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A contextualised case study on teacher perspectives on teaching science practicals.

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Submitted in accordance with the requirements for the degree of BA (Hons) Primary
Education (5-11) with QTS

York St John University
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June 2025

The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

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Introduction

Science uses observation, experiment and analysis to find out about the world around us. This small research study investigates the approaches used by teachers in science practical work in the primary classroom. As a core curriculum subject, alongside mathematics and English, science should be taught frequently throughout the week; however, execution, especially the use of practicals to support learning, does not match expectation.

The aim of this study is to explore the factors affecting deployment of and engagement with science practicals from a teacher perspective to answer the question “What are teacher perspectives on the engagement with science practicals?”. Data was gathered through questionnaires, observations, field notes and reading of school policy and children’s books. A mixed methods approach was used in the questionnaires to gather in-depth qualitative data and to compare numerical data to analyse the extent of perception from teachers. This was carried out as a case study with the data being drawn from one school, providing rich data. An initial electronic survey explored the potential reasons for inconsistent engagement with science practicals and provided guidance on the themes that became the focus of the case study.

From this research, three themes were identified explaining why schools interact with science practicals infrequently, these being teaching content, time and resources.

Literature review

When discussing teacher perspectives on science practical work it is important to first consider what the expectations are and the impact practical work has on pupils. A literature review was used to clarify what theory and research tell us about these expectations and to identify potential factors affecting the inconsistencies in engagement with science practicals. This literature review aimed to explore and clarify the expectations for engaging in science practical and potential barriers to engagement.

Key terms used throughout this research need defining. The term disciplinary knowledge refers to the nature of science, exploring in scientific enquiry and answering questions presented in substantive knowledge, this being what theory tells us. The term superficial learning refers to learning only covering surface knowledge, resulting in a lack of depth of understanding.

Expectations

The national curriculum for science, mathematics and English provide schools with the flexibility to make decisions on how much time is allocated towards delivering the content of the core curriculum subjects. It explains that if all content is taught in each key stage it can be delivered in a manner and time frame best fit for pupils, with the exception of the completion of tests (DfE, 2015: 2013a and 2013b). OFSTED (2021) and The Key (2024) explain that as long as high-quality work is being conducted, allowing for pupils to progress

in their learning of scientific, substantive and disciplinary knowledge and enquiry, and enough time is being allocated for a balanced curriculum, meeting the requirements of the national curriculum, then schools can be as flexible as required in their approach and time allocated towards science and practicals. However, does this lack of guidance present teachers too much flexibility, so science is taught inconsistently?

Reiss and Abrahams (2010, pg.26) suggest that 'most teachers of science see practical work as an essential feature of their everyday teaching, believing that pupils learn better from doing than simply being told.' This supports the seminal theories of Dewey (2011). Teachers understand the importance of linking the 'two domains' of 'ideas and observation' (Millar and Abrahams, 2009), but are science practicals being carried out every day? OFSTED (2013) and Garner (2013) discovered the answer to this question was no. Consequently, pupils may not understand or retain concepts as they are being taught superficially or too much time passes without revisiting and reflecting on the knowledge (Benney, 2019). Sullivan (2015) demands that schools must teach high-quality science lessons two hours every week to ensure enough time to effectively learn and explore concepts and this can further be done cross curricular with English or mathematics, for example applying reasoning and problem solving or descriptive writing to amplify depth and understanding. Nicholson (2021), Newsome (2025) and Johal (n.d.) state that this reduces neglect of content and amplifies pupil performance, with reasoning skills being developed continuously.

