotal evidence gathered by Semta from university officials supports the concerns.
- Recent years have also seen steady flows of those completing Doctorates in relevant fields, with *Chemistry*, *Biology*, *Computer Science* and *Molecular Biology, Biophysics and Biochemistry* leading the list with over 400 PhD achievements each year.
- But perhaps the most significant finding of the analysis arises from examination of the flows from Bioscience-relevant subject courses into employment in one of the three sub-sectors which cover Bioscience. A number of trends are evident over recent years, but the main conclusion is that the fraction of achievers at each HE level who enter Bioscience work is low or very low.[2]

[2] This suggests that there is a significant opportunity for the sector to increase its intake of graduates, postgraduates and PhDs with relevant understanding and skills by *raising the **fraction** of the talent available from Higher Education it attracts* through measures to increase the attractiveness of work in the sector. Such measures are probably the clearest steps the sector can take, that are under its direct control.

Section 4: Vocational Education and Training

Section 4 examines Vocational Education and Training (VET) around the United Kingdom of relevance to Bioscience employers. VET covers Vocational Higher Education, Further Education, and Work-based Learning, which also picks up training undertaken by employers themselves. There are two important elements to this:

- That variations of VET provision around the United Kingdom are rather greater than with Higher Education, and
- That VET has tended to be something of a lower priority for many Bioscience employers, for whom the main interest has tended to be on graduate recruitment.

Some significant findings of Section 4 include:

- There are a number of relevant courses leading to Vocational Higher Education, (HNCs/HNDs and Foundation Degrees in England) and these do not appear yet to play a significant role in Bioscience recruitment
- There are existing, and a number of emerging, sets of National Occupations Standards, covering both Laboratory Technician occupations that could be of value to Bioscience employs, and these should be explored;
- There has been comparatively very low take-up so far of Science-related Apprenticeships (e.g. relating to laboratory work), and it may be that these could be used more in the future to free up graduate resources for work that draws more on their broader, deeper understanding; and
- There is also various opportunities for Work-Based Learning, and employers within the Sector themselves provide very significant amounts of specific training for their staff.

The Quality Assurance arrangements in the four UK nations for VET are summarised, and recent work in relation to Science learning provision is noted.

Section 5: Science Provision in Schools

Section 5 looks at current provision in Schools, in particular Science learning in Secondary Education. Here again there are certain differences around the United Kingdom, in particular relating to the different general education qualifications in Scotland ('Standards' and 'Highers') and the rest of the United Kingdom ('GCSEs' and GCE 'A' Levels). Among the key findings are:

- Provision of Science Education, including Biology and Chemistry, continues to thrive in quantitative terms, although there are concerns about various aspects of quality;
- Concerns focus around such things as lack of student confidence in approaching and understanding Mathematics; lack of confidence with practical skills, and difficulties with some of the more abstract concepts in core science;
- Science teaching in schools has undergone major modernisation over recent years, with responses to initiatives like '21st Century Science' creating more appealing curricula and more effective teaching methods; and
- There are a wide range of resources for Continuing Professional Development of by a Science Teachers, complemented number of Professional body programmes.

Section 5 concludes with information on arrangements for monitoring and tackling quality aspects of learning provision in Schools.

Section 6: Learning provision for the Bioscience Clusters

Section 6 disaggregates the analysis by geographical region to present a picture of overall learning provision for the Bioscience Clusters around the United Kingdom. While graduate labour markets have traditionally been viewed as operating well beyond local areas, and many graduates from relevant HE courses continue to move on from their 'alma mater', the strategic importance of localised Bioscience clusters as the engines of growth in this sector does require analysis of relevant activity at the Higher Education Institutions within each geographical area. The section shows how HE provision between the relevant subjects is distributed between the UK nations and English regions, using total enrolment in relevant subject groups by HEI. It also shows relevant VET provision, recent trends in relevant School provision achievement for England, Wales and Northern Ireland, and for the English Regions a summary of the role played by Cluster bodies on the skills and training front. In general, the UK's Science clusters are thriving, with a wide range of institutional support and networking, and more active involvement and outreach from local universities. SEMTA has discovered, within individual nations or regions, no specific gaps or weaknesses in Sector learning provision from the overall Education and Training related infrastructure, and has had constructive dialogue with the various cluster co-ordination bodies around the UK on skills issues.

Section 7: Conclusions

The main conclusions of the overall analysis are articulated in Section 7. These will influence the action priorities of the Sector Skills Agreement (see Stage 3 Reports), in the light of the detailed analysis of Skills Need and employer learning demand presented in the Stage 1 Report.

1) The major players in the Sector, in particular the large Pharmaceutical companies, are already engaging actively with the Education agenda at all levels, both in terms of a number of specific initiatives and in terms of following and contributing to the various policy developments. This provides a sound base for developing an effective Sector Skills Agreement.

