

4. Science leadership and delivery in schools

This section explores how science is delivered in schools and examines any differences between schools and teachers who use Explorify and those who do not.

4.1 Science leadership in the school

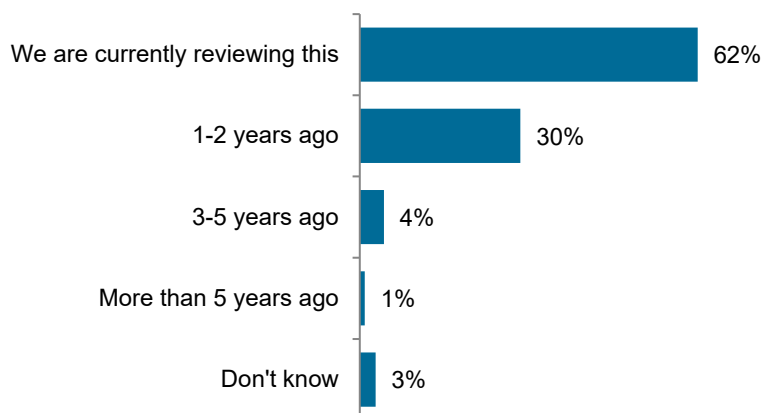
Almost all respondents (98%) to the science leadership survey report that there is a dedicated science leader at their school. Science leaders are responsible for leading science development and teaching in schools, either as an individual subject or as a cross-curricular topic area. A slightly higher proportion of larger schools (schools having a pupil cohort of 200-299 or 300 plus) have a science leader (100% and 99%, respectively) when compared with small schools (defined as less than 100 pupils), at 91%.

The majority of science leaders who responded to both surveys are classroom teachers (95%) and nearly two-thirds (61%) do not hold a science A level¹⁵ or Advanced Higher. One-quarter of science leaders (25%) hold one A level or Advanced Higher, while the remaining 14% hold two or more.

Just under two-thirds (62%) responding to the science leadership survey report that science is included in their School Development Plan for the 2019/20 academic year. This is more common for schools who are currently applying for the PSQM award (91%) compared to those who already hold the award (66%) or those that do not have it (60%). Schools that give their science leader specific release time to lead science (67%) are also more likely to have science on their School Development Plan compared with those who do not (53%).

Nearly two-thirds of schools report they are currently reviewing the way science is taught across the school (as reported in the science leadership survey). A further 30% reviewed this within the last 2 years and 5% reviewed it 3 or more years ago.

Figure 8: When the school last reviewed how science was taught across the school as reported in the science leadership survey. Base=853

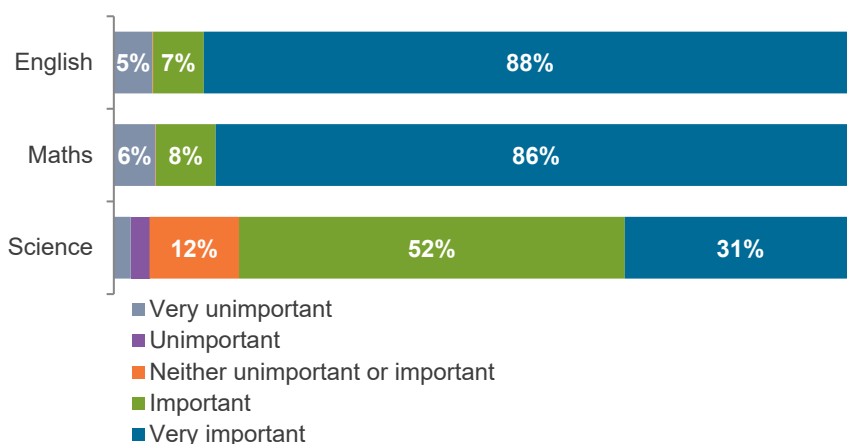


¹⁵ This has been defined as holding a Biology, Chemistry or Physics A level or Advanced Higher.

The importance of science

The majority of respondents to both surveys state that both English (95%) and maths (94%) are 'very important' or 'important' to their school, while a smaller proportion (83%) state their school views science the same way. When the answer 'very important' is examined, science is much lower at 31% compared with 88% for English and 86% for maths; while a further 12% state that science is 'neither important nor unimportant'. These findings are similar to those in the baseline report.

Figure 9: The perceived importance of subjects in school as reported in the science leadership and teaching surveys. Base=1268-1270.



The role that someone holds in a school influences their perceived importance of science, with a much higher proportion (67%) of senior leaders stating that science is 'very important', compared with only 28% of those in other roles. Over one-in-ten respondents (13%) who are not senior leaders state science is 'neither important nor unimportant', compared with only 2% of senior leaders.

Further differences are found by:

- **school size:** 53% of respondents from small schools (those with 99 pupils or less) state that science is 'very important', compared with 30% of respondents from larger schools with 100 or more pupils; and
- **science on the School Development Plan:** 35% of respondents from schools who have science on their School Development Plan state 'very important', compared with 26% of respondents from schools who do not have science on their development plan.
- **science leaders:** 27% of science leaders state 'very important', compared with non-science leaders (38%).

Release time for science leaders

Nearly two-thirds (61%) of science leaders get specific meaningful release time to lead science in their school, in addition to time to plan their own lessons. This is higher than reported in the baseline report when 52% of science leaders in England received release time. A higher proportion of science leaders from the largest schools (300-plus pupils) receive release time (69%) compared with science leaders from schools with between 200-299 pupils (59%), 100-199 pupils (52%) and those with fewer than 100 pupils (32%). A higher proportion of science leaders from schools who already hold, or are currently applying for, the PSQM award (69%) receive release time compared with those who do not hold the award (59%).

Analysis¹⁶ was undertaken to explore the best combination of individual and school-level characteristics that are associated with a science leader receiving release time. The final model was significant and indicates that school characteristics are the only factors that are associated with this. In order of importance these are:

- Larger schools
- Having science included on the School Development Plan
- Viewing science as important to the school

Among those who receive it, the amount of release time taken by science leaders varies. Most report taking release time either every term (29%) or every half term (29%) with only one-quarter (25%) taking regular release time every one or two weeks.

Table 2: Frequency of release time for science leaders as reported in the science leadership survey

Frequency of release time	Proportion
Approximately every week	17%
Approximately every two weeks	8%
Approximately every month	8%
Approximately every half term	29%
Approximately every term	29%
Other	9%
<i>Base</i>	458

The amount of release time taken by all Science leaders across a year is variable, with two-fifths (39%) receiving no release time, just over one-tenth (15%) taking just 10 hours or less a year and a further 17% taking between 11 and 20 hours. Only 5% of Science leaders take 41 hours or more across the year, equating to an average of around one hour per week. This is, however, an improvement on the findings in the baseline report where almost half of science leaders (48%) received no release time.

Table 3: Number of hours of release time taken by science leaders as reported in the science leadership survey

Number of hours of release taken each year	Proportion	Proportion at baseline ¹⁷
No release time	39%	48%
10 hours or less	15%	16%
11-20 hours	17%	16%
21-30 hours	4%	4%
31-40 hours	6%	9%
41 hours or more	5%	6%
Unsure of time/it differs	13%	1%
<i>Base</i>	757	435

¹⁶ Logistic regression. Variables added into the models but no association found for: percentage Free School Meals (FSM), whether school holds/does not hold PSQM, gender, whether Head/SLT or non-management, number years in teaching, full/part time worker, whether hold a science A Level/Advanced Higher, Explorify/comparator school. (Base = 666)

¹⁷ Proportion based on responses from English schools only for comparative purposes.



Around half of those interviewed receive release time for their science leadership duties and a few find that they sometimes have conflicting responsibilities, meaning that release time has to be spent preparing lessons and any other leadership or management responsibilities they have. Those who do not receive any release time describe undertaking their role during evenings and weekends; or they are part-timers and use their days off to make up for time lost. Interviewees who do not receive release time highlight how this inhibits their ability to fulfil the role.

“I get fifteen minutes when my class are doing music on a Wednesday each week, but no, effectively, I don't really get any. [I do it] in the evenings and at the weekends.”

Science leader

Science leaders use their release time to carry out lesson observations, plan lessons, mentor colleagues and, where the school is working towards it, prepare for PSQM. Almost all science leader interviewees who receive release time say it is sufficient and they appreciate the time they are given, taking into consideration that many science leaders and teachers do not have any release time at all. However, almost all agreed that more time would be welcome.

CPD for Science Leaders

In the last 12 months, just over half (57%) of all science leaders have undertaken external CPD lasting one day or more to help them lead or develop science throughout their school, similar to the levels reported in the baseline report. Those in smaller schools are less likely to report this, with only 22% of science leaders from schools with less than 100 pupils compared with those from larger schools with 100 or more pupils (59%). Higher proportions of science leaders from schools who hold the PSQM award (73%) and those applying for the PSQM award (74%) report undertaking CPD when compared to schools who do not hold PSQM (53%), which is not surprising given that participation in CPD is necessary to achieve the award. Nearly two-thirds (66%) of science leaders who are from a school where one or more teachers are using Explorify state they receive CPD, compared with 41% of those who are not.

Analysis¹⁸ was undertaken to consider the range of individual and school-level characteristics that are associated with a science leader receiving or participating in CPD during the last 12 months. The final model was significant and only two school characteristics are associated with this:

- Explorify schools
- Schools that hold the PSQM

On average, science leaders who took part in external CPD did so for 3 days. Over one quarter (29%) undertook one day of external CPD, just over one-quarter (26%) undertook up to two days, one-fifth (20%) undertook between two and three days, and the remainder (25%) undertook more than three days of CPD.

Almost all those interviewed had been on a science leadership course since beginning their role (but not necessarily within the last 12 months). Just over one-quarter attended a course at the STEM Centre in York and learnt about science leadership, different ways to teach science and methods of scientific enquiry. A few interviewees attended courses by The Ogden Trust, universities and Wellcome, focussing on primary science teaching. They found the courses useful in introducing them to different methods for teaching science and for leadership training. Networking opportunities were seen as invaluable by almost all interviewees who took part in external CPD, particularly via science leader network meetings and conferences. These courses and CPD events also allowed them to share best practice with other science leaders.

¹⁸ Logistic regression. Variables added into the model but no association found for: school size, FSM, gender, whether Head/SLT or non-management, number of years in teaching, full/part time worker, whether hold a science A Level/Advanced Higher, school has science on School Development Plan. (Base = 666)

“It was really useful. Very, very practical, very hands-on, hundreds of examples, but then also theory and strategy behind it, so that you’ve got things that you can then present back to your own teachers, things that you can try out yourself.”

