



the Sector Skills Council for Science, Engineering and Manufacturing Technologies

# Phase 4 Diploma in Science: Employer Research

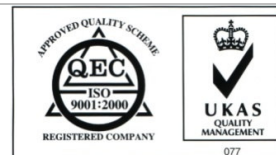
## Final Report

June 2009

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## 1. Executive Summary

### 1.1 Overview

Employers are not expecting the Diploma in Science to provide them with fully-fledged school leavers and graduates that can transit straight into the workplace with no need for further training. Nor do they expect that all of the skills and knowledge that they find useful to have been covered by the science curriculum. It was acknowledged that this is an unrealistic ambition.

**What employers do want to see is a qualification that will equip students at all levels with practical, transferable skills.** This corroborates the findings of the Secondary Research report, a major finding of which was that employers felt that their recruits lacked sufficient practical experience.<sup>1</sup>

Within Principal Learning, and assuming a solid grounding in scientific theory and knowledge, the actual topic content is less important to the employer when compared with the opportunity to gain practical experience that will teach learners *“how to learn.”*<sup>2</sup> **Practical skills reign supreme in employers' eyes and the more practical experience, the better.** Their contention is that practical experience will embed transferable skills such as the confidence to question and challenge, adopt an accurate and analytical approach, and work effectively as part of a team. They also believe that teaching students research methodologies – which is what they mean by learning ‘how to learn’ - will enable young people to pick up the specialist knowledge needed by a specific employer in the future. Moreover, ‘learning by doing’ was considered to be the best means of retaining knowledge over longer periods of time.

*“The science curriculum is a golden opportunity to acquire a solid grounding in practical skills that will be useful for life. No other subject gives this opportunity”*

**Educational resource supplier, East of England**

<sup>1</sup> <http://www.sciencediploma.co.uk/PDF/Secondary-research-report.pdf>

<sup>2</sup> Pharmaceutical research organisation, South East

## 1.2. Conclusions

The following priorities have been highlighted for consideration when reviewing the next stage of development for the Diploma in Science:

- ❖ Employers overwhelmingly stipulated that practical and transferable skills should be the key focus of the Diploma in Science at all levels. They have high expectations of the capacity of the Diploma to add value to a wide range of organisations, regardless of sector, region or size – **provided that** practical and transferable skills are top of the agenda.
- ❖ It was acknowledged that the Diploma in Science has the opportunity to make a discernible difference to the way in which 16 year old school leavers are perceived by employers. Employers feel that they would recruit greater numbers of 16 year old leavers into skilled careers if the Diploma can provide them with relevant skills that prepare them more effectively to transition into the scientific and technical workplace. Given the shortages of technicians in the science sector as a whole<sup>3</sup>, the Diploma in Science could also play a substantial part in promoting this career route to Foundation and Higher level students.
- ❖ Science employers recognise that well over half our young people do not go to university and they see this as an advantage to the nation as long as the school leavers are well equipped and taken into careers that will build their skills and knowledge over a lifetime.
- ❖ Employers believe that the Diploma in Science has too low a profile across the general population.
- ❖ Furthermore they feel that there is a lack of clarity in terms of the students it is aimed at, what it will achieve and whether it can meet the needs of all learners - particularly those at Advanced level going on to study science at university. For example, 10% of the interviewees described the Diploma as a vocational qualification. *“It cannot be all things to all people – it cannot be suitable for aspiring laboratory technicians as well as students*

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<sup>3</sup> <http://www.timeshighereducation.co.uk/story.asp?storycode=406166>;  
<http://www.neweng.org.uk/uploads/news/AShortageofSkills.pdf>

*aiming for higher level education.*<sup>4</sup> In some sectors, concern was expressed that theoretical content would be diluted at the expense of developing employability skills more suited to a vocational qualification than one intended to meet the needs of all learners.

- ❖ It is not clear that there will be sufficient capacity for all Diploma students to access a **meaningful** (i.e. relevant to the science sector) work placement, particularly in rural locations.
- ❖ On paper the requirement is for a *minimum* of 10 days' work experience but doubt was expressed as to whether such placements will actually happen in practice. The majority of employers pointed out that it would be a struggle to accommodate this – despite the widely held view that such a placement would significantly enhance employability skills.
- ❖ Employers remain concerned about the impact that work placements will have on their resources, time and costs. This issue is particularly pertinent in light of the current economic downturn. Employers asked whether the Government would provide money to cover students' travel costs, or to pay for a dedicated resource that could facilitate all work placements in-house, or to fund enhanced CRB checks for employees in contact with young people. NHS employers raised this as a major problem as they are facing significant budget cuts.
- ❖ Several employers suggested that consortia should play a role in brokering placements between schools and industry. This would be welcomed by organisations that have experienced difficulties in managing an ongoing relationship with schools – partly because teachers are too busy, but mainly because it was felt that they lack sufficient understanding of the industry environment, and in some cases, make unreasonable demands<sup>5</sup>.
- ❖ It was emphasised that stronger links are needed between schools/colleges and industry in order for the crucial work experience component to be delivered – *“For the Diploma to be*

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<sup>4</sup> Pharmaceutical research organisation, South East

<sup>5</sup> A large Nuclear organisation in the North East was asked to establish a science project which they spent a lot of time in preparing only to be told by the school that the project had been dropped due to a change in the curriculum. The same organisation was asked to take 30 Engineering Diploma students on site for 2 full days a week, provide a dedicated training centre and meet all of the costs – *“over the top requests like this will simply put employers off”*

*successful, there has to be the buy-in from industry; if that isn't there then schools and workplaces will continue to operate in isolation - if this happens it won't matter what the Diploma tries to teach as it will be guaranteed to fail in delivering a key objective i.e. equipping students with valuable employability skills.”<sup>6</sup>*

## 2. Background to the project

### 2.1 Background to the research

Pye Tait Ltd was commissioned by SEMTA to conduct a series of in-depth semi-structured interviews with up to 50 employers within science and related industries. The purpose of the interviews was to establish a detailed knowledge of the needs of employers and whether these can be met in the Line of Learning Statement (LoLs) for the forthcoming Diploma in Science.

This final report of the findings contains a summary of the key messages, as well as detail of the specific skills and knowledge employers expect to see, relating to Principal Learning, Generic Learning and Additional and Specialist Learning. Implementation issues and career pathways relating to the Diploma in Science have also been addressed. Given that the current LoLc and LoLs is changing as a result of ongoing consultations, it was not a viable option to map the findings directly back to the proposed topics. However some employer thoughts were compatible with existing proposals; this has been highlighted where relevant.

After the research was started, it was announced that the introduction of the Advanced level of the Diploma in Science would be delayed until 2012<sup>7</sup>. The Foundation and Higher levels will still be launched in 2011. The decision to spend more time in developing the Advanced level was welcomed by a number of employers<sup>8</sup>. This decision has not impacted upon the research, as employers were asked about their specific needs and requirements rather than for their feedback on the existing LoLs at particular levels of the Diploma (given that the document is a work in progress, as explained above). The findings can therefore be utilised alongside the ongoing work to further refine the Advanced level of the Diploma in Science.

<sup>6</sup> Engineering organisation, East Midlands

<sup>7</sup> [http://www.dcsf.gov.uk/pns/DisplayPN.cgi?pn\\_id=2009\\_0075](http://www.dcsf.gov.uk/pns/DisplayPN.cgi?pn_id=2009_0075)

<sup>8</sup> “Above all it is the Advanced Diploma that has the opportunity to stand apart from A-levels” Pharmaceutical research organisation, South East

## 2.2 Structure of the Diploma in Science

The Diploma is a new qualification that is being developed for learners of all abilities between the ages of 14 and 19. It will become part of a new suite of qualifications and will sit alongside the traditional educational pathways of GCSEs and A Levels. This qualification will offer students an alternative route of study, blending classroom-based learning with work-related practical experience, which allows students to keep their options open. Students will understand how to apply theory and practice and be able to make informed decisions about their future.

This new qualification will:

- ❖ equip students with essential skills to prepare them for work and continuing education
- ❖ be a challenging qualification valued both by industry and education
- ❖ provide flexibility and choice and give students a variety of study options

The Diploma is designed to combine practical, industry relevant skills with theoretical and some technical knowledge and understanding. It will also support and encourage learners to develop crucial skills such as team working, self management and creative, reflective and independent thinking – collectively known as Personal Learning and Thinking Skills (PLTS). The Diploma requires learners to develop and apply functional skills in English, Mathematics and Information & Communication Technology (ICT). It offers the chance for employers to become involved with schools and colleges in a way that will enrich the learning experience for students, to prepare them for either employment or college/university. The emphasis is on ‘learning by doing’ and teaching will draw upon recent developments from the relevant sector.