2) While sizes of cohorts through the relevant courses, in particular within Higher Education provision, have waxed and waned between specific subjects, overall many of the courses of relevance to Bioscience have suffered since the 1990s from a fall in the numbers of young people wanting to study highly technical subjects, not least since they are often perceived to be (too) difficult. There are some indications of shifts back away from this trend, particularly within schools, but the 'appetite' of the fast-growing sector for an increasing flow of good science graduates and post-graduates requires not just a reversal of falls, but healthy increases. The effect of the action undertaken by the Royal Society of Chemistry, with HEFCE support, has shown that it is possible to turn things round.

3) Employers within the Bioscience sector appear to recruit comparatively very low fractions of the First Degree graduates in relevant HE subjects – many good graduates go to work in other sectors (it is known that many talented Science graduates are recruited at high salaries into Financial Services). This suggests that effort to improve the attractiveness of work in the Sector is probably needed, to be focused both at university students, and in addition, in order to ensure that inevitable negative stereotypes are overcome, at secondary school students.

4) The main subjects of relevance to Bioscience companies are in the (official) categories of
    - Biological Sciences
    - Subjects Allied to Medicine, and
    - Chemistry

Although not all fields within Biological Sciences and Subjects Allied to Medicine are relevant, and it is necessary to remove, for example, Sports Science, Psychology and Pharmacy from the total figures to estimate the real position of relevance.

5) Within the relevance subjects, the specific courses of interest to Bioscience employers are those involving some time in industry, and, for joint Honours degrees, those whose second subject is appropriately complementary (rather than 'less mainstream').

6) Some employers are sceptical about the Integrated Masters First Degrees introduced in the 1990s. On the one hand they help address some of the limitations of school leavers reported by university staff, and in principle deliver a graduate with understanding at Masters level, while on the other some employers think that the four years involved could perhaps have been better spent in other ways. Most employers report satisfaction with those recruited with a (taught) Masters degree following a BSc. There is a continued demand for those with PhDs or other qualifications involving practical research experience.

7) In addition to the main science subjects, there is interest from some employers in new areas like Bio-informatics and more engineering-oriented degrees in Chemical and Process Engineering. This depends on the particular product/market niche of the company.

8) In principle, it would be desirable to try to increase the comparatively small numbers of young people who choose science subjects at school and then Science, Technology Engineering and Mathematics courses at university. It is likely that the greatest influence Bioscience employers would have in contributing to tacking this problem is as part of the overall national strategies emerging. Semta will review the relevant steps and advise employers on the steps likely to have the greatest impact.

9) Within the Vocational Education and Training provision system, there are a number of relevant courses. While not all newer provision has yet found strong take-up by employers, Semta will work with employers to examine how those achieving on these courses might be able to provide good candidates in certain occupational areas. First steps will be to strengthen support and commitment for the emerging National Occupational Standards (NOS)

10) Considerable refinement and improvements have been made over recent years to Science learning provision in schools. Cohorts of those choosing relevant GCSE and A Level and equivalent courses have recently been growing, but the challenge of encouraging more good young people to take such subjects continues.

More Detailed Conclusions for the four Nations:

Scotland:

Higher Education:

Scotland awarded 12.2% of all UK Bioscience First Degrees, across sixteen institutions. In Pharmacology, Toxicology and Pharmacy (12.9% of qualifications in these subjects) and Selected Biological Sciences (13.9%), Scotland is particularly well represented. In Botany 30.8% of First Degrees are awarded in Scotland and in Zoology the figure is 23.9%. The decline in the number of students gaining first degrees in Scotland in the relevant biological sciences has slowed in the last two years. The number of Chemistry graduates follows a similar pattern. Mathematical Sciences are the only area to have shown a net growth from 2003 to 2006.

Vocational HE, Further Education (FE) and Work-based Learning (WBL):

Technical skills for Laboratory Technicians, bio-manufacturing technicians and other skilled occupations at Level 3 are provided by colleges of Further Education (FE). Nine colleges in

Scotland offer Higher National Diplomas in subjects such as Applied Biology, Biomedical Sciences, Chemistry, Pharmaceutical Science/Chemistry.

Secondary Education:

Few people are recruited directly from school into the Bioscience sector, but relevant school qualifications are a requirement of entry into courses in HE and FE. In Scotland the secondary school examination results figures are much higher than elsewhere in the UK: 8.8% of all leavers achieve a Higher qualification at Level 6 (A-C) in Biology. Similarly, 2.8% achieve a Higher at Level 6 in Human Biology, 9.4% in Chemistry, 9.1% in Physics and 17.9% in Mathematics. Additionally, 1.6% of all leavers achieve a Higher at Level 7 (A-C) in Biology, 1.8% in Chemistry, 1.5% in Physics and 2.4% in Mathematics. Changes to the school science and maths curriculum have meant that students are reportedly less well prepared to take up tertiary level study. Universities report that first year students lack fluency in algebraic manipulations; the analytical powers for multistep problems and a proper appreciation of precision and proof. Remedial action in university reduces what can be taught in a 3 year degree. There is no clearly established set of career pathways to guide young people in the choices they make when considering careers in science.