Science leader

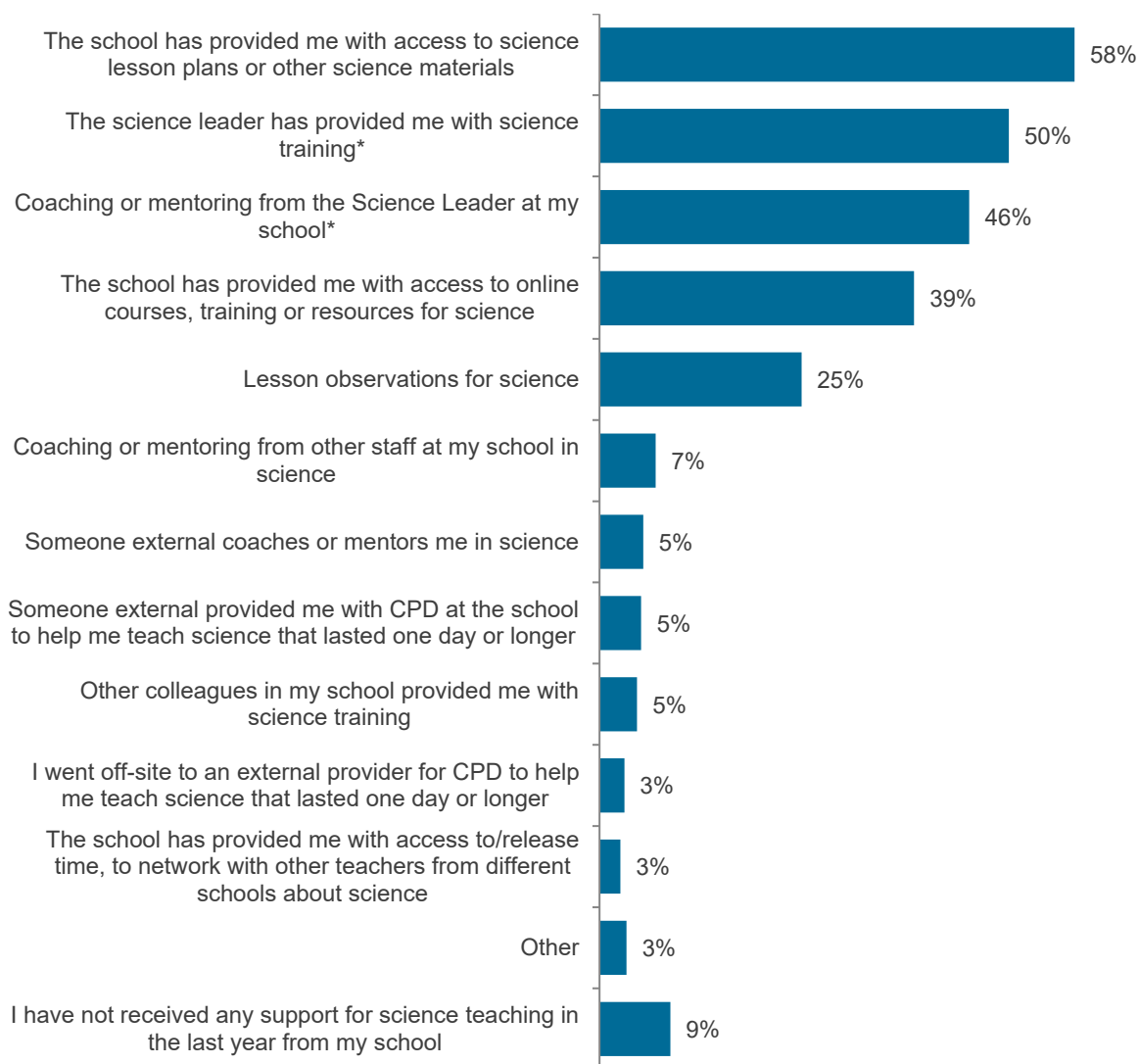
Alongside CPD, around one-quarter of science leaders are working towards, or had been recently awarded, PSQM, which is a CPD programme that allows schools to demonstrate how effective science leadership has a positive impact on science teaching and learning. Interviewees describe how the PSQM has increased the profile of science in their school and pushed them to collaborate with other schools.

Only a few science leaders who had recently taken on the role had not received science leadership CPD and were learning ‘on the job’. They also sourced online CPD, undertook their own research and gained support via colleagues and informal networking. However, they would value training in the future.

4.2 Science support and CPD for teachers

Respondents to the teaching survey (excluding science leaders) were asked to state what support their school had given them to improve their science teaching in the last 12 months. Providing access to lesson plans and materials (58%); training from their science leader (50%); coaching or mentoring from their science leader (46%); and the school providing them with access to online courses, training or resources (39%) were most frequently reported. The majority of respondents received some kind of support, with less than one in ten (9%) not receiving any support. This is lower than reported in the baseline study (at 30%) partly due to those teachers who are at a school that is using Explorify reporting higher support levels than the comparator sample (see Table 4).

Figure 10: Support received to improve science teaching in the last 12 months as reported in the teaching survey (excluding science leaders). Base=390, those with a * Base=389.



Higher levels of support were found between schools using Explorify and those who are not in four areas as shown in Table 4 below. Overall, just 2% of teachers from Explorify schools did not receive any support, compared to just over one-fifth (22%) from comparator schools.

Table 4: Support received to improve science teaching in the last 12 months by Explorify schools as reported in the teaching survey (excluding science leaders).

	Respondents from an Explorify school	Respondents from a Comparator school
The school has provided me with access to science lesson plans or other science materials	65%	42%
The science leader has provided me with science training	58%	35%
Coaching or mentoring from the science leader at my school	54%	29%
The school has provided me with access to online courses, training or resources for science	48%	19%
I have not received any support	2%	22%
Base	268-269	113

A number of other factors influence the likelihood of a teacher receiving support to teach science. These include:

- **holding or applying for the PSQM award:** 99% of respondents from schools that hold, or are applying for, the PSQM award receive support, compared with 89% of respondents from schools who do not hold PSQM;
- **science leader receiving CPD** (in schools with a science leader): a slightly higher proportion of respondents (96%) whose science leader had received CPD in the last 12 months receive support compared with 86% of respondents whose science leader had not received CPD in the last 12 months.
- **science leader release time** (in schools with a Science Leader): a slightly higher proportion of teachers (95%) who have a science leader who receives release time for their role receive support compared with 87% of teachers from schools where their science leaders does not receive release time.

During interviews, teachers describe they are less likely to participate in external CPD which relates to science compared to science leaders. Science leaders typically pass on learning from external CPD they have attended to teachers in their school. More recently, delivering internal CPD has become challenging due to the pandemic and science leaders have responded by using online software to deliver individual and/or group CPD. A few teachers interviewed have found their own CPD; often reliant on online resources which provide advice on delivering specific aspects of science. This was described as even more important for teachers during the lockdown.

Although there is a general acceptance that there is little time for teachers to take part in external science CPD, a few teachers would like to undertake this and one reported undertaking this themselves.

"I knew it would be beneficial for my teaching, and I knew it would help and I wanted to do it, so I just arranged it off my own back."

Teacher

A few teachers said they had received CPD from their science leader over the last year through meetings or individual support. Science leaders describe how they use a combination of school-wide and individual support to ensure the level of guidance is sufficient for each staff member.

"I always do an audit just to see what people's skills are because they're often quite happy to say on paper what they can and can't do... We have CPD every term and we moderate every term and we catch up and chat. We have more informal book looks, communal book looks where we're just saying 'This is what we've done,' and somebody might say, 'Oh, that's a good idea,' or, 'Oh, you could do that,' and so often that happens as well. So, it's a very sharing situation."

Science leader

Science leaders describe how they undertake lesson observations to monitor the delivery of science teaching in their school and give feedback on what they have observed. A few teachers also reported watching their science leader teaching to observe best practice. To try and provide additional opportunities for teachers, a few science leaders also use 'team teaching' where teachers work together to plan lessons, observe each other and collaborate. This approach is viewed as favourable by teachers.

4.3 Science teaching in the school

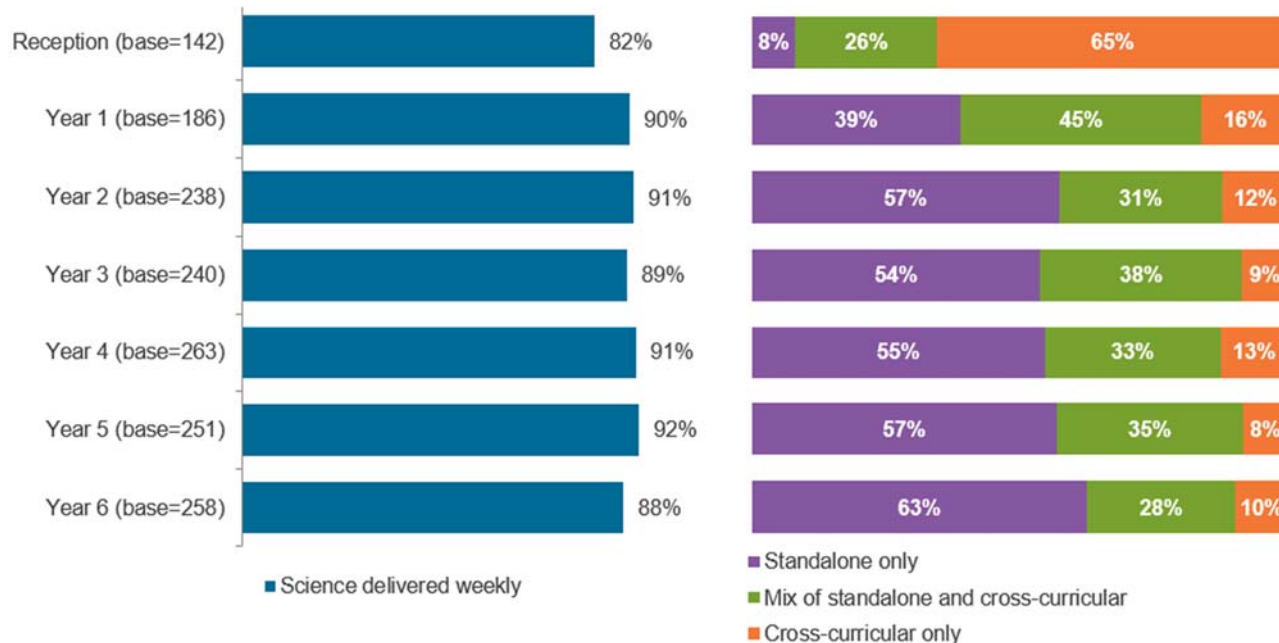
Classroom teachers deliver most science lessons in the vast majority (92%) of schools. Just 4% of schools have a science teacher who takes science lessons, 4% have a mix of the two and just two schools use other staff to deliver science. A higher proportion of small schools (those with less than 100 pupils) have a specific science teacher (13%), compared with 3% of all other schools.