Whilst every Diploma shares a common core framework, all learners may choose to develop and personalise their experience by choosing from a range of options that could include units of existing qualifications such as GCSEs, BTECs, A-Levels and NVQs. These options either broaden the learning at the appropriate level or deepen it depending on whether the learner wishes to spread their spectrum of learning or enhance a particular area of knowledge.

The Diploma recognises achievement at three levels:

- ❖ The Foundation Diploma (level 1) is equivalent to five GCSEs at grades D-G
- ❖ The Higher Diploma (level 2) is equivalent to seven GCSE's at grades A\*- C
- ❖ The Advanced Diploma (level 3) is equivalent to 3.5 A-levels

There is also the 'Progression Diploma' a subset of the level 3 Diploma, is equivalent to 2.5 A-levels. From 2011, Extended Diplomas will be available. The Extended Diploma can be taken at all levels - Foundation, Higher and Advanced. Extended Diplomas will contain more English and maths, as well as more additional and specialist learning. At Foundation level it will be equivalent to 7 GCSEs at grades D to G; at Higher level it will be worth 9 GCSEs at grades A\* to C, and at Advanced level it will be equivalent to 4.5 A levels.

The Diploma in Science aims to enable learners to gain a deeper insight into the world of science, how science is used and its impact on society and the world we live in. Three main categories are at the core of the Diploma in Science – the natural world, the human world and the technological world. Learners will focus on the major challenges for science, the practical uses of science and 'big science questions' within these categories.

The Diploma in Science aims to provide a hands-on approach to acquiring scientific skills and knowledge, illustrating the benefits of scientific methods and their broader application to problem solving. The intention of the Diploma in Science is to put the acquisition of practical and fundamental scientific and mathematical skills at the centre of learning.

**Table 1: Components of every Diploma**

<b>Principal Learning (core)</b>	Knowledge, understanding, skills and attitudes relevant to a sector (or sectors) and how to apply these to work roles, situations and realistic contexts
<b>Generic Learning</b>	Broad skills and knowledge necessary for learning, employment and personal development including functional skills, personal, learning and thinking skills, work experience and a project (explained in more detail in the boxes below)
<i>Functional skills</i>	Learners will be able to develop and apply constructive skills in Mathematics, English and ICT across the whole of the Diploma curriculum
<i>Personal Learning and Thinking Skills</i>	Skills in independent enquiry, creative thinking, reflective learning, team working, self-management and effective participation
<i>Work Experience</i>	At least 10 days' to gain understanding of industry needs – can be consecutive 10 days or more piecemeal
<i>Project</i>	To show potential, breadth and independence of learning; relevant to the chosen sector with the opportunity to focus on a specific areas within a broader specialist subject and integrate learning from all Diploma components
<b>Additional and Specialist Learning</b>	Students choose from a range of options to provide greater breadth of study that relate to individual needs, interests and aspirations

### 3. Aims of the Research

The intention of these in-depth interviews was to investigate with a selected sample of employers within the science field their specific employment needs with regards to their requirements for:

- ❖ Scientific skills and literacy
- ❖ Their different skill/knowledge needs from school-leavers at 16 (Foundation/Higher Diploma), entrants at 18 (Advanced Diploma), and graduate entrants
- ❖ Satisfaction with graduates and existing qualifications
- ❖ Employment of and need for 'level 3/Advanced' students
- ❖ Specific skills and knowledge requirements including for mathematics
- ❖ Links with schools and FE/HE
- ❖ Training, professional and career pathways including the technician route and 'level 2/Higher' students
- ❖ Local/national/regional specifics

Additionally employers were asked for suggestions of Additional and Specialist Learning options that should be offered to students taking the Diploma in Science.

### 4. Methodology

#### 4.1 Initial Approach

Members of the Employer Engagement Group were asked to provide contact names of senior employers within relevant organisations to be interviewed. In advance of the interviews, these contacts were to be provided with a brief that contained no or as little educational jargon about the Diploma as possible. The rationale for this was based on the fact that to date, few employers have come forward to participate in the various consultations that have taken place during 2008/2009. This was seen as an opportunity to involve employers in the development (i.e. preceding any implementation activity) and to hear their views on critical aspects, including what would make the

Diploma and its students attractive from their point of view, at this crucial phase of the Diploma development.

The target numbers and intended range of interviews was as follows:

1. Public Sector employers regardless of size: maximum 10 interviews
2. 40 interviews with private sector employers (across sectors) that employ people who use science in their work, spread as follows -
  - a. 10 large businesses<sup>9</sup>
  - b. 10 to 15 medium sized businesses
  - c. 20 small businesses

## 4.2 Revised Approach

It has been necessary to supplement the contact names provided by the Employer Engagement Group, in order to meet the target of 50 interviews. Many contacts, although agreeing to take part and having seen the material sent to them, were unable to commit to an interview date/time. Of the 25 contacts that were nominated, 13 interviews took place. Extensive desk research has therefore taken place in order to identify and target the most relevant organisations and personnel, in order to complete the remaining 37 interviews. This included a stronger focus on medium and large companies; the first round of interviews identified that larger organisations are in the main able to provide richer data, as they typically employ school leavers and graduates, and have more experience to draw upon when responding to the questions.

50 qualitative interviews were conducted with a range of employers spanning the public and private sector across the UK. A balance of interviews across all regions was achieved, with a slight bias towards the South East due to its higher concentration of Science based employers willing to participate in the research.

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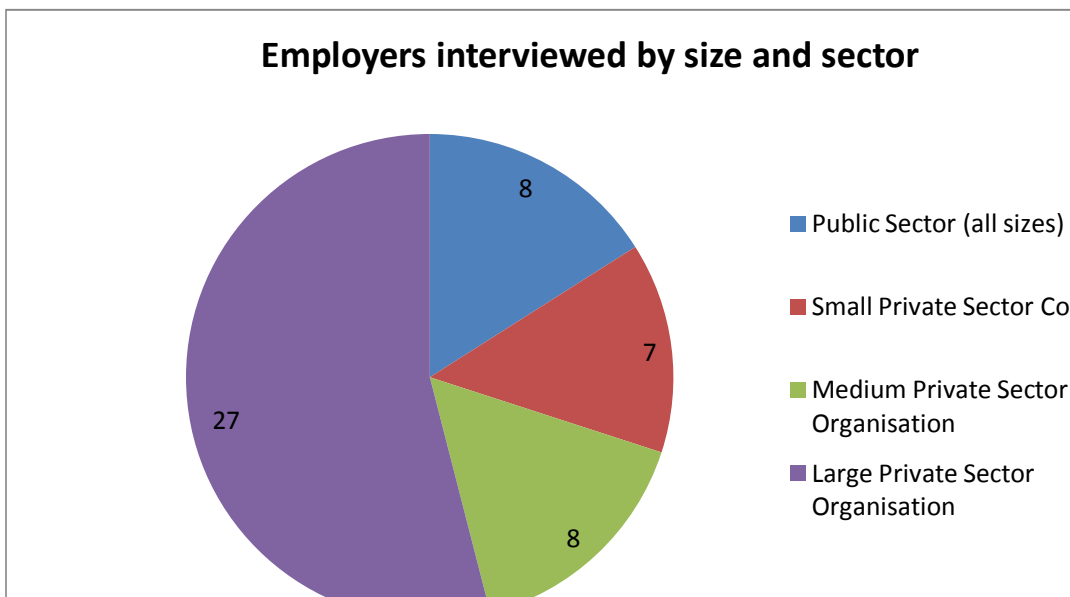
<sup>9</sup> Using DIUS definitions for statistical purposes (micro firm: 0 - 9 employees, small firm: 10 - 49 employees (includes micro), medium firm: 50 - 249 employees, large firm: over 250 employees)

The completed range of interviews was therefore as follows:

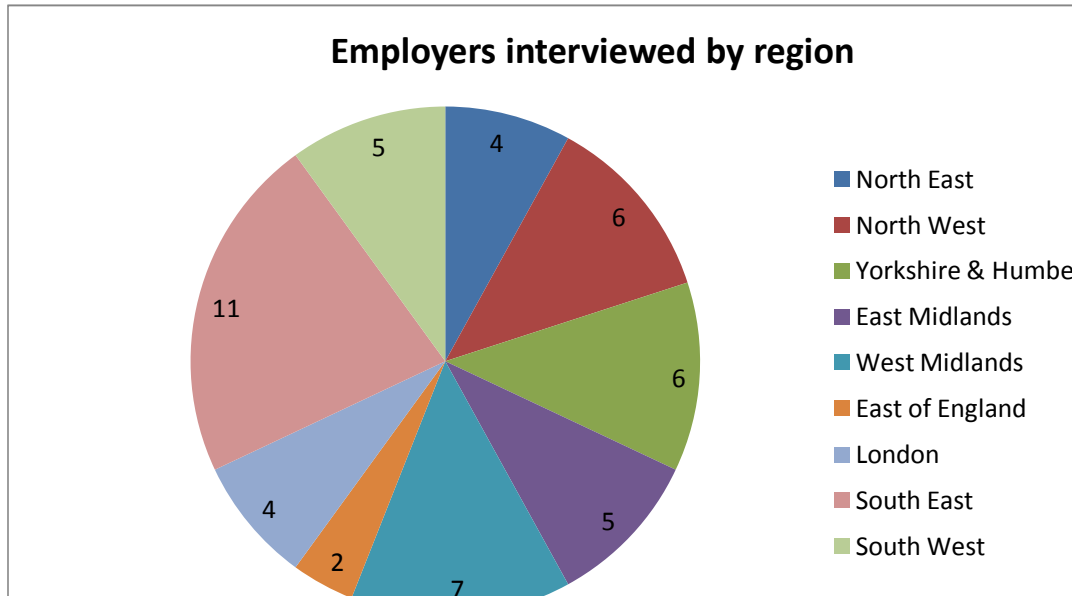
1. Public Sector employers regardless of size: 8 interviews
2. Private sector employers across all sectors that employ people who use science in their work:
  - a. 27 large businesses
  - b. 8 medium sized businesses
  - c. 7 small businesses

Interviews lasted between 20 minutes and 1 hour, depending on the extent of information that employers provided. A qualitative approach was adopted; hence the interviews were conducted in a conversational style with open questions, in order to achieve the necessary full and detailed responses from employers.

**Figure 1: Employers interviewed by size and sector**



**Figure 2: Spread of employers interviewed by region**



## 5. Principal Learning

### 5.1 Scientific skills and knowledge for school leavers

There was a very strong message from employers that existing qualifications do not equip school leavers between the ages of 16 and 18 with scientific skills of significant value and therefore there is a high expectation amongst employers that they will have to supply further training, typically on the job or through an apprenticeship. Clearly this is based on their perception of existing qualifications only as the new science qualifications have not been tried and tested yet.

School leavers are typically lacking in most, if not all of the skills that employers find useful (see table 2 below) and employers expect to supplement the gaps with on the job training.

*“(We have) very little expectations of the school leavers as A-Levels don’t equip them with the necessary skills for the working environment”*

**University hospital, South East**

*“We would be very surprised if they (16 -18 year olds) had any scientific skills”*

**Nuclear organisation, North East**

Employers would therefore welcome a Science curriculum that provided the scope to teach the skills they would find most valuable. Practical experience is the most useful at school leaver age.

Supplementing the scientific skills should be an ability to write reports, communicate well, work effectively as part of a team and an aptitude/willingness to learn new skills. In addition employers would like to see an interest and enthusiasm for science and an insight into current research on subjects like HIV and hepatitis *“and not just the media hype”*<sup>10</sup>

Employers did not notably differentiate between the level of skills and knowledge they would need from a 16 year old and from an 18 year old, but several commented that they would expect that school leavers at the age of 18 to be more mature, disciplined and reliable than those at the age of 16.

The scientific skills of most value to employers are outlined below, with the most important being extensive experience of practical laboratory work – with the proviso that it is **relevant**: *“School leavers have very limited abilities, largely due to antiquated teaching methods – industry does not use Bunsen burners anymore.”*<sup>11</sup> A representative from an NHS hospital also commented that *“they (school leavers) don’t understand how to use the basic scientific equipment, as they are prevented from doing so at school. Hands on experiments; dissection – those skills just aren’t there any more.”*

<sup>10</sup> Clinical trials organisation, South East

<sup>11</sup> Drug development organisation, Yorkshire

**Table 2: Scientific skills and knowledge of most value to employers at school leaver age:**

- Extensive experience in handling different types of modern scientific equipment e.g. centrifuges, burettes, microscopes and waterbaths
- Pipetting skills<sup>12</sup>
- Weighing, balancing and measuring including use of a range of measuring instrumentation
- Make up solutions (from concentrates) accurately
- Record data accurately and input on the computer
- Knowledge of health & safety in the lab
- Good laboratory practice
- Use of chemicals
- Use of PH indicators
- Acid and alkali testing
- How to wash glassware carefully
- How to manage simple experiments (and complex experiments under supervision)
- Review and be able to follow a method
- How to look after and store samples

## 5.2 Non scientific skills and knowledge for school leavers

School leavers are also deemed to be typically lacking in the 'softer skills' and employers would welcome a Diploma in Science that would plug some of these gaps, notably in:

- ❖ Written skills, particularly in report writing
- ❖ Numeracy
- ❖ Interpersonal skills
- ❖ Teamwork – notably a sense of responsibility in order to not let the team down
- ❖ Communication
- ❖ A proactive approach to problem solving
- ❖ Confidence to ask pertinent questions
- ❖ Accuracy and attention to detail
- ❖ Diligence and reliability

<sup>12</sup> [http://www.gaelcommunity.com/blogs/quality\\_news/archive/2008/03/19/calibrating-the-lab-technician.aspx](http://www.gaelcommunity.com/blogs/quality_news/archive/2008/03/19/calibrating-the-lab-technician.aspx)

### 5.3 Scientific skills and knowledge for graduates

Employers expect more in-depth knowledge from graduates, as well as the ability to work unsupervised and demonstrate independent research skills. Of the list below, the majority of employers find that graduates typically lack an understanding of the scientific challenges in the real world and the confidence to test and challenge existing theories when first recruited.

**Table 3: Scientific skills and knowledge of most value to employers at graduate level:**

- Ability to make solutions
- Capacity to analyse stains
- Good laboratory practice
- Capacity to work unsupervised
- Use of laboratory tools and equipment
- Ability to dispense volumes and weigh out small samples
- Understand weights and measures including nanolitres and microlitres
- Experienced in the use of pipettes, chemicals, waterbaths
- Knowledge of health & safety in the laboratory
- Understanding of scientific challenges in the real world
- Understanding of how to learn and develop own strategies
- Research skills – where to look, how to evaluate data, exercise sound judgement and develop the ability to monitor and react to trends
- Follow a protocol
- Develop a method
- Complete statistical analyses to interpret results
- Experiment design
- Test and challenge existing theories
- Knowledge of wider range of scientific equipment or more specialist (or at least have some exposure to) e.g. chemical analysers

## 5.4 Non scientific skills and knowledge for graduates

The majority of employers were dissatisfied with the calibre of their graduate intake when first recruited, and would welcome the introduction of an Advanced Diploma in Science that would address some of these issues at school or college. The key areas highlighted as deficient were:

- ❖ Written skills – structuring and writing reports and reaching logical conclusions
- ❖ Experience of conducting laboratory experiments unsupervised
- ❖ Project management – the ability to plan & follow a method, and organise a team
- ❖ Empathy of the business environment and general commercial awareness
- ❖ Communication skills
- ❖ Presentation skills
- ❖ Interpersonal skills and teamwork – science is an *“emotionally sterile”*<sup>13</sup> subject that fails to develop these areas
- ❖ Lack of confidence – there is a **dependency culture** whereby *“they expect to be told the answer instead of learning ways of finding it out for themselves”*<sup>14</sup>

## 5.5 Practical Skills

**Above all, it is practical skills and experience that are deemed to be of most value and significance to employers of all sizes and sectors.** It was widely manifest that it is the exposure to practical tasks in the laboratories that develop and embed the transferable skills employers need from their recruits at either school leaver or graduate level. A Diploma in Science that enabled the teaching of investigative and practical skills **at all levels** would be of great interest to employers.