Wales:

Higher Education:

In terms of first degrees in all subjects, 5.5% of those awarded in the UK are awarded by HEIs in Wales. The Welsh HEIs provide a range of bioscience related courses. Welsh HEIs are particularly strong in the relevant Biological Sciences: 8.0% of first degrees in these subjects are awarded in Wales. Within this group, 21.7% of the 900 first degrees in Zoology are awarded in Wales and 10.0% of Genetics first degrees. In subjects outside the biological sciences group Welsh HEIs are under-represented, particularly in Maths where only 3.6% of UK first degrees in this subject are awarded in Wales. As in the UK as a whole, the number of students gaining first degrees in the relevant Biological Sciences has declined over recent years, although there have been increases in Anatomy, Physiology and Pathology and in Pharmacology, Toxicology and Pharmacy.

Over the past few years, universities in Wales have benefited from investment through the Science Research Investment Fund (SRIF), a major programme of investment in physical infrastructure for research. There have been a number of bioscience-related investment projects.

Vocational HE, Further Education (FE) and Work-based Learning (WBL):

Technical skills for Laboratory Technicians, bio-manufacturing technicians and other skilled occupations at Level 3 are provided by colleges of Further Education (FE). One college in Wales offers Higher National Diplomas in subjects such as Applied Biology, Biomedical Sciences, Chemistry, Pharmaceutical Science/Chemistry. The University of Wales Institute, Cardiff is the one college that offers bioscience-related HNDs in Wales, offering HNDs in Biomedical Sciences.

In Wales, HEIs are free to develop and offer Foundation Degrees in their portfolios, including through franchise arrangements with FE colleges, although none are currently offered in bioscience-related subjects. Unlike in England, there is no specific policy direction in Wales at present to expand this route above other types of provision. Bridgend College and Coleg Gwent (Crosskeys) offer National Diplomas in Applied Science and Coleg Gwent (Ebbw Vale) offers a First Certificate in Science.

In 2005/6, there were about 400 people in training on the Laboratory and Associated Technical Activities National Vocational Qualification at all levels. The Young Apprenticeship pathway for Science needs to be expanded. In Wales it would be known as the work based learning pathway and would be attached to the Welsh Baccalaureate. FE colleges also teach GCE ‘A' levels in science. This part of the training infrastructure is clearly under-utilised by the bioscience sector.

Secondary Education:

Few people are recruited directly from school into the Bioscience sector, but relevant school qualifications are a requirement of entry into courses in HE and FE. Science is compulsory up to Key Stage 4, but in Wales only a very small minority go on to take GCE A levels in science. 6.8% of all leavers achieve an A level in Biology, 5% in Chemistry, 3.4% in Physics and 7.5% in Mathematics. In Scotland the figures are much higher: 8.8% of all leavers achieve a Higher qualification at Level 6 (A-C) in Biology. Similarly, 2.8% achieve a Higher at Level 6 in Human Biology, 9.4% in Chemistry, 9.1% in Physics and 17.9% in Mathematics. Additionally, 1.6% of all leavers achieve a Higher at Level 7 (A-C) in Biology, 1.8% in Chemistry, 1.5% in Physics and 2.4% in Mathematics. Changes to the school science and maths curriculum have meant that students are reportedly less well prepared to take up tertiary level study. Universities report that first year students lack fluency in algebraic manipulations; the analytical powers for multistep problems and a proper appreciation of precision and proof. Remedial action in university reduces what can be taught in a 3 year degree. There is no clearly established set of career pathways to guide young people in the choices they make when considering careers in science.

Northern Ireland:

Higher Education:

In terms of *all* qualifications awarded in *all* subjects, 2.4% of UK HE qualifications are awarded by the two universities in Northern Ireland. These institutions, Queen's University Belfast and the University of Ulster provide a range of bioscience related courses. In Anatomy, Physiology and Pathology (3.4% of qualifications in these subjects) and in Pharmacology, Toxicology and Pharmacy (5.3%), Northern Ireland is particularly well represented. The University of Ulster is one of 25 universities across the UK that offers first degrees in Pharmacology.

While the number of students obtaining first degrees in the relevant biological sciences and chemistry has fallen substantially in the UK as whole, in Northern Ireland this has not been the case. From 2002/3 to 2004/5, the number of graduates increased, although there has been a fallback in 2005/6. In other bioscience-related subjects there have been increases overall. Queen's University Belfast offers postgraduate courses in Bioprocessing, but there are not any postgraduate courses available in Northern Ireland.