Regularity of science teaching

Teaching science weekly

Across schools, a high proportion of year groups are taught science weekly either as an individual subject or as part of cross-curricular work. Stand-alone science lessons are more prevalent for older year groups while Reception pupils are more likely to receive cross-curricular lessons only, reflecting the baseline findings.

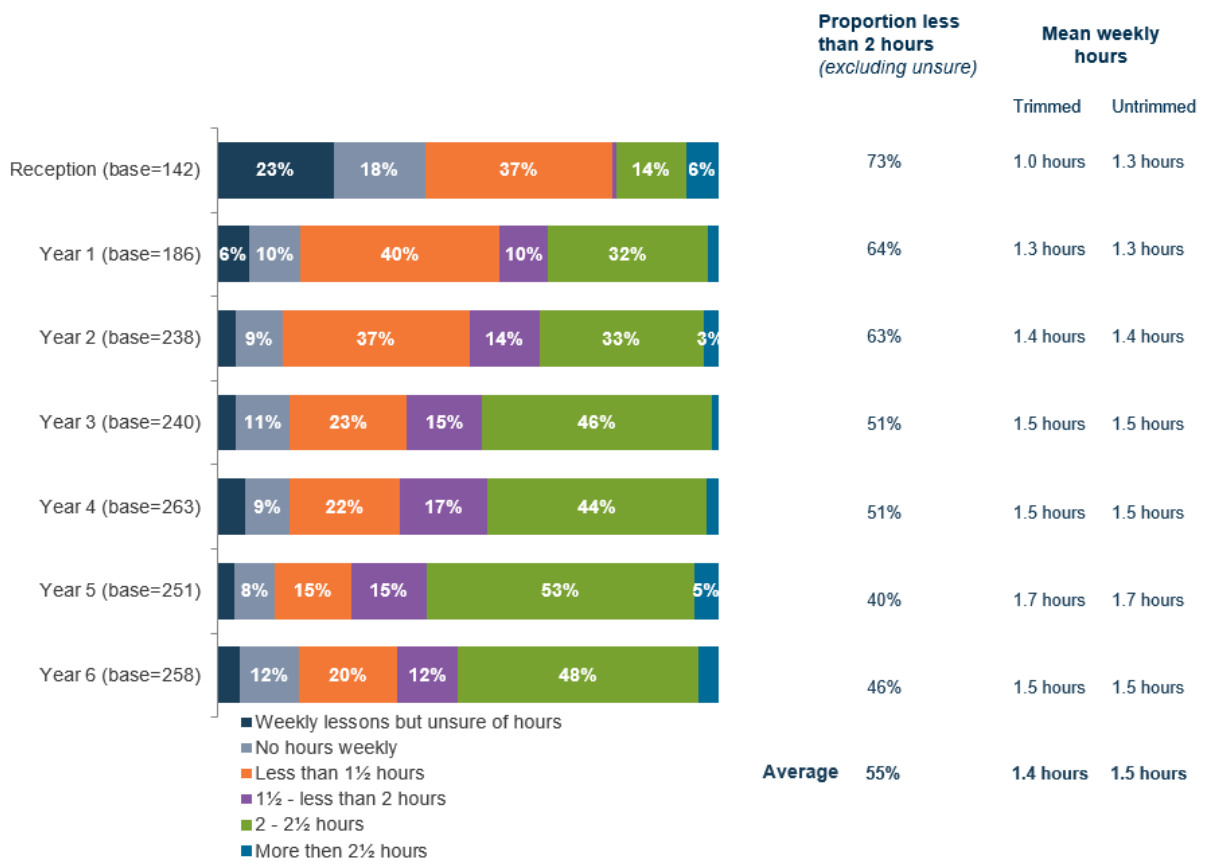
Figure 11: Weekly science delivery by year group and mode of delivery as reported in the science leadership and teaching surveys



On average, science is taught weekly for 1.4 hours a week (1 hour and 24 minutes) and 55% of classes receive less than 2 hours a week (excluding those who were unsure about the time but including those who teach no science weekly). On average, younger year groups receive fewer hours of weekly lessons, with the amount of science taught increasing slightly as pupils get older, reflecting the baseline findings.

Just under one-quarter (23%) of those teaching Reception pupils are unable to estimate the amount of time they spend teaching science. For the remaining year groups, the proportion who could not indicate the number of hours spent teaching science is much lower.

Figure 12: Hours of weekly science delivery by year group as reported in the science leadership and teaching surveys¹⁹



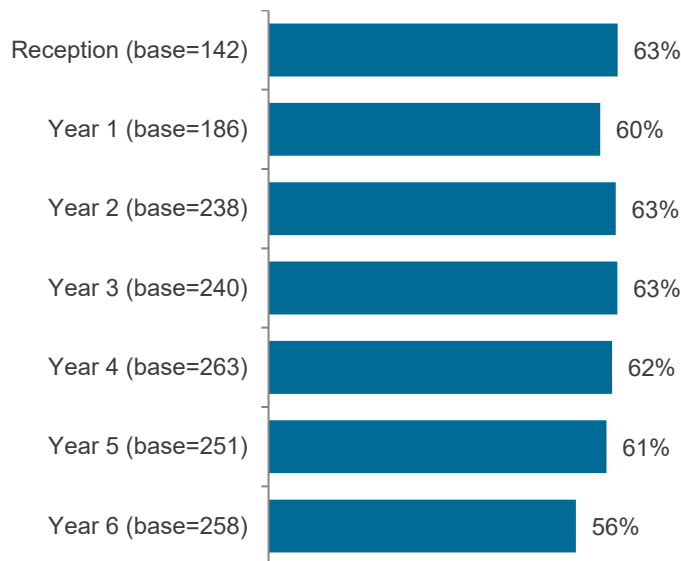
Dedicated science weeks

Just over two-fifths (43%) of those who teach science deliver it through dedicated science weeks. For most teachers, (see Figure 15 later in this chapter), this is an additional activity that complements other delivery methods rather than being a stand-alone approach. For the majority (88%) of teachers, science weeks are delivered once a year. Only a small minority delivered two or more science weeks a year (See Appendix 2 for a full breakdown by year group).

¹⁹ A trimmed mean at 5% was used to calculate these figures. This excludes 5% of responses in the sample (2.5% of cases from the lower end of the scale and 2.5% from the higher end of the scale) to prevent the mean being skewed by schools with extremely high or low figures. This ensures that the mean more accurately reflects the majority of schools in the sample.



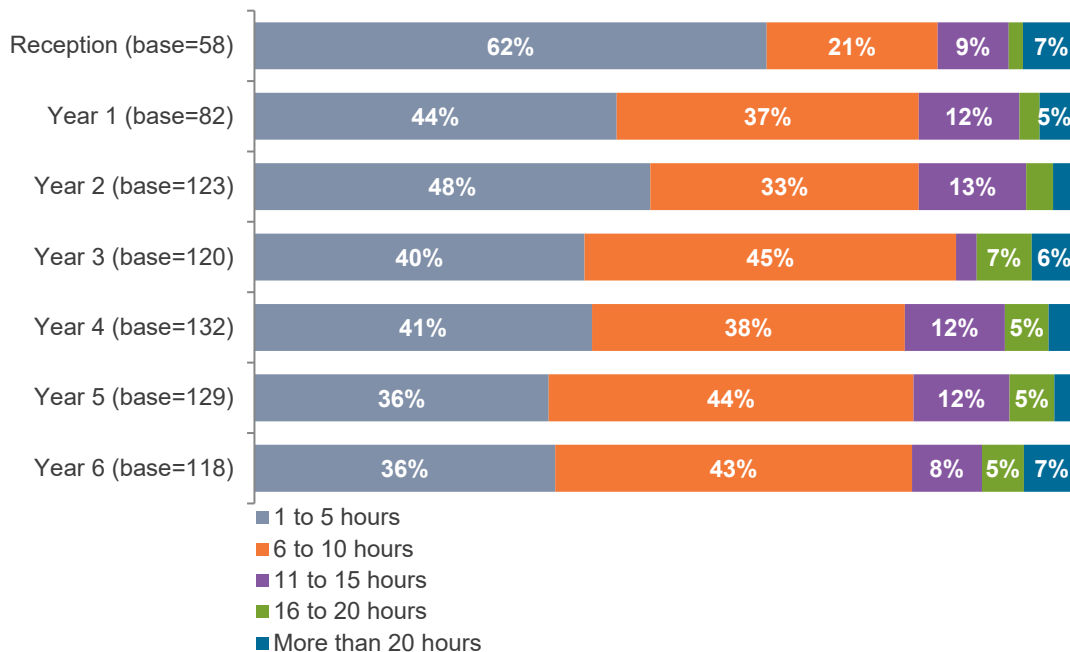
Figure 13: Dedicated science week delivery by year group as reported in the science leadership and teaching surveys.



Dedicated science week hours of delivery

In each science week, most teachers typically teach science for up to 10 hours for each class, with an average of between 7 and 9 hours across the week (Figure 14).