*“(Give the students) actual practical experience not just exposure through watching the teacher”*

**NHS hospital, East Midlands**

<sup>13</sup> Technology organisation, West Midlands

<sup>14</sup> Pharmaceutical research organisation, South East

*“They (the students) absolutely have to do more practical work”*

**Pharmaceutical research organisation, South West**

*“Dissection is a key skill that is not taught, and should be”*

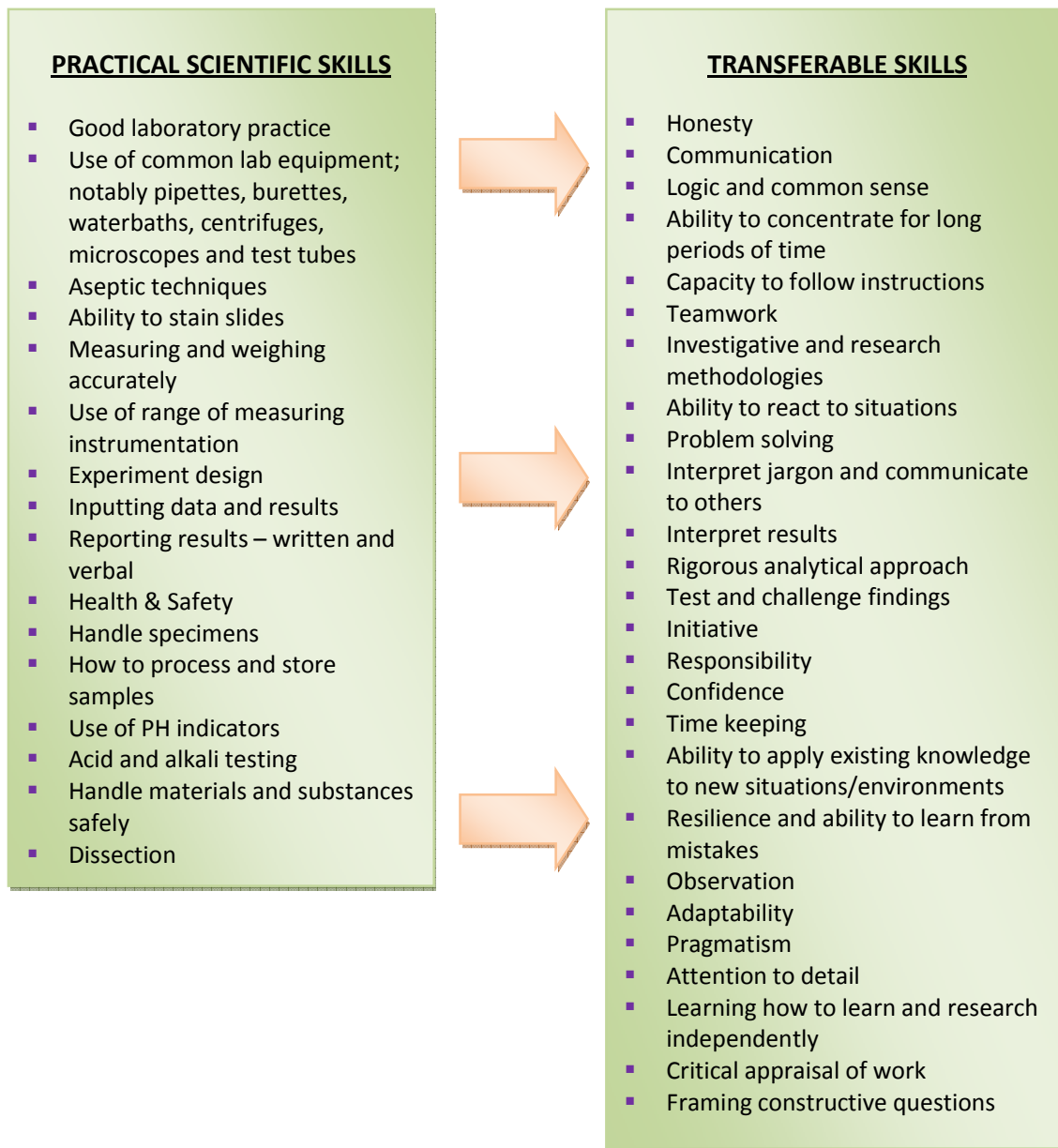
**Royal Horticultural Society**

*“Practical laboratory skills should be an important element of the diploma as it is these skills that graduates and school leavers are lacking”*

**Chemicals organisation, North West**

The majority of employers would prefer to see more weight given to practical skills and experience than theoretical knowledge in the Diploma in Science for the first two levels.

**Figure 3: Practical skills that employers want to see taught within the Diploma in Science that engender valuable transferable skills**



## 5.6 Topic content and structure

Employers made a clear distinction between topic content and the skills learnt from studying the topics; the majority stated that the skills were of far more importance than the actual topic content.

*“It doesn’t matter what the topic is – it could be the behaviour of a dolphin – as long as the students have the means to grasp the basics, plan their answers and use practical skills”*

**Nuclear organisation, North West**

Employers want to see topics structured in a way that will enable students to learn core disciplines in biology, chemistry, physics and maths – and more importantly, to know **how to apply them**. For instance, maths should not be treated as a subject separate from science, but should be inherent within science topics. Measuring and weighing in order to make up solutions is a prime example of this. It was emphasised many times that the way in which the topics are actually taught will determine the extent of success of the Diploma.

Employers are keen that schools and colleges adopt an approach that is **unified**, not only teaching the core scientific content, but also encouraging teamwork and effective communication, problem solving ability, the development of written and verbal presentation skills and providing regular opportunities to do practical work. Where possible, teaching should also link in with other relevant departments such as Geography, as there is a danger of duplicating topics such as geology that could be a part of either the Science or Geography curriculum.

For employers, the actual topic content of the Diploma in Science also wanes in interest compared with the way in which it will be taught. Employers are keen to see work related scenarios used in the classroom that relate to the way in which science is used ‘in the real world’; this they believe will engage and motivate students. Although employers were not specifically asked about assessment of the Diploma, several requests were made for a mix of continuous assessment and exams. The employers that raised this also spoke of the modular approach i.e. where students are taught one

module, assessed on it and then move on to the next - and stated that this is not an effective means of retaining skills and knowledge.

Of the suggestions for topic content that were made, many tie in with proposed topics within the draft LoLs of February 2009 (albeit this is for information only as it must be taken into consideration that this document is currently being revised). Only four suggested topics from the list below - dissection, how medicines work in the body, how light produces colour and electromagnetism - do not feature in the draft LoLs as at February 2009. Employers were unable to link their ideas to specific levels of the Diploma; a number stated that the topics suggested were important at all levels.

- Blood circulation
- Physiology
- Disease prevention
- Energy
- Dissection
- Human biology
- Anatomy
- Mechanics
- Electronics
- How medicines work in the body
- The solar system
- Electromagnetism
- Organs of the body
- Diet and nutrition
- Wavelengths
- Ethics
- Distillation
- Plant biology
- How light produces colour
- Genetics
- Applied Physics
- Reproduction
- Electricity

It should be noted that employers do not expect that the Diploma can be or indeed should be structured in a way that seeks to cover every topic and skill they deem to be important. It was acknowledged that this would be an unrealistic ambition. Instead, they would like to see the inclusion of topics that will engage the students, and exemplify the bigger picture in terms of how science relates to the real world, including awareness of significant companies in each sector and key influential figures in science.

*“Every company and sector is different...the Diploma couldn’t possibly cover every type of science...it is the general techniques underpinning this knowledge that will be of the most value”*

**Petrochemicals organisation, North West**

As already stated, the relative importance of topic content diminishes when compared with the acquisition of practical skills. It is the transferable skills that are predominantly, in employer’s eyes, engendered through practical work, that are of most value.

