

# Provision of science subjects at GCSE

2009

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## Introduction

The introduction of the National Curriculum saw a major change in the provision of science in secondary schools. In the early 1980s, students took combinations of the three traditional science subjects: biology, chemistry and physics, or a single subject (general) science course. With the introduction of GCSE examinations and the National Curriculum, there was a move away from the traditional science subjects to a double award science GCSE.

However, recent changes to the GCSE curriculum have provided schools and students with a much greater choice and the opportunity to make GCSE science more relevant to all students. Since 2006 (first certification in June 2008), awarding bodies offer a suite of science GCSEs aiming to ensure that pupils will be studying science that is relevant and up-to-date and that there is choice in the courses pupils take to prepare them for different career routes post-16.

The new programme of study for science sets out a core of content that is relevant to all pupils and specifies curriculum requirements for the equivalent of a single GCSE.

Additionally, the GCSE science double award qualification, where students received two identical grades for a course with twice the content as the GCSE science single award, was replaced by two single awards: GCSE science (known as core science) and one of two complementary GCSEs: GCSE additional science or GCSE additional applied science. These are intended to provide pupils with greater flexibility of choice of science qualifications and are graded separately. Additional science, which has a more academic focus, prepares students for progression to study AS and A-levels in the sciences. By giving more emphasis and space to more fundamental ideas in the sciences, it provides a stimulating preparation for more advanced study. The additional applied science is for practitioners of science and there is a strong focus on work-related learning. Young people learn the importance of standard operating procedures and how to apply them in problem-solving.

Students can also study separately GCSE biology, GCSE chemistry and GCSE physics to gain three full GCSEs in science.

Since 2002 (first results issued in 2004) there is a vocational route in science offered at GCSE level: applied science double award. This qualification is designed to offer students the opportunity to widen their participation in vocationally related learning. The course provides students with the technical knowledge, skills and understanding needed in the workplace, in further education or training. In particular, it aims to provide students with the ability to apply their science knowledge and skills to solving scientific problems in a variety of vocational contexts.

Therefore, the most common ways of covering the programme of study in science at GCSE level include:

- GCSE science
- GCSE science + GCSE additional science
- GCSE science + GCSE additional applied science
- GCSE biology + GCSE chemistry + GCSE physics
- GCSE applied science double award

Recently, there have been claims about science options being restricted in some schools and the effect that it could have on students' futures. In fact, some young people have reported that they had compromised their choices by tailoring their options to what the schools could make available.

Also, the Government had a target that by September 2008, all pupils achieving at least level 6 at Key Stage 3 would be entitled to study triple science GCSE (although, not necessarily in their own schools) and all science specialist schools were meant to offer triple science GCSEs.

This report investigates briefly the provision of the GCSE science subjects in secondary schools in England in 2009 by school type, school attainment and school deprivation. We define that a school provides a subject if at least one candidate from that centre takes the exam in that subject. This means that a school might be able to provide additional subjects if there were demand for them.

It should be borne in mind that there are other science qualifications at level 2, equivalent to GCSE, that account for a small percentage of the volume of science offered in schools (e.g. BTEC in applied science or OCR National Awards in science). They are an alternative to the courses considered in this report and they provide students with the technical knowledge and skills needed in the workplace, in further education or in training and the percentages of candidates taking them are increasing.

## **Data**

The analyses in this report were carried out using the data for the entire GCSE cohort (all awarding bodies in England) in 2009.

### *Sciences entries*

Entries in all science qualifications at GCSE level were obtained from the National Pupil Database (NPD). This database is compiled by the Department for Children, Schools and Families and it holds national examination data for all candidates that sit an examination in an academic year.

Some independent schools in England enter their candidates for IGCSE<sup>1</sup> examinations in science. It should be noted that the NPD has no information on any course that the students might have taken but which did not culminate in a public examination and, therefore, entries for the IGCSE are not considered in this report.

### *School type*

School type information was obtained from the awarding bodies' NCN (National Centre Number) database of educational establishments. The following types of schools were considered:

- Comprehensive schools
- Secondary modern schools
- Grammar schools
- Independent schools

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<sup>1</sup> The International General Certificate of Secondary Education, or IGCSE, is an international qualification for school students. The IGCSE is typically taken by 14 to 16-year-olds, and it prepares students for further academic work, including progression to AS/A-level study and the IB Diploma Programme.