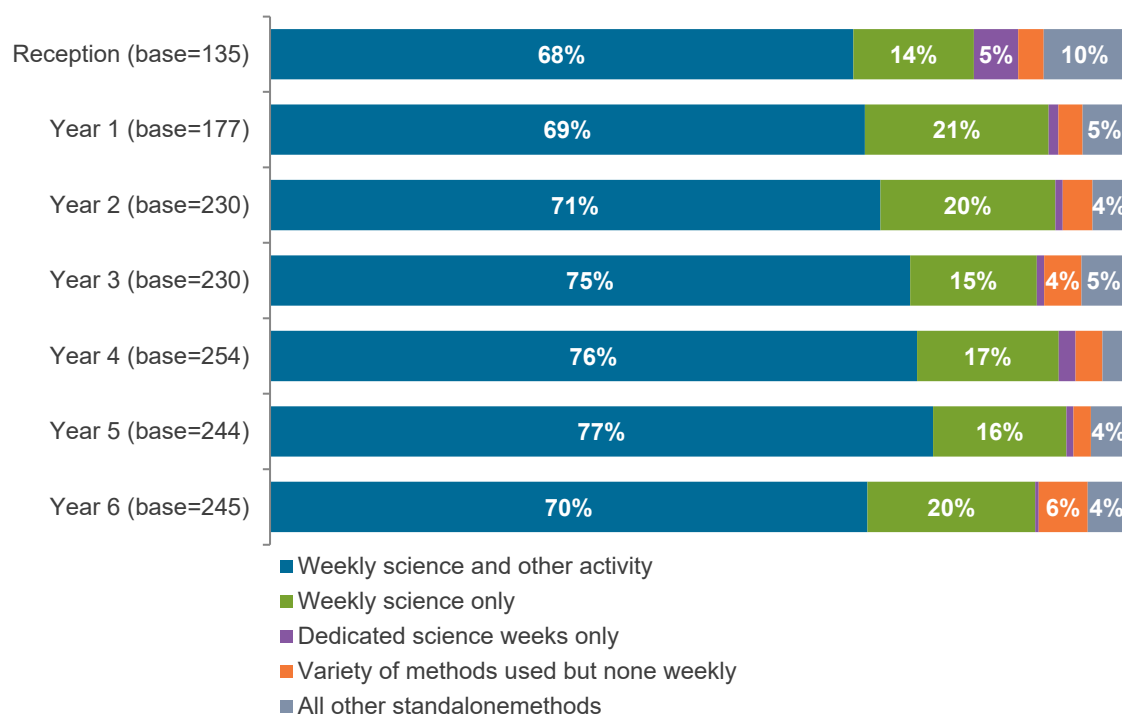
Figure 14: Total number of hours delivered through each science week in the school year as reported in the science leadership and teaching surveys



Main delivery methods

Science is not only taught through weekly lessons or science weeks but in a wide variety of ways. While the majority of respondents teach some form of science weekly, most combine this with other types of activity such as dedicated science weeks, science days and visits, which all increase the amount of science taught to pupils. Only a small proportion (up to 5%) teach science through dedicated science weeks only. Under 6% of respondents teach science through a variety of methods (more than one method used but none undertaken weekly) and 3%–10% through a stand-alone method (such as block teaching or fortnightly lessons). These are similar findings to those in the baseline report.

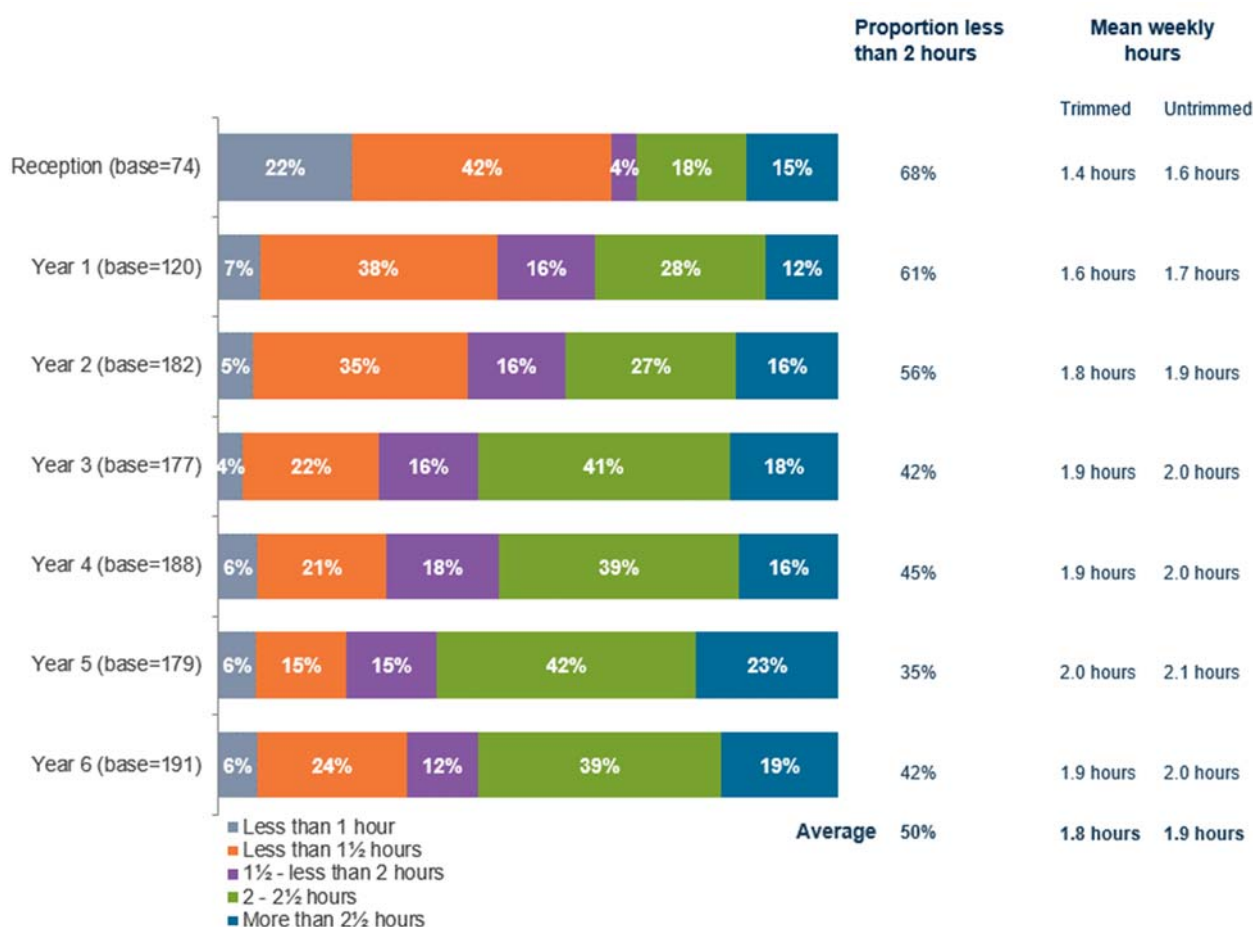
Figure 15: Overall delivery method by year group as reported in the science leadership and teaching surveys



Total hours of delivery

Across the various methods used by teachers, the number of hours of teaching was combined to calculate a total number of hours taught in a year. This was then averaged across 39 weeks of the school year to calculate a weekly average. On average, science is taught for 1.8 hours a week (1 hour and 48 minutes a week). The proportion of year groups receiving *less than 2 hours of science teaching* a week decreases by age from 68% in Reception to 42% in Year 6.

Figure 16: Average number of hours of science delivery per week by year group as reported in the science leadership and teaching surveys



Deciding how many hours to teach science

Almost all interviewees report that the amount of time spent teaching science is decided by senior leaders in the school. Science leaders (if not a senior leader) have limited input into how much time is specified, as English and maths are often prioritised. Around half of all interviewees report they would like to teach more science but that it is not possible.

“I would always campaign for way more science. Science has sort of dropped down the priority list in most primary schools, which I don't like and don't agree with, but that's the way it is. So, timetabling in terms of that comes from a higher level. The big focus recently has been on reading, so that has kind of squeezed any extra time out of the timetable really.”

Science leader

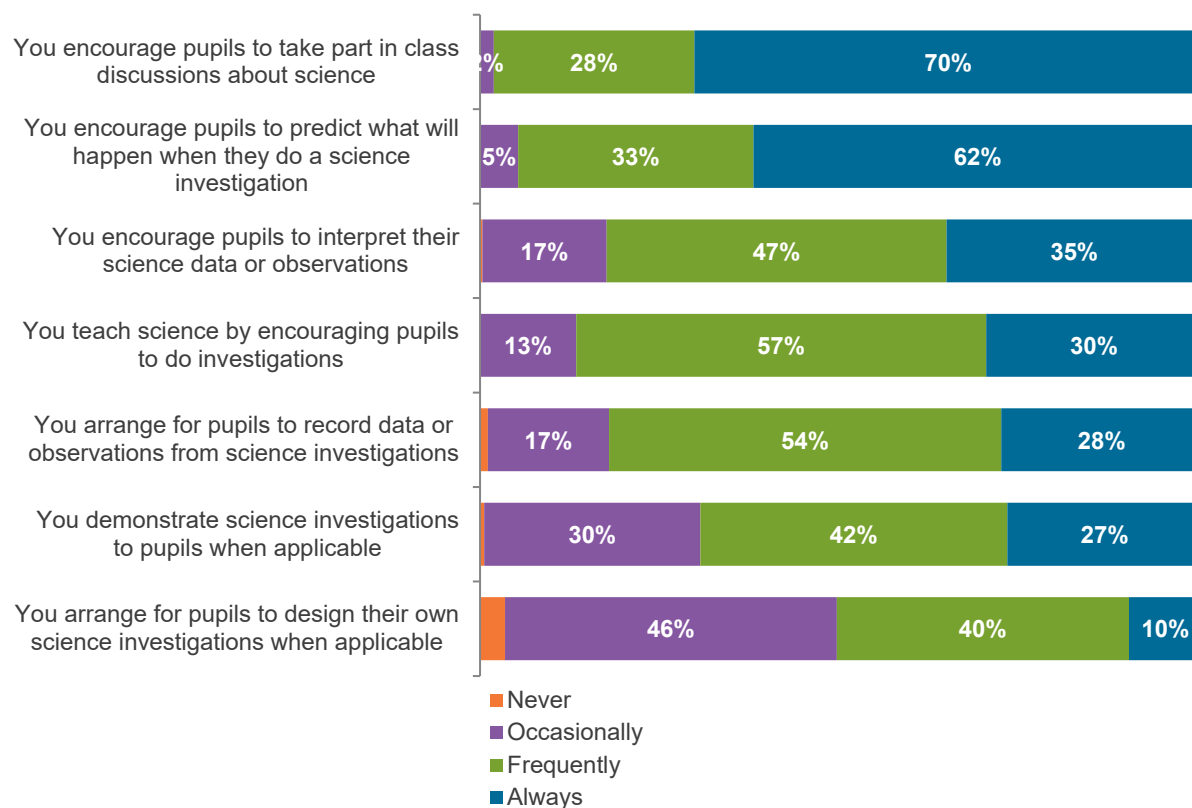
A few interviewees from schools with religious affiliations report that stipulations to teach Religious Education for a certain number of hours also inhibits their capacity to teach more science.