*“It is more important to understand how to apply principles to other areas – transferrable skills learnt at schools are the most valuable. It is not about knowing every formula or experiment plan, but about knowing how to go away and research what is needed”*

**Pharmaceutical research organisation, South East**

### 5.7 Single sciences versus the multi-disciplinary approach

Overall, there was a very even balance between preference for the study of single sciences and a multi-disciplinary approach. Employers could see value in both methods, and one pointed out that *“you could argue both sides of this forever.”*<sup>15</sup> However when asked specifically about school leavers between the ages of 16 and 18, there was a clear preference for the multi-disciplinary approach. It was highlighted that the multi-disciplinary approach not only provides a broad background in core scientific disciplines, but also raises awareness of a wider range of career options and gives insight into the bigger picture. *“Multi-disciplinary builds a range of knowledge from an early stage, developing a broader understanding of how each subject fits into the broader scientific context and the bigger challenges and questions.”*<sup>16</sup>

Employers do, however, want to be reassured that the multi-disciplinary approach of the Diploma in Science will:

<sup>15</sup> Electronics manufacturer, South East

<sup>16</sup> Pharmaceutical research organisation, South East

- ❖ Provide scope to develop sufficient relevant practical skills<sup>17</sup>
- ❖ Teach students how to apply knowledge in different contexts<sup>18</sup>
- ❖ Deliver range of content but not at the expense of depth; it is important not to dilute any one discipline<sup>19</sup>
- ❖ Be structured correctly, with themes from all scientific disciplines threaded through the whole course – relationships between disciplines should be explained so students can see how they interact<sup>20</sup>

## 5.8 Work related learning

Employers were extremely receptive to the idea of using work related scenarios as a basis for teaching the Diploma in Science. It was suggested that representatives could go into schools and colleges and give demonstrations, or provide a class with a work related project specific to the organisation. The latter proposal had already been put into practice by some of the larger organisations interviewed. It was acknowledged that it is typically the large companies that have the time and resources available to contribute in this way, particularly where funding is made available through Corporate Social Responsibility policies.

Further suggestions included:

- ❖ Filming work undertaken in laboratories (subject to confidentiality restrictions), so that students could observe 'A Day in the Life'
- ❖ Creation of structured guidelines to help teachers deliver a particular topic
- ❖ Basic titration – use of colourful chemicals and how they relate to different industries
- ❖ Activities to show how science works e.g. building a racing car
- ❖ Visits to science environments
- ❖ Virtual working environments
- ❖ Science clubs – focusing on projects set by local employers

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<sup>17</sup> Education resource supplier, East of England

<sup>18</sup> Electronics manufacturer, South East

<sup>19</sup> University hospital, South East

<sup>20</sup> Pharmaceutical research organisation, South East

Giving learners the opportunity to 'see science in action' was of fundamental importance from the employer perspective. On the whole, employers appeared more willing to become involved in the development of work related learning activities than 'work placements'.

## 6. Generic Learning

### 6.1 Functional Skills

It is acknowledged by employers that the Diploma in Science has a valuable opportunity to make its mark. However one employer from the engineering sector stressed that it must quickly establish *where* it will add value to employers, as they will soon grasp when the first students come through the ranks whether or not it is making a difference to key skills like literacy, numeracy and practical ability<sup>21</sup>. It is of great importance to employers that the school leavers and graduates they recruit have skills in English, Mathematics and ICT.

#### 6.1.1 Mathematics

Employers expect both school leavers and graduates to be numerate; *"it should be engrained"*<sup>22</sup> but the majority of employers reported that all age groups are notably lacking in mathematical ability.

*"Maths should figure more prominently in all areas of the curriculum where possible, to embed understanding"*

**NHS hospital, Yorkshire**

The mathematical skills of most value to employers and therefore the areas they would like to see taught within the Diploma in Science are:

<sup>21</sup> Engineering organisation, North East

<sup>22</sup> Nuclear organisation, North West

- ❖ Mental arithmetic
- ❖ Statistics: how to calculate a mean; understand standard deviation and the significance of numbers; consider the confidence interval and check data for reliability and validity
- ❖ Percentages
- ❖ Fractions and decimals
- ❖ Ability to use different formulae and apply them to different situations
- ❖ Calculus (requested by NHS and the Chemicals sector )
- ❖ Algebra
- ❖ Ratios
- ❖ Equations
- ❖ Units of weight and volume
- ❖ Ability to use a scientific calculator
- ❖ Ability to draw graphs
- ❖ Times tables – enables students to look for and find patterns in numbers
- ❖ Pure maths in mechanics (Requested by the Chemicals and Engineering sectors)
- ❖ Develop general confidence - *“too many students are scared of maths”*<sup>23</sup>

In order for this to be ‘engrained’ as employers require, it was widely suggested that mathematics should be applied to scientific contexts, rather than taught in isolation. Therefore science teachers will need the confidence to teach mathematics in order for this to be effective.

### ***6.1.2 Literacy and communication***

Employers are typically disappointed with the standard of literacy amongst the school leavers and graduates they recruit. Communication skills are also deemed to be poor. When asked if and how the Diploma in Science could address these issues, over half of the employers pointed to **report writing and presentations** as the best means of developing literacy and effective communication. They would like to see a much larger requirement for report writing and presentations on the Science curriculum, specifically for individual as well as group presentations, and for the delivery of concise reports that summarise and prioritise the findings.

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<sup>23</sup> Pharmaceutical research organisation, South East

Other suggestions included:

- ❖ Present scientific information in a **meaningful** way – without jargon<sup>24</sup>
- ❖ Teachers need to provide constructive criticism in order to improve grammar and spelling and give extra weight to the quality of English when marking science assignments
- ❖ Group projects; the students should have to solve a problem and deliver a presentation at the end
- ❖ Group discussions – ideally where students are compelled to comment on what others have said, so they become accustomed to receiving feedback
- ❖ Read scientific articles or watch programmes; the students should be tasked with reporting back either verbally or in the form of a written report **minus the scientific jargon** – this develops research and evaluation skills as well as communication
- ❖ Group debates – to help students to construct an argument and present it logically
- ❖ Ask students to verbally present their written reports
- ❖ Task the students with writing a business plan – this could be linked to a real organisation

### **6.1.3 ICT**

Employers are less concerned about skills in ICT than literacy and numeracy – mainly because the people they recruit “*tend to be computer literate.*”<sup>25</sup> They are satisfied with the standards in existing qualifications and would encourage the ongoing use of PCs to help with research, presentations and written reports. The ideal for employers would be to recruit students with experience of different types of software.

## **6.2 Personal Learning and Thinking Skills**

Whilst all of the personal learning and thinking skills inherent within the teaching of the Diploma were held in high regard by employers, team working and independent enquiry were the skills

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<sup>24</sup> Healthcare organisation, South East

<sup>25</sup> NHS hospital, London

highlighted by employers as the attributes that would add most value to an organisation. Team working, particularly when combined with the requirement to give presentations, was considered to be another means of helping students relate to the workplace, as well as an effective method of improving communication skills. Independent enquiry was linked back to practical skills and experience, with a number of employers arguing that this was the best way to encourage the enquiring mind and research/investigative skills.

*“Team-working in itself is a vital skill for the workplace”*

**Nuclear organisation, North East**

Employers considered that both school leavers and graduates were deficient in some areas of the personal learning and thinking skills identified by the Diploma in Science.

**Table 4: Employer satisfaction with personal learning and thinking skills of graduates and schools leavers**

Personal Learning and Thinking Skills	Employer comments about Graduates	Employer comments about School leavers
Independent enquiry	<p>“There is a dependency culture – they expect to be told the answer so do not question and challenge”<sup>26</sup></p> <p>“They don’t demonstrate independent thought”<sup>27</sup></p>	<p>“Too many young people are ‘spoon fed’ and find it very difficult when put in a position to think for themselves”<sup>28</sup></p>
Creative thinking	<p>“No evidence of taking it to the next level”<sup>29</sup></p>	<p>“They need to be able to develop innovative ways of solving problems”<sup>30</sup></p>
Reflective learning	N/A	<p>“Reflective learning is essential – so that students think about how</p>

<sup>26</sup> Pharmaceutical research organisation, South East

<sup>27</sup> Education resource supplier, West Midlands

<sup>28</sup> Drug development organisation, Yorkshire

<sup>29</sup> Education resource supplier, West Midlands

<sup>30</sup> Electronics manufacturer, South East

		the process could be changed and improved” <sup>31</sup>
Team working	“They find it difficult to develop good working relationships” <sup>32</sup>	“They need to learn how to work as part of a team, how it might be strengthened and what different individuals can bring to the process” <sup>33</sup>  “Their work impacts on the rest of the department; it isn’t an individual thing like at school. Their behaviour also impacts on others – they don’t appreciate that” <sup>34</sup>
Self-management	“They lack project management skills” <sup>35</sup>	“The hardest thing for school leavers to grasp is that they must get to work on time and deliver what they promise – they seem to think that once school is behind them, work will be on their terms” <sup>36</sup>
Effective participation	“They have poor interpersonal skills” <sup>37</sup>	“They need to learn how to be a good team member and understand that all contributions are important” <sup>38</sup>

### 6.3 Work experience

Work experience is recognised to be a crucial component of the Diploma. Employers believe that placements develop useful traits such as confidence, motivation and an enthusiasm for science, in addition to providing exposure to the working environment which helps students make an informed choice when deciding on a career.