Linking to the development of skill, reasoning and problem solving, there is a wide range of literature that promotes the use of practicals to support pupils to digest scientific concepts. SCORE (2008) identifies science as a practical subject implying that learning should be constantly hands-on because activity stimulates and engages pupils in learning. This suggestion provokes the question of whether this can realistically be embedded in every lesson for all children of all ages and needs (Brunning, 2023 and Butler, 2019) and whether teachers will provide the time to create meaningful practicals (Henshaw, 2024 and Seeber, 2018). Focussing on the use of stimulating and engaging learning, Hodson (1990, pg.30-33, cited in Abrahams and Reiss, 2016) and The Gatsby Foundation (2017, pg.16-17) discuss how practicals support the 'motivation' and enhancement of learning for pupils, using 'visual' and verbal learning to improve understanding of disciplinary and substantive knowledge. Goldsworthy, Watson and Wood-Robinson (2000) add that visual and verbal learning allow pupils to learn skills and engage in enquiry and investigation, for example learning the skill of communication by partaking in a group practical. Hofstein and Lunetta (2003, pg.38), NMSI (2024) and Millar and Abrahams (2009, pg. 59) support the notion that science practicals are significant to learning as they are an 'effective' strategy to understand 'scientific concepts, interests, motivation, problem solving abilities' and to 'understand the nature of science'. Taking a hands-on approach allows pupils to enjoy learning and develop further interest in scientific enquiry. Osborne and Dillon (2010, pg.108) reinforce this with 'the aim of science' being 'to increase our understanding of the natural world', understanding the what and how of science by teaching pupils substantive and disciplinary knowledge, and to 'develop

understanding of scientific enquiry' (Millar, 2009, pg.7). Though teachers need to ensure that practicals are being taught appropriately and not similar to a 'cookbook recipe' Clarkson and Wright (1992). Masri, Erduran and Ioannidou (2021) explain this approach in which students follow instructions mindlessly until the expected outcome is produced. Salkind (2004, pg.213), Januarie (2023) and Geelan, Nichols and McDonald (2022, pg.201) present that cookbook recipe experiments lack a development of understanding or learning of skill as children are not given the opportunity to visualise scientific concepts through 'trial and error'. Pupils should feel motivated by teachers and schools to engage in science practicals by becoming the scientist and exploring substantive and disciplinary knowledge, alongside the appropriate input from teachers, and develop depth of understanding and skill.

Barriers

The literature indicates three main hinderances for science practicals in schools, one of which being limited resources. RSB (2014) conducted a survey including 39 primary schools and 46 secondary schools and found that £1.62 was spent per pupil on science in a year in Scotland in comparison to £2.89 in England and that 98% of teachers identified insufficient resources as a major issue. Although this study was conducted in Scotland using a mixture of primary and secondary schools, data was taken from a larger sample size which gives it more generalisability and population validity. RSC (n.d.) and RSC (2023) discuss how the lack of funding for resources leads to practical activities being unsupported and ineffective. Solter (2017), Kauffman and Hallahan (2011, pg.447) and ENCfMaSE (2003, pg.33) suggest this has further implications for the learning of pupils with Special Educational Needs and Disabilities (SEND) who require tactile learning. Data Harvest (n.d), RSC (n.d.) and See Science (2025) are three of several companies that offer further opportunities for schools to apply and receive funding for science in extension to the Government budget already provided allowing schools to potentially procure money for practicals.

Regardless of budgets, there is the question: do teachers have sufficient subject knowledge? Dagnell (2024) explains how there is a large lack in teacher confidence with subject knowledge and the ability to deliver science appropriately. Because of these teachers choose to avoid engaging in scientific enquiry. Adam (2017), Palmer (2024) and Jeschke et al (2021) state that teachers who are professional, have the skill set and secure subject knowledge should have the ability to apply their knowledge and understanding into creatively teaching and resourcing practicals. Only with secure subject knowledge will teachers know how to appropriately plan and create their own resources that are inexpensive and effective to use in practicals because they understand the processes with support from substantive and disciplinary knowledge (Aubrey, 2022, Pollard et al, 2005 and Trainanou, 2007). Homer, Miller and Harrington (2016), Rothman and Andrus (2021) and Urban (2019) all provide simple and affordable ways to complete science practicals, demonstrating that resource availability should not be a barrier to practicals. Nonetheless, a significant confidence or knowledge gap might limit enthusiasm for such opportunities.