Teaching methods

Improving the quality of science teaching is a key objective of the primary science campaign, encouraging pupils to take part in class discussions, predict what will happen when doing investigations and undertaking their own investigations. A majority of respondents ‘always’ or ‘frequently’ encourage pupils to take part in class discussions and encourage pupils to predict what will happen when they do science investigations. A

much lower proportion state they ‘always’ or ‘frequently’ arrange for pupils to design their own science investigations.

Figure 17: Frequency of science delivery methods used in lessons as reported in the science leadership and teaching surveys. Base=1,182–1,196.



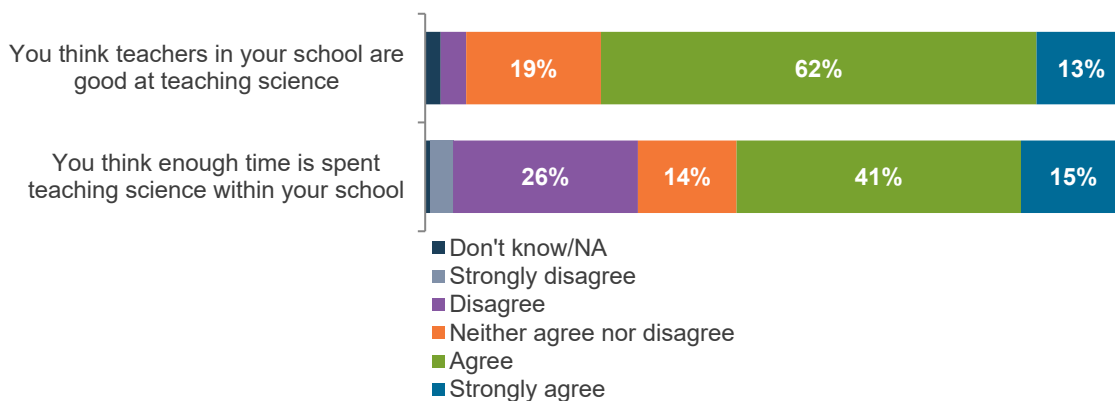
Differences are found by whether or not someone is an Explorify user:

- **you encourage pupils to take part in class discussions about science:** 73% of Explorify users state ‘always’, compared with 67% non-Explorify users; and
- **you arrange for pupils to design their own science investigations when applicable:** 44% of Explorify users state ‘frequently’, compared with 37% non-Explorify users.

4.4 Attitudes towards teaching of science

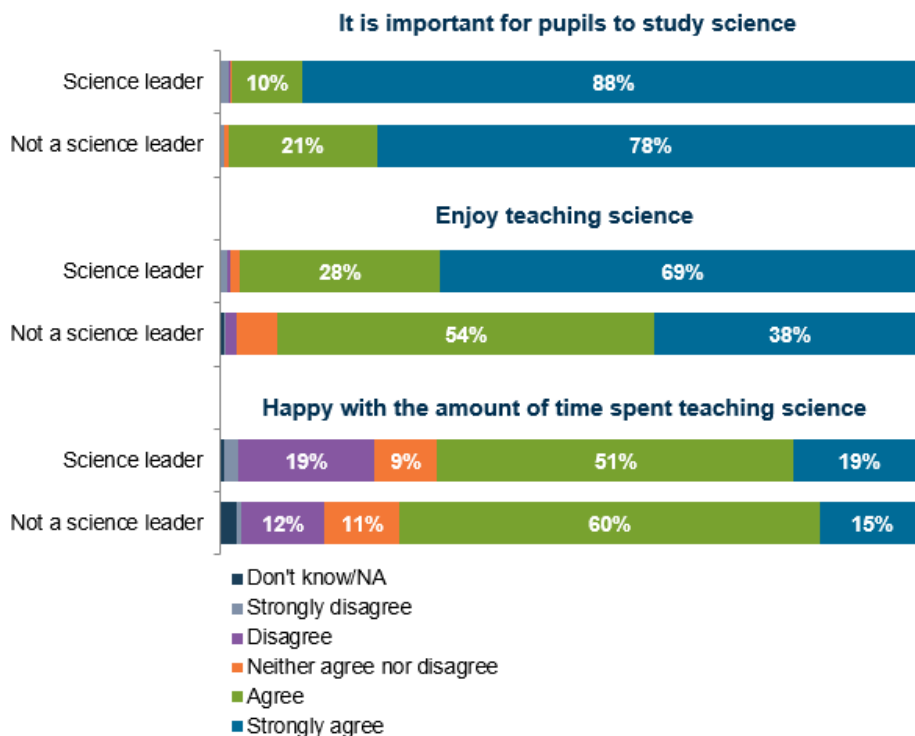
Three-quarters of respondents to the science leadership survey (75%) ‘strongly agree’ or ‘agree’ that teachers in their school are good at teaching science. However, a much lower proportion (56%) think that enough time is spent teaching science in their school, which reflects the baseline findings.

Figure 18: Extent of agreement about time spent teaching science and how good teachers are at teaching science as reported in the science leadership survey. Base=853.



Nearly all survey respondents (99%) ‘strongly agree’ or ‘agree’ that ‘it is important for pupils to study science’, while 95% enjoy teaching science. Only 71% of respondents ‘agree’ or ‘strongly agree’ that they are happy with the amount of time they spend teaching science.

Figure 19: Extent of agreement about science views by role as reported in the science leadership and teaching surveys. Base: science leader=786, Non-science leader=488.



Respondents from the teacher survey were asked to state the first three words which came to mind when describing science. Figure 20 provides an overview of the most common words reported.

Figure 20: Word cloud representation of the most common words teachers think of when describing science



Three-fifths (60%) of all 1,263 words provided were of a technical or scientific nature relating to the process of undertaking scientific experiments or investigations (see Figure 25) with, for example, the words ‘Investigation’, ‘Experiment’, ‘Practical’ often cited. A smaller proportion (6%) of responses related to the wider application of science, for example ‘Knowledge’, ‘Understanding’ and ‘World’; with 3% linked to school topic areas such as ‘Space’, ‘Environment’, ‘Nature’ or to the science disciplines ‘Biology’, ‘Physics’ and ‘Chemistry’.

One-quarter (24%) of responses were related to positive emotions – expressing the positive aspects of learning or teaching science – using words, for example, including ‘Fun’, ‘Exciting’ or ‘Interesting’. Negative emotions were less frequent and equated to 2% of responses, such as ‘Daunting’ or ‘Jargon’, or linking to the complexity of science, with responses including ‘Puzzling’, ‘Challenging’ or ‘Complex’.

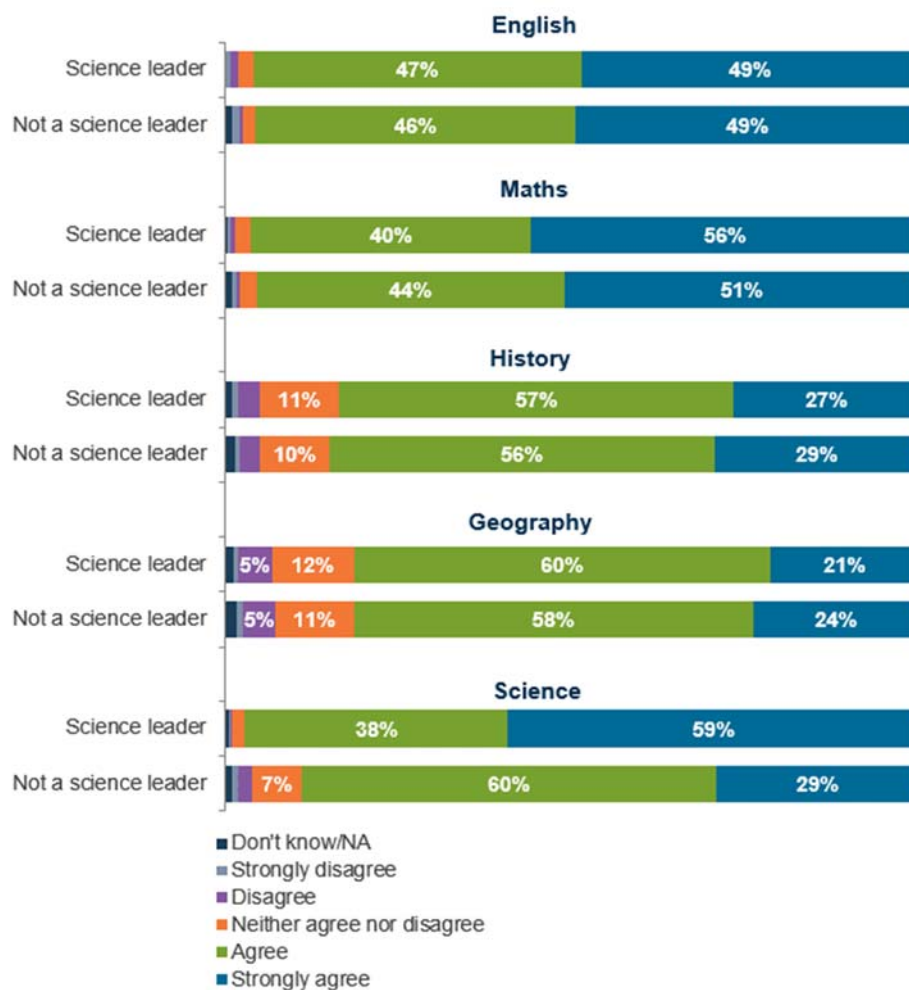
Figure 21: Word cloud representations of words relating to the process of undertaking scientific experiments or investigations (blue); positive emotions about science (green); and negative emotions and the challenges of science (orange).



4.5 Confidence teaching subjects

Levels of confidence in teaching maths, science and English are similar, with most respondents stating they 'agree' or 'strongly agree' (see Appendix 2). While there is very little difference between science leaders and non-science leaders' confidence in teaching English and maths, confidence in teaching science is much higher among science leaders (59% 'strongly agree' compared with 29% of non-science leaders) indicating it is specific to science.

Figure 22: Extent of agreement about confidence teaching subjects by role as reported in the science leadership and teaching surveys. Base: science leader=785 – 786, Non-science leader=487 – 488.