<sup>31</sup> NHS hospital, Yorkshire

<sup>32</sup> Technology organisation, West Midlands

<sup>33</sup> Utilities organisation, London

<sup>34</sup> NHS hospital, Yorkshire

<sup>35</sup> Nuclear organisation, North East

<sup>36</sup> Polymers organisation, North West

<sup>37</sup> NHS hospital, Yorkshire

<sup>38</sup> Utilities organisation, London

Many employers stated that work experience typically involves a lot of work with very little guidance from schools. Many organisations are willing to participate in work experience but have no idea how to organise this; it was felt that schools and students could do more to make the experience productive, for example by researching the organisation in advance or bringing a project with them.

*“It is essential to establish a clear objective before students arrive, so that both parties know what they want to gain from the experience”*

**Utilities organisation, London**

A high proportion of employers believed that placements of two weeks were not long enough to add value for either the employer or the student. One NHS employer felt that this was largely because the students step into a “*controlled environment*” and thus they are typically shielded from any problems that arise during their visit. Suggestions for the length of work placements ranged from one month,<sup>39</sup> six weeks<sup>40</sup> and six months,<sup>41</sup> however it was recognised that it is unlikely the latter two proposals would be put into practice.

## 7. Additional and Specialist Learning

### 7.1 Overview

Employers were asked for their suggestions for additional and specialist learning (ASL) content. The concept of ‘bolt-on’ options to the Diploma in Science was well received, especially if subjects chosen would offer students a more rounded outlook and help to stimulate enthusiasm for learning. However there were some caveats to be taken into consideration. A ‘joined up’ approach would be encouraged by employers to avoid duplication of subject matter. For example, geography would not be considered to be the most complementary topic given that some areas such as geology can often overlap with science. Employers would like to see careers guidance offered to help students make

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<sup>39</sup> Chemicals organisation, North West

<sup>40</sup> Food analysis laboratory, West Midlands

<sup>41</sup> Diagnostics organisation, South East

an informed choice in terms of their ASL options as it was felt that some subjects could help to bridge the gap between schools/colleges and the workplace.

*“ASL is all well and good but there is no point doing specialist units unless it will follow on to a career or higher education choice. Will students be quizzed about their interests and future goals before being asked to choose? How many 16 year olds know for certain what they want to do as a career? ASL should be linked in to careers guidance”*

**NHS hospital, Yorkshire**

It was suggested that a more independent approach to ASL could be adopted at Advanced level<sup>42</sup>; for instance setting a project on a specific topic and tasking the student to develop their own research methodology to investigate a hypothesis and report back on the findings. This could be incorporated with work related learning and exposure to the workplace, for instance by sending the student to interview an industry representative as part of the research. It was also stated that ASL would be of most value at Advanced level because of the scope afforded to students to study one area in detail. One employer proposed that tailored ASL courses should be developed specifically for the Diploma, *“rather than relying on the old, staid A-levels and GCSEs.”*<sup>43</sup>

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<sup>42</sup> Food analysis laboratory, Yorkshire

<sup>43</sup> Engineering organisation, South West

## 7.2 Proposed ASL options

**Table 5: Employer suggestions for ASL options for the Diploma in Science**

Suggested Option	Advantages for Employer
Business Studies*	To equip students with a wealth of useful skills such as a general exposure to the ways in which businesses operate; project planning; introduction to relevant legislation; structuring a business plan; knowledge of costs and margins and an insight into sales and marketing. It was also suggested that an understanding of business studies helps build credibility
IT	More in-depth knowledge of IT would improve employability skills
Health & Safety	A number of Engineering and Manufacturing employers stated that learning about Health & Safety as a topic in its own right would help embed knowledge of processes and procedures relevant in the workplace
Languages	“It would not be an essential in terms of selection criteria, but it would certainly help young people stand out from the crowd” <sup>44</sup> Many companies, particularly the larger ones, deal with a wide range of countries making language capability highly sought after by employers
Concrete Technology	Specialist knowledge reduces burden and costs of training
Advanced Maths**	Should be offered as an option for those that will need more in-depth knowledge, for instance where going on to study physics at university
History of Science	Knowledge of key figures and major discoveries is not necessarily of direct benefit to an employer, but helps students develop a more rounded understanding of science and develop research skills
Statistics**	To assist with analysis of figures and enable students to

<sup>44</sup> Polymers organisation, North West

	identify the significant numbers
Design Control	As a topic in its own right, design control provides skills in project planning and design, which are useful in every industry
Design/ Graphic Design	“Quite literally going back to the drawing board” <sup>45</sup> would facilitate a move into a career as a design engineer
Microbiology**	Could be linked to current affairs such as the development of a flu vaccine
Drug development**	Specifically of interest to drug discovery organisations
Quality control/quality assurance	Suggested by Engineering organisations in particular
Biotechnology	Of value for Food Science, Medicine and Agricultural sectors
Control engineering	Useful for Petrochemical and Engineering employers if students can gain an insight into key chemical engineering principles such as reaction, distillation, pyrolysis and catalysis
Renewable energy technology	Suggested by several Utilities organisations
Environmental Studies	Of particular interest to employers in the Horticulture and Utilities sectors
Career “tasters”	An NHS employer suggested that small projects within different career paths would add value to employers as students would be better equipped to make an informed choice. NHS “taster” areas could include: physiotherapy techniques; occupations therapy techniques and how to keep and manage patient records
Genetics**	Of most value to students intending to progress to higher education
Advanced English	Notably report writing
Haematology	A potentially useful introduction for students that progress to a career within the NHS
Media Awareness	A course that could be specifically tailored for science students would be useful – to educate them of the ways in which information can be portrayed and how that should be critically analysed, and not taken at face value. This would be of

<sup>45</sup> Nuclear organisation, North West

	particular value to controversial organisations such as those that conduct testing on animals as part of their research
Animal husbandry/Zoology	Given that the role of animal technician is a popular destination for school leavers between 16 and 18, this would be a very useful addition to the Diploma
Economics	To broaden general knowledge and help develop commercial awareness
History	Helps students to relate science to the real world and the bigger picture – history could educate students about science in warfare and the impact of technological advances on real people; for example events like Hiroshima
Art	To help bring science to life in terms of the development of different colours and textures (for instance, fabric design)
Plant/Soil Science	For students with particular interest in Horticulture
Metallurgy	Helps bridge the gap and thus enable faster transitions into design or engineering roles

\*20% of all employers interviewed suggested that Business Studies would be of the most value, particularly at Foundation and Higher level where students plan to go straight into the workplace rather than to Higher Education

\*\*Employers noted that these options would be most relevant at the Advanced level of the Diploma in Science

## 8. Career pathways

### 8.1 Careers guidance and the Diploma in Science

The overriding message from employers is that learners must be given sufficient exposure to science as it happens in industry – to see that *“it is exciting, and truly relates to the real world.”*<sup>46</sup> However there was much concern expressed that careers advice and guidance is *“traditionally poor.”*<sup>47</sup> The majority of employers do not have faith in schools and colleges to promote the benefits of science

<sup>46</sup> Nuclear organisation, North East

<sup>47</sup> Royal Horticultural Society

careers, especially in terms of salaries and job satisfaction.<sup>48</sup> Many interviewees strongly recommended that career guidance should come from an external source, given that many teachers (particularly in further education) have never worked in industry and thus lack the knowledge to enable them to give advice.