### *School attainment*

The GCSE performance of a school was calculated as the average of the GCSE attainment of the students attending it. The GCSE attainment of the students was based on their mean GCSE score. This was calculated by assigning marks to the GCSE grades (A\*=8, A=7, B=6, C=5, D=4, E=3, F=2, G=1, U=0) and the 'mean GCSE' indicator was calculated by dividing the total score by the number of subjects attempted. The mean GCSE score ranges from 0 to 8.

The pupil-level GCSE performance data used to calculate the school level indicator of attainment was obtained from the NPD (see above).

The schools attainment variable was continuous and therefore was divided into three equal-sized groups (low, medium, high) using percentile values and schools were classified accordingly.

### *School deprivation*

The deprivation score of each school was calculated as the average IDACI score of the students attending it. This score is computed for each lower super output area (LSOA)<sup>2</sup> and it is an index of 'income deprivation affecting children'. It shows the percentage of children in the LSOA where the student's postcode lies who live in families that are income deprived. This data was obtained from the Pupil Level Annual School Census (PLASC) provided by the Department for Children, Schools and Families. The PLASC data gives detailed information about all the pupils in the English state school system, including personal data, such as ethnicity, first language or mother tongue, special needs, deprivation and eligibility for school meals.

The schools' deprivation variable was continuous and therefore was divided into three equal-sized groups (least, middle, most) using percentile values and schools were classified accordingly.

There is a clear relationship between school attainment and school deprivation (see Table 1). For example, 47% of the schools in the highest performing category are in areas of low deprivation compared to 11% of the schools in the lowest category.

Table 1: School attainment and deprivation, 2009

Attainment	Deprivation		
	Least	Middle	Most
Low	11.34	36.91	61.93
Medium	41.17	49.16	30.69
High	47.48	13.93	7.38

## **Results**

Table 2 presents the most popular combinations of science subjects offered in secondary schools in England. It should be noted that the triple science was available in about 46% of schools. This percentage increased about 11 points since 2007 (Table A1) and therefore more schools are offering triple science now. This fact

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<sup>2</sup> LSOAs are a conglomeration of a number of census output areas (each output area has about 150 households). They usually have a minimum population size of 1000 and an average of 1500. For more information visit <http://www.statistics.gov.uk>.

might, in part, account for the rise in the number of entries for GCSEs in biology, chemistry and physics in the last couple of years.

The provision figures for the double award (core and either additional or additional applied science in 2009) decreased about 10 percentage points from 2007 to 2009 and the percentages of schools offering a combination of science subjects which includes the applied science double award dropped about 6 percentage points in the same period.

In 2009, 80% of the schools were offering a science option that prepared their students for progression to study AS and A-levels in the sciences (that is, the triple science or the core plus additional science). This compares with 86% of the schools in 2007.

Table 2: Percentages of schools offering science subjects, 2009

Science combinations	% of schools
Biology - Chemistry - Physics (only)	2.50
Biology - Chemistry - Physics - Science: core	1.57
Biology - Chemistry - Physics - Science: core - Science: additional	27.77
Biology - Chemistry - Physics - Science: core - Science: additional applied	9.21
Biology - Chemistry - Physics - Science: core - Applied science DA <sup>3</sup>	3.50
Biology - Chemistry - Physics – Science: additional applied - Applied science DA	0.97
Science: core	11.95
Science: additional	0.21
Science: additional applied	0.15
Applied science DA	0.21
Science: core - Science: additional	24.34
Science: core - Science: additional applied	0.47
Science: core - Science: additional - Science: additional applied	7.77
Science: core - Applied science DA	0.23
Science: core - Science: additional - Applied science DA	2.31
Science: core - Science: additional applied - Applied science DA	0.04
Science: core - Science: additional - Science: additional applied - Applied science DA	0.53
Combinations including Biology - Chemistry - Physics	45.52 <sup>4</sup>
Combinations including Applied science DA	7.79 <sup>5</sup>

Table 3 presents the percentages of schools offering science subjects by school type. The provision of the three separate sciences was higher in independent and grammar schools than in comprehensive and secondary modern schools. The double award (core plus additional science) followed the opposite pattern. Note that there are some independent schools that offer the IGCSE science qualification instead of GCSE science subjects.