Vocational HE, FE and WBL in Northern Ireland:

Overall, this part of the training infrastructure is clearly under-utilised by the bioscience sector. However, in Northern Ireland a face-to-face survey of 75 science companies by Further Education (FE) staff found that many had used training provided by FE colleges. The main areas were, in order of interest: Health and Safety, Analytical Techniques, Laboratory Skills, Environmental Testing and Science Technician Skills.

Secondary Education:

Few people are recruited directly from school into the Bioscience sector, but relevant school qualifications are a requirement of entry into courses in HE and FE. Science is compulsory up to Key Stage 4, but in Northern Ireland only a very small minority go on to take GCE A levels in science. 6.8% of all leavers achieve an A level in Biology, 5% in Chemistry, 3.4% in Physics and 7.5% in Mathematics. Pass rates at A*-C in both the individual sciences and the GCSE Science Double Award are higher than those in England and Wales. Similarly, for GCE 'A' level, the percentage of students that achieve grades A or B is also higher. Changes to the school science and maths curriculum have meant that students are reportedly less well prepared to take up tertiary level study. Universities report that first year students lack fluency in algebraic manipulations; the analytical powers for multistep problems and a proper appreciation of precision and proof. Remedial action in university reduces what can be taught in a 3 year degree. There is

no clearly established set of career pathways to guide young people in the choices they make when considering careers in science.

England:

Higher Education:

English HEIs awarded 80% of all UK Bioscience First Degrees, across 83 institutions. In Molecular Biology (88% of qualifications in this subject) and in Mathematical Sciences (85%), England is particularly well represented. In Zoology (53% of all bioscience first degrees), Microbiology (57%) and Botany (62%), English HEIs award proportionately fewer first degrees than would be expected, with Scotland and Wales being particularly strong in these subjects.

There has been a substantial decline in the number of students gaining first degrees in England in the relevant biological sciences subjects in the last few years, and also a decline in the numbers achieving degrees in Chemistry. There has, however, been a growth in the number achieving degrees in Anatomy, Physiology and Pathology and to a lesser extent in Mathematical Sciences over the same period.

Vocational HE, Further Education (FE) and Work-based Learning (WBL):

Technical skills for Laboratory Technicians, bio-manufacturing technicians and other skilled occupations at Level 3 are provided by colleges of Further Education (FE). Fourteen colleges in England offer Higher National Diplomas in subjects such as Applied Biology, Biomedical Sciences, Chemistry, Pharmaceutical Science/Chemistry. Across the whole of the UK there are relatively few HNDs achieved in the Bioscience-related subjects: only 130 students gained Higher National qualifications in Biology in 2006 and in each of the other subjects relevant to Bioscience there are no more than a few dozen.

About 20 Universities in England offer the new Foundation degrees in science, although take up is low, with only 130 new entrants per year in Biological Sciences excluding Sports Science and Psychology. Nineteen institutions in England offer 31 Foundation Degrees in Bioscience-related subjects. Within England, 28% of BTEC Science learners are studying in London, 18% in the North West and 17% in the West Midlands. 9% are found in both the south east and south west, and 6% in the east midlands and in Yorkshire and the Humber. Only 3% are in the East Midlands and the North East. Most Level 2 BTECs are awarded in London and the West Midlands, while Level 3 BTECs are more evenly spread across the regions. In 2005/6, there were over 400 people in training on the Laboratory and Associated Technical Activities (LATA) National Vocational Qualification at all levels. There are Apprenticeship programmes and also a new Young Apprenticeship in Science for young people still in school to gain experience in the sector. There are more LATA NVQs being undertaken in the North West than any other English region (39% of the total). 23% are in the North East and 11% in both Yorkshire and the Humber, but there are none in the East Midlands and very small numbers in the East of England. It is clear that the vocational education and training part of the learning infrastructure is under-utilised by the bioscience sector.

Secondary Education:

Few people are recruited directly from school into the Bioscience sector, but relevant school qualifications are a requirement of entry into courses in HE and FE. Science is compulsory up to Key Stage 4, but in England only a very small minority go on to take GCE A levels in science. 6.8% of all leavers achieve an A level in Biology, 5% in Chemistry, 3.4% in Physics and 7.5% in Mathematics. Changes to the school science and maths curriculum have meant that students are reportedly less well prepared to take up tertiary level study. Universities report that first year students lack fluency in algebraic manipulations; the analytical powers for multistep problems and a proper appreciation of precision and proof. Remedial action in university reduces what can be taught in a 3 year degree. There is no clearly established set of career pathways to guide young people in the choices they make when considering careers in science