*“Careers advisors should be from industry, not academia otherwise they cannot hope to do a good job”*

**Utilities organisation, West Midlands**

In order to promote the diverse range of careers on offer within science industries, employers suggested a number of initiatives:

- ❖ Career talks delivered by employers to schools and colleges
- ❖ Careers fairs in schools incorporating interactive events and presentations from local employers; invite parents as well as they influence career choice
- ❖ Field trips to experience different industries
- ❖ Encourage employers to get involved in National Science Week
- ❖ Work placements – see industry in action
- ❖ Hold ‘Milk round’ recruitment cycles for school leavers, not just graduates
- ❖ Science clubs in schools and colleges
- ❖ Encourage attendance from schools and colleges at high profile science events such as the Big Bang Fair in London
- ❖ Improve and extend the range of careers information on the internet, as this is typically the first port of call for students – utilise modern channels such as Twitter or YouTube
- ❖ Involve bodies such as the Royal Society of Chemists to help promote science careers
- ❖ Visits from HR managers of local employers to inform students between the ages of 14 to 16 that it is not mandatory to go to university to start a career in science
- ❖ Encourage schools and colleges to make use of STEM ambassadors and recruit more people to take on similar roles

<sup>48</sup> *“There is a clear message to be delivered to schools – improve the careers advice, and quickly”* Nuclear organisation, North West

Concern was expressed that potential recruits between the ages of 16 and 18 would not view the career path of technician as attractive because the role is perceived to be under-valued and poorly paid. A priority should be to promote this role and make it much more attractive to school leavers – particularly as it is the most accessible route into a science career for this age group. A representative from the clinical research sector stated that salaries for science careers need to be more widely publicised, as there is a sense amongst graduates in particular that they can earn more money in other sectors.<sup>49</sup> It was suggested that the manufacturing sector does not appeal to many school leavers or graduates because there is a damaging perception of what it is like – “*we need to de-bug the myth that manufacturing is a dirty, smelly place.*”<sup>50</sup>

A pharmaceutical research employer pointed to the celebrity factor, arguing that in today’s society of magazines and television programmes, recruiting ‘idols’ in the public eye could have a significant impact in terms of popularising a scientific activity or campaign and may help to make science more appealing to a wider range of young learners.

## 8.2 Career options identified by employers interviewed

**Table 6: Potential job roles/divisions for graduates by sector**

Sector	School Leavers
Biometrics	Statistician Statistical Programmer Research & Development
Biopharmaceutical	Drug Design and Development Clinical Trial Evaluation
Biotechnology	Research & Development Quality Control
Chemicals	Research and Project Development
Clinical Trials	Researcher Laboratory Scientist

<sup>49</sup> Clinical trials organisation, South East

<sup>50</sup> Petrochemicals manufacturer, North West

Defence	Chartered Engineer
Drug Development and Clinical Research	Laboratory Technician Science Associate Researcher Study Co-ordinator Business Development
Ecology	Computer Science Ecology Researcher
Education Resources	Sales & Marketing Project Manager IT Manager Bid Team Leader
Electrochemicals	Research & Development Sales & Marketing
Energy	Finance HR Project Manager Engineer
Engineering	Research & Development Metallurgist Electrical Engineer Electronics Engineer Research and Testing Commercial HR Finance
Food and Drink	Laboratory Technician Technical Manager Managerial roles across all departments
Healthcare	Analytic Development Scientist Formulation Development Scientist Process Development Scientist Technology Engineer Process Engineer
Horticulture	Research Assistant Botanist Plant Pathologist Soil Scientist

Manufacturing	<p>Trainee Managers in all departments                      Research and Testing                      Mechanical Engineer</p>
NHS	<p>Junior role (upon graduation) in a range of departments including pathology, diagnostics, life sciences, physiotherapy, pharmacology and physical engineering                      Research Scientist                      Clinical Scientist                      Biomedical Scientist</p>
Nuclear	<p>Nuclear Engineer                      Project Manager                      Scientist                      Physicist                      Finance                      HR</p>
Petrochemicals	<p>Operations                      Manufacturing                      Technical Process Improvement                      Research Engineer                      Chemical Engineer                      Mechanical Engineer</p>
Pharmaceutical Research	<p>Study Co-ordinator                      Research &amp; Development Scientist                      Clinical Testing                      Sales &amp; Marketing                      Chemistry Design Scientist                      Synthetic Analyst</p>
Polymers	<p>Research &amp; Development                      Microbiologist                      Chemist</p>
Technology	<p>Project Manager                      Mechanical Engineer                      Research &amp; Development</p>
Utilities	<p>Trainee Managers in all departments                      Team Leaders in Operations</p>

There are fewer jobs within the science sector on offer to 16 year olds than to 18 year olds – particularly where the role is in an environment that would be deemed dangerous, or where the employment of 16 year olds would be restricted by regulations. Furthermore, generally speaking employers are more willing to recruit a higher proportion of 18 year olds as there is a perception that 16 year olds are not sufficiently mature for the workplace, albeit many are accepted into apprenticeships where they will receive in-depth training and development. Unsurprisingly, employers have lower expectations of school leavers between the ages of 16 and 18 than they do of graduates.

The majority of employers interviewed for this research recruit more graduates than level 3 students. Several reasons were given for this:

- a. Expertise is needed at graduate level in a particular field
- b. Having formerly recruited within this age group, the company policy is now to outsource the work that this age group would have undertaken, to companies based overseas
- c. School leavers do not have sufficient skills or experience to put them into the more challenging situations – therefore only graduates would be selected

However, just over a quarter of the employers interviewed stated that they would be keen to recruit more school leavers at levels 2 and 3 - and in some cases, level 1 - if they could demonstrate that they possessed the skills listed above. A representative from a large Biotechnology organisation stated that if such skills could be embedded through the Diploma in Science, then school leavers would be of interest to logistics departments that need meticulous and confident people to handle the materials. **Thus there is a clear opportunity for the Diploma in Science to make a difference to the way in which employers perceive students leaving school with Foundation and Higher level qualifications, by equipping them with the skills and knowledge of most value to them.**

Having considered the structure of the Diploma in Science, employers were asked to consider whether it would enable them to recruit more school leavers if they had this qualification. The majority of employers stated that they did not anticipate that it could make a significant difference to the types of roles/levels school leavers were recruited in at. This is partly because the bulk of the organisations interviewed typically promote graduates only, and to progress through the ranks,

school leavers would be expected to study for further qualifications. Only one employer, a Biotechnology organisation, perceived that there could be a different role on offer for school leavers at entry stage (as a materials handler) if the Diploma in Science equipped them with skills in accuracy and attention to detail.

Representatives from the Petrochemicals and Energy sectors could see scope for people with a Higher level Diploma to ultimately progress into managerial roles; however others were more reticent, stating that they would have to reserve judgement until they have seen the quality of the individuals leaving school with a Diploma. Generally speaking, employers may be prepared to **consider** recruiting more school leavers if they have the Diploma in Science - with the stipulation that it actually delivers what it promises in terms of the key skills they value. *“If we were asked to choose between two trainees and one had more practical experience than the other, then that person would have the advantage.”*<sup>51</sup>

**Table 7: Potential job roles/divisions for school leavers by sector**

Sector	School Leavers
Biometrics	Administration
Biopharmaceutical	Preference for graduates
Biotechnology	Laboratory Technician
Chemicals	Manufacturing Assistant
Clinical Trials	Junior Technicians (18 years + only)
Defence	Apprenticeships Technician
Drug Development and Clinical Research	Laboratory Assistant Sample Processor Animal Technician
Ecology	Trainees in all departments

<sup>51</sup> Engineering organisation, East Midlands

Education Resources	Administration Office junior
Electrochemicals	Trainees in all departments (limited intake at age 16) General Assembly Administration
Energy	HR Assistant Finance Assistant Electrical Cabling Joiner Electricity Maintenance Technician
Engineering	Apprentice Electrician Apprentice Mechanical Fitter Machine Operative Trainee Supervisory role within Operations or Maintenance
Food and Drink	Apprenticeships Laboratory Assistant
Healthcare	Apprenticeships Assistant Administrator
Horticulture	Retail Assistant Catering Assistant Trainee Gardener (18 years + only)
Manufacturing	Apprenticeships Laboratory Assistant Sample Processor
NHS	Administration Laboratory Assistant ECG/Respiratory Measurement Assistant Trainee Pathology Technician* Trainee Phlebotomist* Radiography Assistant* Pharmacology Assistant* Audiology Assistant* Physiotherapy Assistant* Trainee Biomedical Scientist** Pharmacy Technology Assistant* Equipment Technician
Nuclear	Technician Administration

Petrochemicals	Apprenticeships Production Technician Engineering Technician Laboratory Assistant Process Plant Operations Maintenance Technician
Pharmaceutical Research	Research & Development** Animal Technician Trainee Pathology Assistant* Laboratory Assistant Trainee Histologist* Trainee Assistant in Metabolism* Administration
Polymers	Laboratory Technician
Technology	Laboratory Assistant Administration
Utilities	Apprenticeships Trainee Quantity Surveyor** HR Assistant Finance Assistant

\*With the caveat that school leavers will only be accepted into these roles if they concurrently study for a relevant specialist qualification to supplement their existing ones (e.g. GCSEs or A-Levels or Diploma at all levels) such as animal husbandry.