<sup>3</sup> Double Award.

<sup>4</sup> This percentage is the sum of the percentages of all science combinations that include biology, chemistry and physics.

<sup>5</sup> This percentage is the sum of the percentages of all science combinations that include applied science double award.

The percentages of grammar and independent schools offering a GCSE in applied science double award were very small (around 1%), compared to the percentages of maintained schools doing so (11%).

From September 2007, Key Stage 4 students have a statutory entitlement to have access to a course of study leading to at least two science GCSEs. Schools have to offer all students access to either science GCSE and additional science GCSE or all three of physics, chemistry and biology GCSEs. Schools may choose to offer other combinations of qualifications, but these must be in addition to, rather than instead of, these combinations. Table 3 shows that, in 2009, the triple science choice was available in more than half of the maintained schools. Core plus additional science was offered in about 73% of maintained schools and less than 1% of maintained schools offered the core science GCSE only.

Tables 4 and 5 show the percentages of schools offering science subjects by school's attainment and deprivation, respectively.

There is a strong pattern in the provision of science subjects by school attainment. Schools with high ability students are more likely to offer GCSEs in the three separate sciences than schools with low ability students (67% of the high attaining schools in comparison with only 17% of the low attaining schools offered the triple science). The percentages of schools offering only the core science GCSE or only a combination of core and additional science GCSEs decrease with the school's attainment.

Likewise, schools with pupils who live in areas with low deprivation are far more likely to offer GCSEs in the three separate sciences than schools with pupils who live in areas with high deprivation (62% vs. 31%). Also, the percentages of schools offering only the core science GCSE or only a combination of core and additional science GCSEs increase with increasing deprivation. This might lead to restricted options for high ability students who live or attend school in a deprived area.

Table 3: Percentages of schools offering science subjects by school type, 2009

Science combinations	Type of school				
	Comprehensive	Grammar	Secondary Modern	Independent	Maintained <sup>6</sup>
Biology - Chemistry - Physics (only)	0.19	11.31	0.00	9.30	0.81
Biology - Chemistry - Physics - Science: core	0.76	4.76	1.16	3.23	1.01
Biology - Chemistry - Physics - Science: core - Science: additional	29.25	66.67	16.76	44.61	30.64
Biology - Chemistry - Physics - Science: core - Science: additional applied	15.00	4.17	5.78	0.00	13.85
Biology - Chemistry - Physics - Science: core - Applied science DA	5.48	0.00	1.16	0.40	4.92
Biology - Chemistry - Physics – Science: additional applied - Applied science DA	1.64	1.19	1.16	0.00	1.58
Science: core	0.27	0.60	1.16	6.20	0.34
Science: additional	0.00	0.00	0.00	0.40	0.00
Science: additional applied	0.00	0.00	0.00	0.00	0.00
Applied science DA	0.04	0.00	0.00	0.00	0.03
Science: core - Science: additional	26.16	10.12	36.99	25.07	25.88
Science: core - Science: additional applied	0.19	0.00	1.73	0.00	0.27
Science: core - Science: additional - Science: additional applied	12.19	1.19	15.61	0.00	11.76
Science: core - Applied science DA	0.19	0.00	1.16	0.13	0.24
Science: core - Science: additional - Applied science DA	3.62	0.00	4.62	1.08	3.47
Science: core - Science: additional applied - Applied science DA	0.08	0.00	0.00	0.00	0.07
Science: core - Science: additional - Science: additional applied - Applied science DA	0.95	0.00	0.00	0.00	0.84
Combinations including Biology - Chemistry - Physics	52.32	88.10	26.01	57.55	52.81
Combinations including Applied science DA	12.00	1.19	8.09	1.62	11.16

<sup>6</sup> Maintained schools include comprehensive, grammar and secondary modern schools.