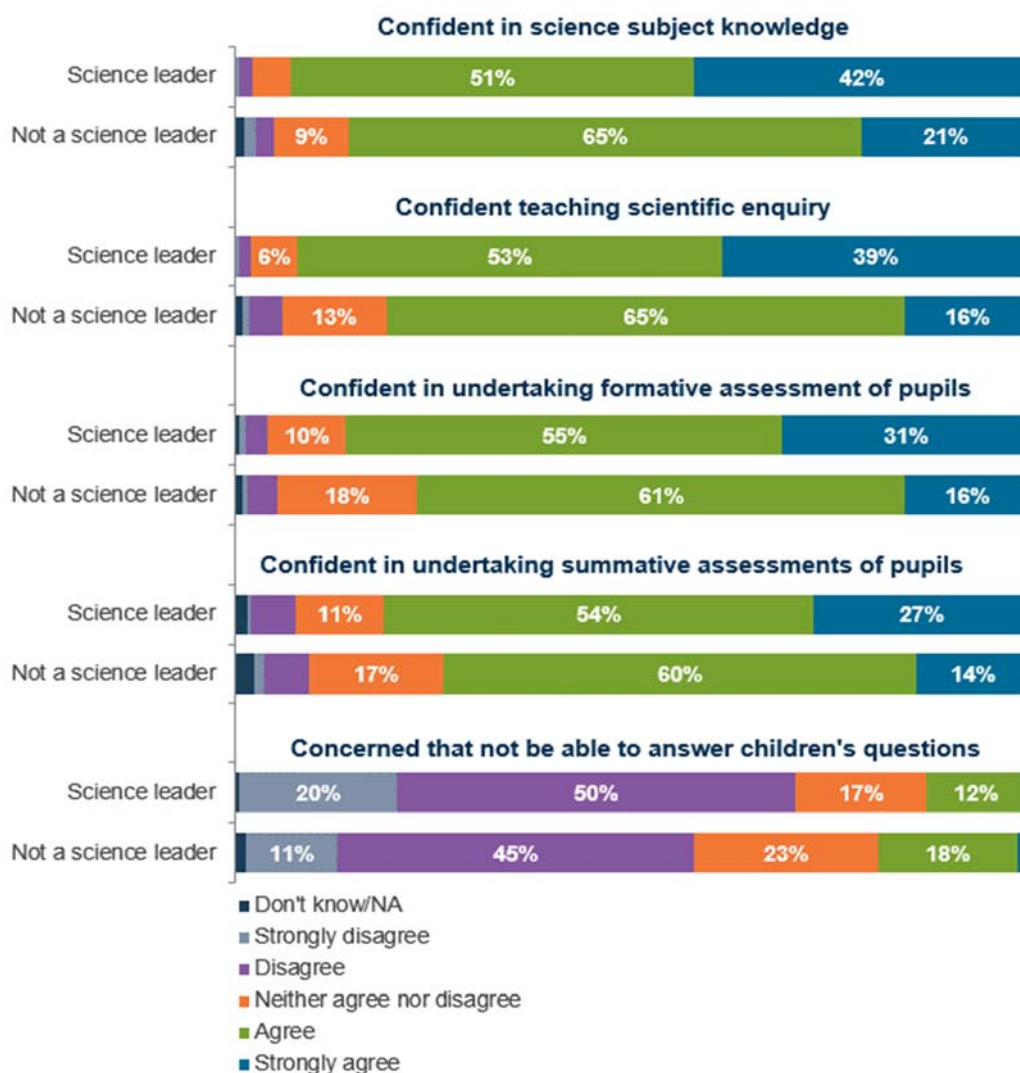


While confidence levels among science leaders is higher, a higher proportion who receive release time state 'strongly agree' (64%) compared with those who did not (52%).

Different aspects of science confidence were explored. Just over one-third (34%) of respondents 'strongly agree' they are confident in their subject knowledge, with a slightly lower proportion (30%) stating they feel confident teaching scientific enquiry. While overall confidence levels are relatively high, 15% of respondents 'strongly agree' or 'agree' that they are concerned they might not be able to answer children's questions about science. In addition, 19% state they 'neither agree nor disagree' (see Appendix 2).

As with overall confidence, science leaders are more confident about different aspects of teaching science than those not in that role. One-in-five (20%) of science leaders 'strongly disagree' that they are concerned that they may not be able to answer children's questions about science, compared with just 11% of non-science leaders.

Figure 23: Extent of agreement about confidence teaching science by role as reported in the science leadership and teaching surveys. Base: science leader=785 – 786; Not a science leader=487 – 488.



Analysis was undertaken to explore which individual and school-level characteristics have most influence over different aspects of confidence when teaching science.²⁰ All models were significant accounting for between 13% and 39% of the variance in confidence, with other factors which have not been measured through the study accounting for the unexplained variance. The common characteristics that have the most influence across different aspects of confidence when teaching science are:

- Enjoying teaching science
- Being a science leader in a school compared to non-science leaders
- Viewing science as important to the school
- Holding a science A Level²¹ or Advanced Higher qualification

²⁰ Multiple regression. Variables added into the models but no association found for: school size, percentage FSM, number of years working in the teaching profession, full/part time worker, Explorify/comparator school, school has science on School Development Plan, number of Explorify activities used, mean number of hours teaching science per week.

²¹ This is defined as holding a Biology, Chemistry or Physics A Level or Advanced Higher.



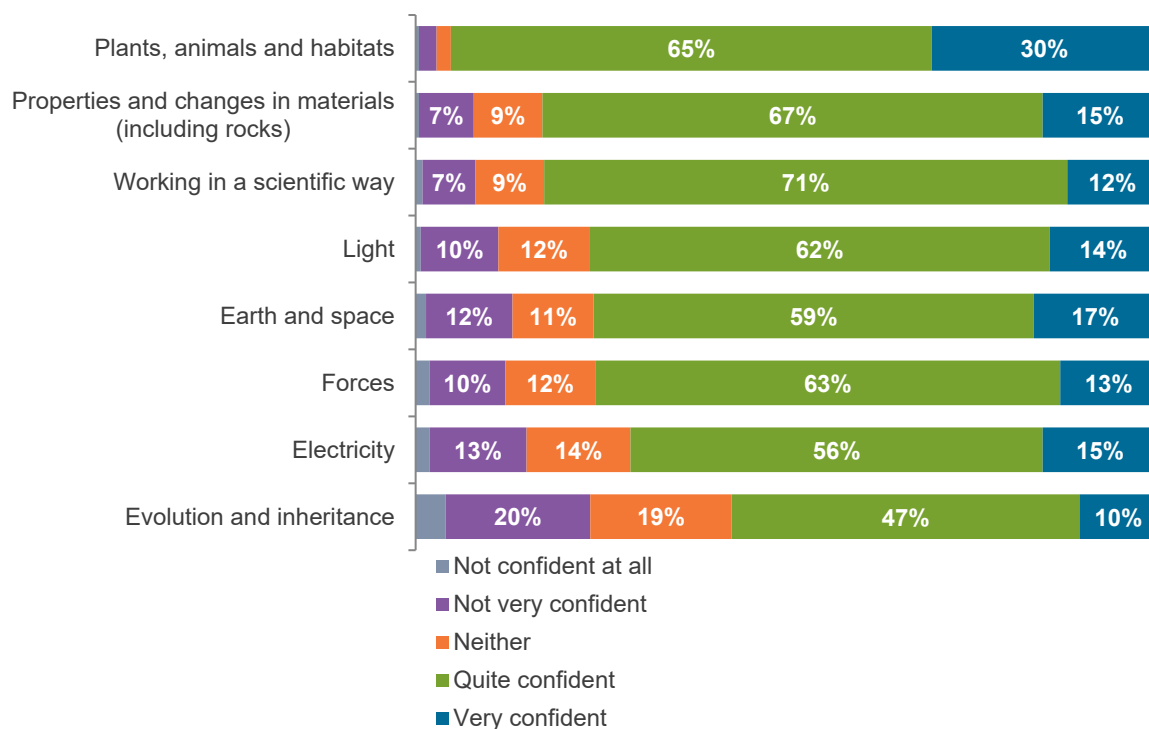
A more detailed breakdown of the characteristics that influence different aspects of confidence when teaching science is shown in Table 5. Whilst this analysis found that the number of Explorify activities a respondent has undertaken with their classes does not influence their confidence in teaching science, 'enjoying teaching science' does and taking part in Explorify increases teachers' enjoyment of teaching science, as outlined in the previous chapter.

Table 5: Rank order of variables affecting each question through multiple regression for confidence teaching science as reported in the science leadership and teaching surveys (bases = 620-625)

	Rank linear regression for influences				
	Confident teaching science (39% of variance explained)	Confident in science subject knowledge (33% of variance explained)	Confident teaching scientific enquiry (31% of variance explained)	Confident in undertaking formative assessment of pupils (20% of variance explained)	Confident in undertaking summative assessment of pupils (13% of variance explained)
Enjoyment teaching science	1	1	1	1	1
Person is a Science leader	2	4	2	4	3
Holding a science A Level of Advanced Higher	3	2	4	3	5
School holds the Primary Science Quality Mark (PSQM)	4				
School views science as important	5	5	3	2	2
Males		3	5		
Head Teachers/Senior Leaders					4

Respondents to the teaching survey were asked how confident they are in teaching the various aspects of science shown in Figure 24. A higher proportion state they are 'very confident' or 'quite confident' at teaching 'plants, animals and habitats' (95%), followed by 'properties and changes in materials' (83%), 'working in a scientific way' (83%) and 'earth and space' (76%). Only 57% are as confident in teaching 'evolution and inheritance'.

Figure 24: Confidence teaching aspects of science as reported in the teaching survey. Base=420 – 481.



Further analysis was carried out to explore which individual and school-level characteristics have most influence over the confidence of teaching various aspects of science²². Associations were found, accounting for between 12% (confident teaching forces) and 29% (confident working in a scientific way) of the variance, with other factors which have not been measured through the study accounting for the unexplained variance. The common characteristics associated with higher levels of confidence in teaching different aspects of science are:

- Enjoying teaching science
- Viewing science as important to the school
- Training being provided by Science Leaders
- Being male
- Holding a science A Level²³ or Advanced Higher qualification

²² Multiple regression. Variables added into the model but no association found for: school size, percentage FSM, being a Science Leader as opposed to non-Science Leader, whether school holds/does not hold PSQM, Explorify/comparator school, school has science on School Development Plan, mean number of hours teaching science per week, Head Teacher/SLT vs. non-management role, school has provided access to science lesson plans or other science materials, the school has provided access to online courses, training or resources for science, lesson observations for science, not received any support for science teaching in the last year from school.

²³ This is defined as holding a Biology, Chemistry or Physics A Level or Advanced Higher.