The second barrier is the lack of curriculum time due to the emphasis on literacy and numeracy pushing other subjects out, even the third core curriculum subject science. RSC (2022), NASUWT (n.d.) and NEU (2025) explain that teachers are expected to teach too much in too little time. Gregori (n.d.) and Severs (2025) explain how more time and effort is going into the other core subjects therefore diverting attention away from scientific enquiry. From surveys of science subject leaders across England, George (2017) and Leonardi et al (2020) detected that although eighty-two percent of respondents understood the importance of studying science for pupils only one hour and twenty-four minutes is done a week due to lack of resources, time and support in subject knowledge or guidance. Twenty-five percent of teachers had concerns about not being able to answer children's questions. Forty-two percent however do teach it for two or more hours a week, which Leonardi recommends. Despite this, many schools are completing science lessons for a half-term and then going another half-term without; this is referred to as block teaching (Weldon, 2022). Rettig and Canady (1999), Thomas (2001) and Huebner (2022, pg.25) discuss how this lack in consistency can lead to a decrease in 'retention' as children struggle to remember and connect to prior learning. Block teaching is being done because of a struggle to balance time between all curriculum subjects. Block sessions can lead to superficial learning (Fransineanu, 2013, Lindblom-Ylance, Parpala and Postareff, 2018 and Rogers, 2022) resulting in a lack of challenge (Shurlock, n.d.) and failure to engage students' curiosity (OFSTED, 2013 and Blue, 2022), causing over-reliance on teacher direction as pupils lack confidence in knowledge and thus look to teachers to provide guidance for them (Beltran, 2019). This makes science a tick box lesson rather than a lesson where time is spent developing learning (Glasse, 2017, Schools Week Reporter, 2018 and Wolstenholme, 2020). Skelton (2020), Baxter (2011) and Thomas and Albany (2017) suggest tests also reduce curriculum time as teachers are pressured to reallocate time that could be used on practicals. Polack and Miller (2022), Tunnell (2024) and Cremin and Arthur (2014, pg.203) say tests are unavoidable and support 'teacher judgement' on the gaps in pupil knowledge, but these are typically in SATs related subjects not science.

Finally, the use of fun activities rather than learning science in relation to theory or concepts also causes failure to develop deeper understanding and skills. OFSTED (2021) found that 'teachers can often prioritise 'wow' moments without clear reference to any curricular goal. There can be a focus on covering the content, rather than ensuring it was learned, or completing practical activities with meaning and intent of developing understanding of substantive and disciplinary knowledge and skill. OFSTED (2023) found that knowledge was not being retained by students because there was not a balance between disciplinary and substantive knowledge engagement. There was not enough being done to develop the why and how, pupils were experimenting with no understanding of how it fit into scientific concept. In response to this Primary Science Education Consultancy (2023) suggested that there was too much time pressure on school timetable and some pupils would go an entire half-term without learning science, linking back to the previous barrier of lack of curriculum

time, or because there was a lack of secure subject knowledge. Because of this, teachers choose to use science related activities as and when they can but not with the support of concepts and theory (NCSE, 2020, Abrahams, 2011 and Gasella, Nitiasih and Santosa, 2021).

Methodology

Research approach

This research began with an electronic survey [Appendix 1] that explored teachers' experiences of delivering science practical work. The use of an initial survey [Appendix 1] helps to guide the research on what opinions arise from a larger sample or potential ways questions need adapting to provide clarity for the participants to ensure understanding of what is being asked (Regmi et al, 2016).

Case study was utilised because a variety of methods were required to understand and identify the reasoning due to the complexity of engagement with science practicals. (Crowe et al., 2011, NUASC, 2025 and Heale and Twycross, 2018). The case was a small rural school with three fulltime teachers. Drew (2023), Cote (2023) and Hanson, Eisman and Hoyden (2023) explain that case studies can help to provide a holistic understanding of why something complex is being done a certain way in an uncontrolled, natural environment which can reveal unexpected events. It has been noted that case studies focus on a singularity, and this can limit the generalisability and wider population validity of the research (Nissen and Wynn, 2014). However, this can be counteracted to some extent by the use of the initial survey which presents a higher level of population validity demonstrating findings were applied to other schools. Additionally, for this specific school, there is high population validity as all teachers took part.

Participants

Three class teachers from a small school covering the age range from Early Years to year 6 participated in the study. Class teachers taught in mixed age classroom, for instance Early years and year 1 taught together, year 2, 3 and 4 taught together and year 5 and 6 taught together. Gumpili and Das (2022), Vasileiou et al. (2018) and Shelby (2023) state that a small sample size provides better quality of data as research can be easily done in more depth and errors can be identified more simply, therefore making the findings more reliable (Samuels, 2017), but this only represents the specific sample (Sarid, n.d.).