Table 4: Percentages of schools offering science subjects by school's attainment, 2009

Science combinations	Attainment		
	Low	Medium	High
Biology - Chemistry - Physics (only)	0.70	0.86	5.97
Biology - Chemistry - Physics - Science: core	1.19	1.15	2.37
Biology - Chemistry - Physics - Science: core - Science: additional	8.76	27.55	45.41
Biology - Chemistry - Physics - Science: core - Science: additional applied	3.78	13.66	9.24
Biology - Chemistry - Physics - Science: core - Applied science DA	2.03	4.78	3.40
Biology - Chemistry - Physics - Science: additional applied - Applied science DA	0.42	1.84	0.51
Science: core	35.11	1.96	1.86
Science: additional	0.28	0.17	0.19
Science: additional applied	0.42	0.06	0.00
Applied science DA	0.56	0.00	0.13
Science: core - Science: additional	26.42	26.22	20.33
Science: core - Science: additional applied	1.47	0.00	0.06
Science: core - Science: additional - Science: additional applied	6.87	11.64	4.30
Science: core - Applied science DA	0.77	0.00	0.00
Science: core - Science: additional - Applied science DA	3.08	3.11	0.71
Science: core - Science: additional applied - Applied science DA	0.07	0.06	0.00
Science: core - Science: additional - Science: additional applied - Applied science DA	0.70	0.69	0.19
Combinations including Biology - Chemistry - Physics	16.89	49.86	66.90
Combinations including Applied science DA	7.64	10.49	4.94

Table 5: Percentages of schools offering science subjects by school's deprivation, 2009

Science combinations	Deprivation		
	Least	Middle	Most
Biology - Chemistry - Physics (only)	1.49	0.77	0.43
Biology - Chemistry - Physics - Science: core	1.02	1.01	0.78
Biology - Chemistry - Physics - Science: core - Science: additional	37.49	22.74	18.09
Biology - Chemistry - Physics - Science: core - Science: additional applied	16.08	10.60	7.15
Biology - Chemistry - Physics - Science: core - Applied science DA	4.86	4.56	3.53
Biology - Chemistry - Physics – Science: additional applied - Applied science DA	1.41	1.31	0.95
Science: core	5.33	11.68	16.54
Science: additional	0.00	0.00	0.00
Science: additional applied	0.08	0.15	0.26
Applied science DA	0.08	0.08	0.26
Science: core - Science: additional	17.80	26.53	29.11
Science: core - Science: additional applied	0.00	0.62	0.95
Science: core - Science: additional - Science: additional applied	8.24	10.75	9.99
Science: core - Applied science DA	0.08	0.08	0.52
Science: core - Science: additional - Applied science DA	1.80	2.55	4.31
Science: core - Science: additional applied - Applied science DA	0.00	0.00	0.17
Science: core - Science: additional - Science: additional applied - Applied science DA	0.16	1.16	0.69
Combinations including Biology - Chemistry - Physics	62.35	40.99	30.92
Combinations including Applied science DA	8.31	9.67	9.91

## Appendix: Provision of GCSE science subjects in 2007

This appendix contains a reproduction of the tables in the report using data from 2007. As this was the last year the old science GCSE specifications were examined, Tables A1-A4 can be useful for comparison.

Table A1: Percentages of schools offering science subjects, 2007

Science combinations	% of schools
Biology - Chemistry - Physics	2.59
Biology - Chemistry - Physics - Science: SA	0.97
Biology - Chemistry - Physics - Science: DA	13.06
Biology - Chemistry - Physics - Applied science DA	0.13
Biology - Chemistry - Physics - Science: SA - Science: DA	11.79
Biology - Chemistry - Physics - Science: SA - Applied science DA	0.09
Biology - Chemistry - Physics - Science: DA - Applied science DA	2.48
Biology - Chemistry - Physics - Science: SA - Science: DA - Applied science DA	2.96
Science: SA	8.68
Science: SA - Science: DA	21.72
Science: SA - Applied science DA	0.22
Science: SA - Science: DA - Applied science DA	4.15
Science: DA	22.50
Science: DA - Applied science DA	3.35
Applied science DA	0.35
Combinations including Biology - Chemistry - Physics	34.07
Combinations including Applied science DA	13.71