\*\*With the caveat that those accepted into these roles would also be expected to study part-time for a degree or HND in order to progress from trainee level. This therefore limits these roles to students aged 18 and above with A-levels or an Advanced Diploma as 16 year olds would not have the minimum entry requirements to be accepted on to a degree course.

## 9. Implementation

### 9.1 Work experience issues

Although the work experience component of the Diploma was deemed to have a positive impact for learners and ultimately for employers, in the short-term, actually sourcing and managing the number of relevant work experience places needed for forthcoming Diploma in Science students is widely perceived to be a challenge. It will be vital to ensure that issues are considered and resolved prior to the introduction of the Diploma in Science, as the work experience component is a vital element.

*“Lots of employers still see it as a lot of work for them. This perception will impact on its success unless it is addressed now. Actual practical advice is not readily available – the only thing we can find is promotional material with employers saying how good it is, not how it works in practice”*

**Nuclear organisation, North East**

It was noted that the South East is *“the place to be for science”*<sup>52</sup> due to the high volume of science employers in the region but it was acknowledged that not all regions would be as well supplied with relevant organisations for work placements. This was noted as a problem for the South East and West Midlands in particular, where there are a higher proportion of small organisations that typically have fewer resources, time and money to support students on work experience.

A number of employers stressed that placements must be meaningful and relevant; a representative from the Engineering sector pointed out that the Diploma documentation does not stipulate that the placements must be relevant to the science sector and stated that work experience is only valuable when it involves ‘real’ activities or work shadowing – *“two weeks doing the filing will not help.”*

Even though many employers expressed the view that work placements in excess of 10 days would be a better option, the majority still stated that it was difficult to accommodate students. Whilst the

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<sup>52</sup> Electrochemicals organisation, South East

requirement of the Diploma is for a **minimum** of 10 days' work experience, it appears unlikely that longer placements will be the norm. The impact of the current economic downturn has also deterred a number of employers from taking work experience students, as they inevitably have other priorities. One NHS employer pointed out that budgets are being squeezed for internal staff training, which leaves little, if any, left in the pot to support links with schools. The health and safety factor is also recognised as a possible barrier; *"the requirements are so demanding that they (the learners) have to be wrapped up in cotton wool and this makes it off-putting."*<sup>53</sup>

A problem raised by a large proportion of employers was that schools and colleges do not have the links with industry to facilitate work experience placements. It was acknowledged that whilst teachers have a busy workload, they could still adopt a more proactive approach towards developing relationships with local employers. Employers would particularly welcome attempts from schools to gain an understanding of their circumstances and therefore understand the impact of placement students, and as such, make feasible requests. One employer warned that many organisations will be discouraged from participating due to unreasonable demands.<sup>54</sup> For instance an NHS employer in London was asked by one school to take 30 students but could only just accommodate 8; *"this was impractical and unworkable but the school did not seem to realise this."* One employer pointed out that he had written to the local secondary school offering opportunities for work placements but to date had received no reply.<sup>55</sup> Employers would like to see schools taking more accountability; they could for instance develop relationships with the Science Ambassadors.

The majority of employers recognise that they have their part to play and are willing to do so, as students that are better equipped for the working environment provides them with a longer-term benefit. Very few of the employers interviewed stated that they would not be prepared to contribute to work placements, and those that did say this had good reasons; such as the company was far too small or legislation prevented them from doing so. However they want schools and colleges to provide more administrative and logistical support, as well as clarity in terms of what is expected of them. For instance, a representative from a Utilities organisation questioned whether all of the employees that would come into contact with students would need to have an enhanced CRB disclosure. Another stated that the school had asked to do a health & safety visit before the

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<sup>53</sup> Technology manufacturer, South East

<sup>54</sup> Nuclear organisation, North East

<sup>55</sup> Technology organisation, West Midlands

students arrived but this turned out to be more like a full scale audit and felt they should have been notified of this in advance.<sup>56</sup>

Additionally, employers expect the local consortia to get involved and act as broker between schools/colleges and industry to arrange placements.

*“The consortia should be working to source a range of placements that will span a variety of sectors”*

**Engineering organisation, South West**

## 9.2 Other issues

It was suggested that the teaching methodology of the Diploma in Science may be problematic notably in London, given the strong likelihood that it will require students to attend a number of different sites to access all of the resources required. A representative of an educational materials supplier was of the opinion that *“there will be terrible problems experienced with Diplomas in transporting the children around. The idea that 16-18 year olds will move around happily from school to school is wrong.”* Other employers asked whether the Government would provide additional funding to cover students’ travel costs, or whether employers and parents would be expected to foot the bill.

The costs of developing appropriate materials for relevant work related scenarios was raised as an area for consideration by a limited number of employers.

Some employers also suggested that the introduction of the Diploma in Science could be detrimental unless sufficient thought was given to the impact on the curriculum. For example, schools with large class sizes may require additional resources in the form of laboratory teaching assistants and science teachers may need training to be able to effectively teach mathematics within the science syllabus.

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<sup>56</sup> Electrochemicals organisation, South East

Furthermore it was felt that a 40 minute lesson was not long enough to teach practical skills and undertake experiments.

*“It (Diploma in Science) sounds great on paper but it is possibly being pushed through too quickly without due consideration of the resources that will be needed”*

**Ecology research organisation, South West**

## **10. Other Points Raised**

### **10.1 Positive Feedback**

Representatives from sectors including the NHS, nuclear, pharmaceutical research, educational resources and engineering all expressed positive feedback about the Diploma in Science, particularly with regard to its aim of developing employability skills.

One employer who is also a member of the Science Council highlighted that the Diploma in Science is more likely to engage young learners if there is scope for actually doing experiments and seeing science in action in industry contexts. The applied learning approach has been particularly well received, as has a focus on the big (science) questions and “major challenges” as topic content can be adapted from this nucleus in line with the changing environment.

Particular support was expressed for the Foundation level; a number of employers believed that it could go a long way towards improving scientific literacy amongst 16 year olds.

### **10.2 Concerns**

Employers were broadly in agreement that the Diploma, if it is structured in a way that develops practical skills, will add value at all levels - particularly in assisting the transition into the workplace for students aged between 16 and 18. However the main cause for concern amongst employers is that the Diploma in Science still has a very low profile across the general population; parents and

teachers remain confused, particularly with regard to the target learners. One employer emphasised that *“unless the Diploma in Science has a clearly defined objective and target audience, it will fail.”*<sup>57</sup> Several employers actually referred to the Diploma as a vocational qualification even after reading through the background information. One NHS employer believed that not all organisations would see the value of the qualification, which may limit the options of some school leavers in the future if they sought support to study for further qualifications. A representative of an education resources supplier stated that the Diploma will only be able to overturn the perception that it is only suitable for the less able students if the content is relevant to the workplace and has sufficient substance.

Employer reactions to the Advanced level - specifically whether it will be sufficient to prepare students for higher education - were ambiguous. This was mainly because employers did not feel that the content of the Advanced level had been sufficiently defined to enable them to comment. However employers from the NHS, Drug development and Nuclear sectors all expressed concern that the theoretical content would be diluted at the expense of developing employability skills.

Limited comments were made about the assessment of the Diploma in Science, with a clear preference shown for examinations to be part of the process as opposed to a modular structure with continuous assessment.

### **10.3 Gender**

Employers have noted that there do not appear to be any significant problems in terms of gender inequality in science careers; the most common response was that it is very balanced certainly at graduate and school leaver intake. Within physics disciplines there is a stronger bias towards males, and in biology careers there is a stronger bias towards females, but this was not deemed to be a major problem by any employer.

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<sup>57</sup> Pharmaceutical research organisation, South East

#### **10.4 Local/National/Regional Specifics**

There were no major discernible differences in employer responses from region to region. However it was thought that schools and colleges in the South East and the West Midlands may experience the most difficulties in securing a range of relevant work placements for their Diploma in Science students.