Data collection

Mixed methods were used to collect data, although most of the collection was qualitative data because for this study it was important to gather attitudes and reasoning (Delve, 2020, Bhandari, 2025 and Noble and Smith, 2014). Vaughan (2021) supports the use of qualitative data as it is in-depth and rich in meaning therefore being beneficial to the aim of this study to explain the reasoning behind the minimal engagement with science practicals. On the other hand, quantitative data does not provide explanation but presents numerical data

which can lack explanation (Walsh, n.d., Bisht, 2024 and Lim, 2024). Quantitative data was used in the questionnaire [Appendix 1, question 15-17 and Appendix 2, question 11-13] to measure the extent of opinion in areas where qualitative data could not represent the depth in opinion. The use of a scale allows participants to have the flexibility to more precisely measure where they sit in opinion rather than stating yes, somewhat or no, they have the option to show the extent within opinion (Aishwarya, 2024). Both forms of data collection are vastly subjective (Bumbuc, 2016) concluding in a reduced ability to generalise findings to a wider population, but for the means of this research that does not provide an issue as of the use of a contextualised case study.

Participants completed questionnaires [Appendix 2] which allowed the time to consider responses and for responses to be in-depth, reliable and valid (Cleave, 2023, Williams, 2025 and Stevenson, 2020). It also allowed anonymity which would not be possible with interviews. Interviews may lead to a lack of reliable and valid information because of the need to present desirable information to help the researcher or to avoid being perceived negatively (Nikolopoulou, 2023). David (2025) and Pickett et al. (2013) found that questionnaires can become superficial if questions are not asked appropriately and follow up questions are not provided, though to remedy this the questionnaire included a range of questions informed by the initial electronic survey.

3 science lesson observations were carried out in the school. Ellis (2023) and Delve (2020) describe how observations are an effective form of data collection because complex information can be studied from an alternative perspective in a natural environment. Observations provide the data collection with evidence on the reality of what gets carried out in science practicals rather than what teachers say they carry out. But, whether these observations are reliable can be questioned because teachers knew they were being observed (Howard, 2010) and the way data is recorded, which could be shaped the researcher to support their ideals, causing risk of researcher bias (Smith and Noble, 2014 and TES, 2023), especially with the use of field notes [Appendix 3] to transcribe (Helleso, Melby and Hauge, 2015). Phillippi and Luaderdale (2018) and Williams (n.d.) found that field notes allow the researcher to make unstructured notes allowing for richer data to be collected.

To develop understanding of the expectations the reading of school policy, planning documents [Appendix 5, 6, 7] and children's books [Appendix 4] was undertaken to assess whether what was being reported by teachers was being engaged with in practice. Thompson (2015) explains that policy demonstrates what schools have written about how they want to function in an ideal way, rather than the real way. This informs the research of what the expectations are in relation to the reality. Book looks are important to inform what the progress of pupils are (Evans, 2017 and McGill, 2016) in relation to what they should be learning, which informs the expected versus reality aspect of the research, but Didau (2015) contradicts this as it does not represent all learning, especially practical work.

Limitations

As this research is a case study, there are limitations of generalisability and wider population validity as findings cannot easily be taken and applied to other contents and schools from a focus on one school with three teachers (Faber and Fonseca, 2014). Simundic (2013) states that researcher bias can cause distorted results since researchers could try to find data that favours their prior conceptions.

Ethical considerations

Ethical clearance was provided by York St John University through an ethical form [Appendix 8] and gatekeeper consent was given by the headteacher of the school [Appendix 9], with further consent being provided by the 3 participants prior to partaking [Appendix 11]. Consent was provided to participants in the initial survey [Appendix 10]. Marshall (2007) and Holton (2024) say that consent is vital in research to ensure participants are treated fairly and respectfully. Anonymity was guaranteed throughout with no names being used, Kang and Hwang (2023) illustrated how this protects participants from harm of evasion of privacy.