Table A2: Percentages of schools offering science subjects by school type, 2007

Science combinations	Type of school				
	Comprehensive	Grammar	Secondary Modern	Independent	Maintained
Biology - Chemistry - Physics	0.46	2.41	0.00	10.11	0.54
Biology - Chemistry - Physics - Science: SA	0.19	0.60	0.00	3.75	0.20
Biology - Chemistry - Physics - Science: DA	8.73	52.41	5.20	30.46	10.96
Biology - Chemistry - Physics - Applied science DA	0.15	0.00	0.00	0.12	0.13
Biology - Chemistry - Physics - Science: SA - Science: DA	15.55	16.87	4.62	9.86	14.99
Biology - Chemistry - Physics - Science: SA - Applied science DA	0.15	2.41	0.00	0.37	0.27
Biology - Chemistry - Physics - Science: DA - Applied science DA	3.98	0.00	1.16	0.25	3.60
Biology - Chemistry - Physics - Science: SA - Science: DA - Applied science DA	4.82	0.00	1.16	0.00	4.34
Science: SA	0.42	0.00	1.16	3.50	0.44
Science: SA - Science: DA	26.90	4.22	44.51	10.11	26.66
Science: SA - Applied science DA	0.27	0.00	0.58	0.00	0.27
Science: SA - Science: DA - Applied science DA	6.45	0.00	6.94	0.00	6.12
Science: DA	23.03	18.67	26.01	25.72	22.96
Science: DA - Applied Science DA	5.27	0.00	4.62	0.00	4.94
Applied science DA	0.30	0.00	0.58	0.00	0.30
Combinations including Biology - Chemistry - Physics	34.03	74.70	12.14	54.93	35.03
Combinations including Applied science DA	16.12	2.41	10.40	0.75	15.03

Table A3: Percentages of schools offering science subjects by school's attainment, 2007

Subject combinations	Attainment		
	Low	Medium	High
Biology - Chemistry - Physics	0.67	1.35	5.52
Biology - Chemistry - Physics - Science: SA	0.52	0.53	1.82
Biology - Chemistry - Physics - Science: DA	1.94	8.00	27.77
Biology - Chemistry - Physics - Applied science DA	0.22	0.12	0.06
Biology - Chemistry - Physics - Science: SA - Science: DA	3.29	14.66	15.86
Biology - Chemistry - Physics - Science: SA - Applied science DA	0.15	0.12	0.00
Biology - Chemistry - Physics - Science: DA - Applied science DA	1.35	3.59	2.26
Biology - Chemistry - Physics - Science: SA - Science: DA - Applied science DA	1.94	4.71	1.94
Science: SA	26.08	2.18	1.00
Science: SA - Science: DA	27.06	25.13	13.61
Science: SA - Applied science DA	0.45	0.24	0.00
Science: SA - Science: DA - Applied science DA	5.23	5.83	1.44
Science: DA	20.33	23.66	23.07
Science DA - Applied science DA	4.41	4.83	0.88
Applied science DA	0.67	0.41	0.00
Combinations including Biology - Chemistry - Physics	10.09	33.08	55.24
Combinations including Applied science DA	14.42	19.84	6.58

Table A4: Percentages of schools offering science subjects by school's deprivation, 2007

Subject combinations	Deprivation		
	Least	Middle	Most
Biology - Chemistry - Physics	0.64	0.64	0.82
Biology - Chemistry - Physics - Science: SA	0.48	0.40	0.27
Biology - Chemistry - Physics - Science: DA	15.98	7.53	5.00
Biology - Chemistry - Physics - Applied science DA	0.00	0.00	0.36
Biology - Chemistry - Physics - Science: SA - Science: DA	18.47	13.54	6.55
Biology - Chemistry - Physics - Science: SA - Applied science DA	0.08	0.08	0.18
Biology - Chemistry - Physics - Science: DA - Applied science DA	4.10	2.80	2.55
Biology - Chemistry - Physics - Science: SA - Science: DA - Applied science DA	4.18	3.61	3.55
Science: SA	3.78	8.25	12.83
Science: SA - Science: DA	20.96	27.72	26.66
Science: SA - Applied science DA	0.32	0.08	0.45
Science: SA - Science: DA - Applied science DA	3.53	5.93	6.64
Science: DA	21.85	20.75	22.66
Science DA - Applied science DA	2.33	4.65	6.01
Applied science DA	0.00	0.32	0.91
Combinations including Biology - Chemistry - Physics	43.94	28.61	19.29
Combinations including Applied science DA	14.54	17.47	20.66