A more detailed breakdown of the characteristics that influence confidence in teaching different science topics is provided in Table 6. Higher use of Explorify activities was associated with higher confidence levels in teaching science topics about 'light', but was not found to influence any other aspects of science teaching. However, enjoying teaching science continues to be a main influencer which Explorify has a positive impact on.

Table 6: Rank order of variables affecting each question through multiple regression for higher confidence levels teaching various aspects of science as reported by teachers in the teacher survey²⁴ (bases = 180-181)

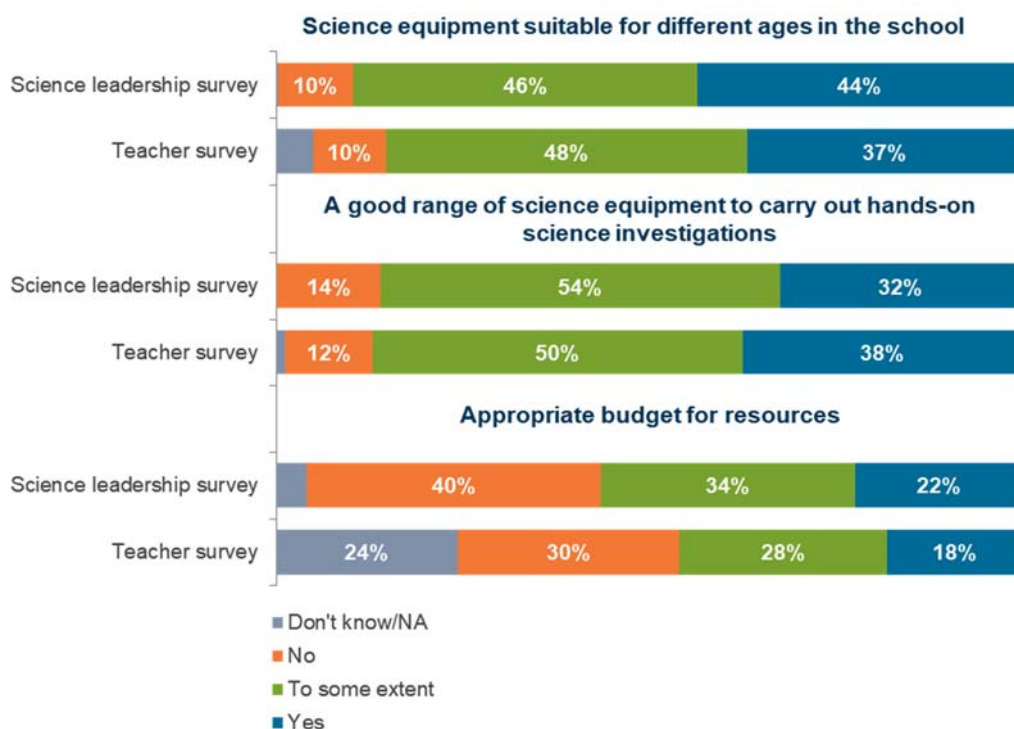
	Rank linear regression for influences					
	Working in a scientific way (29% of variance explained)	Properties and changes (including rocks) (23% of variance explained)	Electricity (23% of variance explained)	Plants, animals and habitats (21% of variance explained)	Light (18% of variance explained)	Forces (12% of variance explained)
Enjoyment teaching science	1	1	1	1	2	1
Holding a science A Level of Advanced Higher			4	4		2
School views science as important	2	3		2		
Males		4	3		1	
Science leader has provided science training	3	2		3		
Part-time worker						3
Higher use of Explorify activities					4	
Working in teaching profession for a longer period of time			2			
Not receiving coaching/mentoring					3	

4.6 Science resources in the school

Less than half (44%) of all respondents to the science leadership survey consider that the science equipment in their school is suitable for different ages compared with just over one-third of respondents to the teaching survey. Approximately one-third completing the science leadership (32%) and teaching surveys (38%) state that their school has a good range of equipment to enable children to carry out hands-on science investigations. Less than one-quarter (22%) of science leadership respondents state that their school has the appropriate budget for science resources, and 40% state that their school does not have the appropriate resources – compared with 30% of those completing the teaching survey.

²⁴ The multiple regression models for confidence levels in teaching science topics about evolution and inheritance and topics about earth and space were non-significant.

Figure 25: Extent of agreement about the suitability of science resources in schools as reported in the science leadership and teaching survey. Base: science leadership survey=850; teaching survey=420 – 421.



Teachers' views of the suitability of resources for different ages are associated with the perceived importance of science in the school, with a higher proportion of teachers who perceive science as 'very important' to their school stating 'yes' (50%) compared with those who perceive it as 'important' (33%) and 'neither important or unimportant' (21%).

Three-quarters of science leaders interviewed report they are responsible for monitoring and replenishing science resources and equipment within their school. A few science leaders have complete autonomy over what they decide to buy (within an allocated budget) while most need any spending agreed by a senior leader – especially where there is not a specified budget.

“I would approach my head and say we need this and then it would be budget that would decide or dictate whether we could afford it [there's] no budget allocated to subjects.”

Science leader

The most challenging aspect of resourcing was the replacement of single-use items and often interviewees used their own money to buy things such as vinegar or baking soda for lessons or would try and adapt their lesson to avoid using resources that are difficult to source or too expensive. To maximise available budgets science leaders describe gaining access to external grants from charities or scientific organisations (i.e. the Physics Society); gaining resources from CPD providers who “throw in” certain consumables; borrowing or pooling resources with other local schools; and also asking parents or guardians to supply resources such as household items for specific lessons.

Almost all interviewees have observed a decrease in their science budget over recent years. Despite this, over half thought the budget they had for science was sufficient.

“If I was running low on budget, and there was something that I thought would be beneficial, as long as I could, sort of, tell [the headteacher] why it's beneficial and why I need it, there's a bit of movement management-wise that we could probably find the resources.”

Science leader

5. Conclusions

This section summarises the key conclusions emerging in relation the use of Explorify in schools, the early impacts of Explorify and the leadership and delivery of science in schools.

The use of Explorify

Most science leaders continue to find out about Explorify through external science CPD they have attended. They pass this knowledge and experience on to teachers in their school who, in turn, spread the word among their colleagues. Most science leaders either formally advocate the use of Explorify or have recommended it to colleagues informally. This highlights the importance of science leaders and the role they play in encouraging others to use resources in their school but presents challenges in engaging those who do not attend CPD. Lack of time continues to be the primary reason why teachers have not yet used the resource or have not used all aspects of Explorify, such as newsletters or blogs. This lack of time highlights the difficulties in promoting the resource through targeted emails or newsletters as these are often not read even when engaged with.

The resource being free is critical to encouraging teachers to use it alongside the fact that it has high-quality visuals and is easy to use. This continues to motivate teachers to use the resource alongside the wealth of activities, the links to the curriculum and ultimately the impact it has on teachers and pupils.

On average, respondents use Explorify once a week with pupils in their class, although this varies greatly between teachers. Explorify is frequently used during science lessons, although many use it during other lessons and at various times throughout the school day. The activities are easy to use and many are short which enables teachers to use the resource with little planning allowing them to fit extra science in at the end of, or between, lessons. There are examples of where teachers use Explorify for the whole lesson, but it is most frequently used as a short exercise at the start or end of a lesson to introduce or consolidate learning, or to assess knowledge.

The impact of Explorify

Those who use Explorify describe the wide range of impacts the resource has on pupils and teachers. The nature of Explorify activities ensures pupils of all abilities are able to take part in class discussions and stimulates curiosity encouraging pupils to ask questions. A key factor in encouraging pupils to engage in class discussions is that strong literacy skills are not needed and there is less fear of being wrong and it is, therefore, important for SEN pupils or those from a disadvantaged background. Pupils enjoy science lessons more and Explorify helps to break down stereotypes of science as 'boring or scary', which motivates pupils as they do not start lessons with a negative attitude. Pupils not only increase their science knowledge through Explorify but also develop critical skills including scientific reasoning and observation techniques. Explorify also supports pupils to develop their oracy skills (sometimes a strategic priority within schools), with an even greater impact on those who are SEN, struggle with literacy or are in early years' classes.

Using Explorify not only has an impact on pupils but also has a range of positive impacts on teachers and their teaching practice. Almost all respondents agree that Explorify has led to them more frequently encouraging pupils to take part in class discussions and, as a result, there has been an increase in pupil-led learning. Teachers use Explorify when planning their lessons and regularly use it to assess pupils'

knowledge either before or after lessons. Two-fifths of teachers describe how using Explorify has increased the amount of time they spend teaching science. All interviewees describe how time constraints make it difficult to teach more science as it can conflict with the time needed for other subjects. Despite this, Explorify is used between lessons or in lessons other than science and can, therefore, lead to pupils being exposed to more science. Although the time spent teaching science has not always increased, teachers report the quality of their/colleagues teaching has improved. Alongside influencing teaching practice, Explorify has led to teachers enjoying teaching science more, improving their confidence and, for a minority, has motivated them to undertake CPD.

Strategic issues relating to science delivery

Most schools have a dedicated staff member responsible for leading science development and teaching across their school. Nearly two-thirds of science leaders get specific release time to lead science in their school, in addition to time to plan their own lessons, which is slightly higher than reported in the baseline report although, for most, only a relatively small amount of time is taken throughout the year, with their role often undertaken during evenings or weekends. Science leaders in larger schools, where science is included on the School Development Plan and is viewed as important are more likely to receive release time.

While respondents believe science is important to their school, a much lower proportion believe it is very important when compared to English and maths. Just under two-thirds of schools have science included in their School Development Plan for the 2019/20 academic year and nearly two-thirds are currently reviewing the way science is taught across the school.

Just over half of all science leaders have undertaken external CPD in the last year to help them lead or develop science throughout their school. Science leaders in schools who use Explorify or hold PSQM are more likely to have received CPD in the last year which suggests the school views the development of science leadership as important. This learning is then passed down to teachers, with teachers being unlikely to receive external CPD themselves. Teachers at schools where Explorify is used are more likely to report they receive support from their school to teach science, compared with those in schools not using Explorify. They are also more likely to receive support if the science leader receives release time and/or CPD. That support most frequently consists of receiving lesson plans, coaching or mentoring from a science leader; being provided with science training; or gaining access to online courses, training or resources.

The delivery of science

Teachers mostly report teaching science weekly either as a stand-alone subject or through cross-curricular lessons. Younger pupils typically receive cross-curricular science teaching rather than stand-alone lessons and for fewer hours. On average, science is taught weekly for 1.5 hours (1 hour and 30 minutes) and 55% of classes do not receive 2 hours of science a week or more.

Weekly lessons are often supplemented with other methods such as science weeks, science visits or other methods. When combined with the number of hours taught on a weekly basis, the total amount of science delivered throughout the academic year, on average, still equates to less than two hours per week across all year groups. On average, classes are taught science for the equivalent of 1.9 hours a week (1 hours and 54 minutes) in total and 50% of classes receive less than 2 hours a week (similar to the times reported last year).

Teachers often encourage pupils to take part in class discussions and encourage pupils to predict what will happen when they do science investigations. However, there is less opportunity for pupils to design their own science investigations.

Perceptions of science

Overall, respondents are positive towards science and think it is important for pupils to study the subject. However, many believe that not enough time is spent teaching science in their school. Within the teacher survey, respondents were asked to state the first three words which came to mind when describing science. A high proportion of the responses relate to the process of undertaking scientific experiments or investigations with words such as 'Investigation', 'Experiment', 'Practical' cited. Approximately one-quarter of the responses are associated with positive emotions; conversely, around 2% of responses link to negative emotions or those which relate to science being 'Complicated'.

Respondents are broadly confident in their ability to teach science, although they rate this lower than their confidence to teach English and maths with the exception of those in the science leader role. Enjoying teaching science is a key predictor of an individual's confidence levels alongside being a science leader, viewing science as important to the school or holding a science A level. Higher use of Explorify activities was only associated with higher confidence levels in teaching the science topic 'light', but was not found to be a predictor for any other aspects of science teaching. However, enjoying teaching science continues to be associated with higher confidence which Explorify has an impact on. For teachers, receiving training from their science leader also was associated with higher levels of confidence.

APPENDIX 1: RESPONDENT CHARACTERISTICS

Characteristics of those responding to the Science Leader survey

School size

	Number	Percentage
99 or less pupils	54	6%
100 - 199 pupils	140	17%
200 - 299 pupils	258	31%
300 or more pupils	381	46%

School role

	Number	Percentage
Classroom teacher	754	88%
Deputy/Assistant Headteacher	38	4%
Acting Headteacher	5	<1%
Headteacher	45	5%
Other role	10	1%

Years working in the teaching profession

	Number	Percentage
5 years or less	215	26%
10 years or less (more than 5)	223	27%
20 years or less (more than 10)	246	29%
30 years or less (more than 20)	134	16%
More than 30 years	18	2%
<i>Mean</i>		12 years
<i>Range</i>		0 – 41 years

Full time or part time status

	Number	Percentage
Full time	668	79%
Part time	182	21%

Gender

	Number	Percentage
Female	701	82%
Male	149	18%

Class responsibility

	Percentage
Reception	12%
Year 1	15%
Year 2	23%
Year 3	22%
Year 4	25%
Year 5	25%
Year 6	25%
Our school does not have specified school years due to offering special/alternative provision	<1%
None	12%

Characteristics of those responding to the teacher survey

School size

	Number	Percentage
99 or less pupils	10	2%
100 - 199 pupils	42	10%
200 - 299 pupils	103	26%
300 or more pupils	246	61%

School role

	Number	Percentage
Classroom teacher	413	98%
Deputy/Assistant Headteacher	5	1%
Other role	3	1%

Years working in the teaching profession

	Number	Percentage
5 years or less	131	33%
10 years or less (more than 5)	92	23%
20 years or less (more than 10)	111	28%
30 years or less (more than 20)	57	14%
More than 30 years	6	2%
<i>Mean</i>		11 years
<i>Range</i>		0 – 40 years

Full time or part time status

	Number	Percentage
Full time	346	83%
Part time	72	17%

Gender

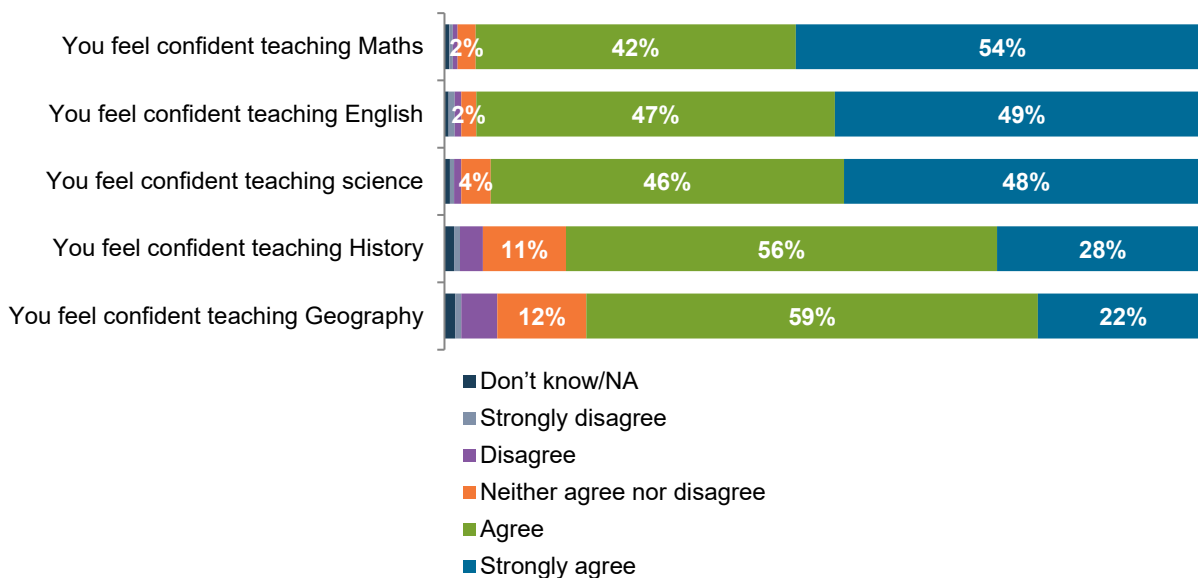
	Number	Percentage
Female	371	89%
Male	47	11%

APPENDIX 2: ADDITIONAL ANALYSIS

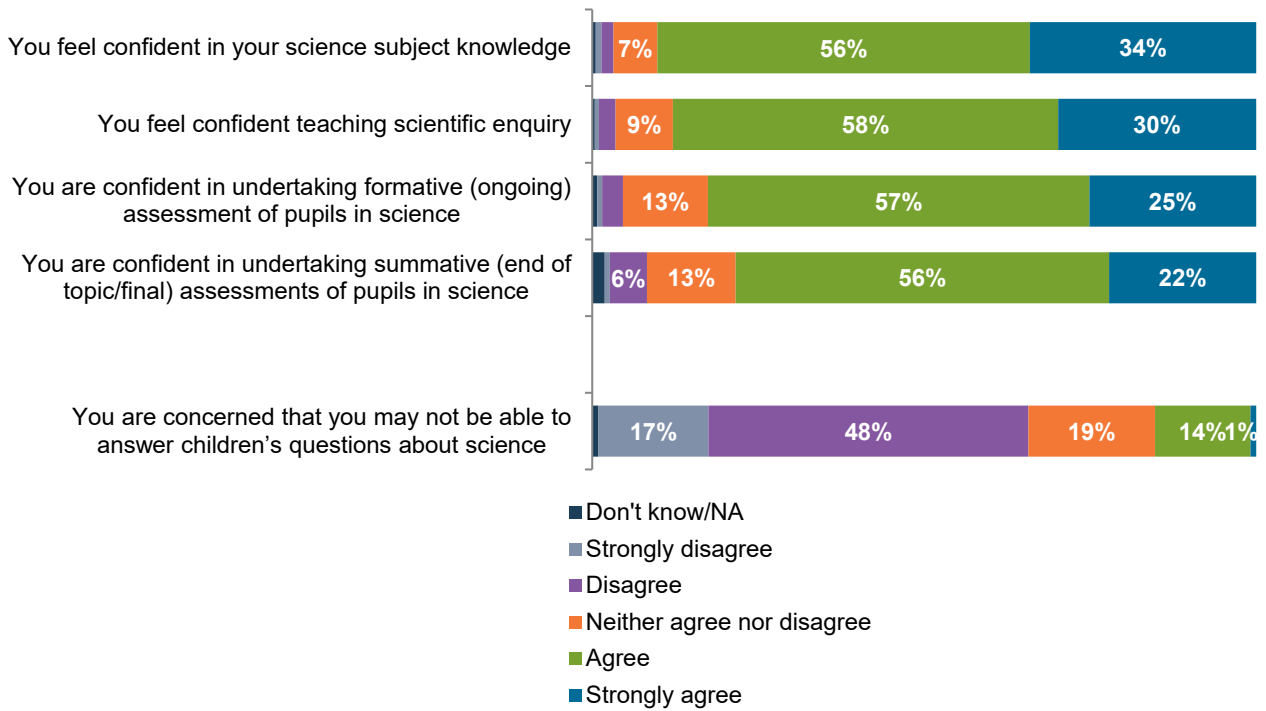
Number of weeks and hours dedicated science weeks are delivered as reported in the science leadership and teaching surveys

	1 week	2 weeks	3 weeks or more		Mean hours delivered each week
Reception (base=79)	80%	11%	9%		7 (base=58)
Year 1 (base=99)	88%	9%	3%		8 (base=82)
Year 2 (base=141)	88%	7%	5%		8 (base=124)
Year 3 (base=145)	90%	3%	6%		8 (base=121)
Year 4 (base=153)	88%	7%	5%		8 (base=132)
Year 5 (base=143)	92%	6%	2%		9 (base=129)
Year 6 (base=139)	88%	9%	4%		9 (base=118)

Extent of agreement about confidence teaching science as reported in the science leadership and teaching surveys. Base=1,271 – 1,273



Extent of agreement about confidence teaching science as reported in the science leadership and teaching surveys. Base=1,273 – 1,274



**Wellcome exists to improve health
by helping great ideas to thrive.**

**We support researchers, we take on big
health challenges, we campaign for better
science, and we help everyone get
involved with science and health research.**

**We are a politically and financially
independent foundation.**

**Wellcome Trust, 215 Euston Road, London NW1 2BE, United Kingdom
T +44 (0)20 7611 8888, E contact@wellcome.ac.uk, wellcome.ac.uk**

The Wellcome Trust is a charity registered in England and Wales, no. 210183.
Its sole trustee is The Wellcome Trust Limited, a company registered in England and Wales, no. 2711000
(whose registered office is at 215 Euston Road, London NW1 2BE, UK).