Data analysis

Thematic analysis was utilised in this research to simplify and identify patterns in the findings (Naeem et al, 2023 and Caulfield, 2024) to explore what teacher perspectives on the engagement with science practicals are. Pope, Mays and Popay (2007) support the use of thematic analysis as it prevents an overload of information being presented, however Hecker and Kalpokas (n.d.) suggests that thematic analysis can oversimplify findings of research, though the purpose of thematic analysis is to consolidate key findings (Jones, 2022).

Findings

Electronic survey

From 18 responses, 94% of teachers suggested that planning for science teaching was well supported. 72% said planning was supported by subject leaders. 72% said resources were sometimes well supported. 50% reported the use of block teaching and insufficient planning time for science. From this the themes of teaching content, time and resources began to emerge.

Case study

Questionnaires

Questionnaires were then completed by three teachers, one male and two female, in the small school. Responses indicate that the Programme of Study, the national curriculum and school policy provides enough guidance and support for teachers to effectively plan and teach. Planning schemes generally also support effective planning and teaching but need updating and adapting so information is readily accessible, clear and implementable. Two

teachers said practicals are well resourced. One said they are dated and not systematically organised. Science is promoted beyond timetabled lessons in school trips, provision areas (understanding the world) and cross curricular planning. The school’s ethos and values promote science through individuality, this being following personal lines of enquiry and interests (KWL – What I know, What I want to know, What I learned). The subject lead somewhat supports guidance for planning and teaching and CPD opportunities are not (according to two teachers) provided/offered by the school to support science teaching.

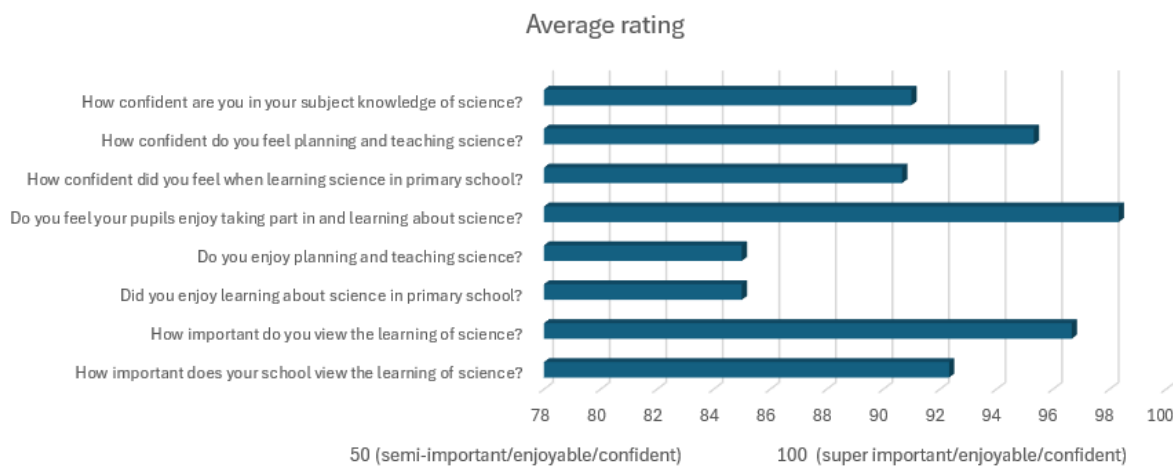


Figure 1

Figure 1 demonstrates that teachers feel science is very important and that pupils enjoy taking part in learning. Teachers say they enjoyed learning science in primary school and felt very confident learning science in primary school. Teachers enjoy planning and teaching the subject. They feel very confident in their subject knowledge and very confident when planning and teaching. Teacher confidence in science surpasses teacher enjoyment of science.

Motivation comes from linking to pupil interests, with practicals sometimes being planned to link to interests. Practical elements are included in every science lesson, for example experiments and resources. Differentiated sheets, recaps, references to practical lessons, visual resources, printed instructions/explanations, working walls, preteach aim to remedy challenge. Two teachers say they aim to ensure the result is accurate to what science suggests it should be and one said sometimes. All three teachers say their pupils understand the science within practicals and that it develops understanding and all teachers say their pupils enjoy taking part in science. Book expectations reflect the planned activity from the age-related curriculum. One teacher noted upcoming tests sometimes influence time spent on science; two said it did not.

Observations and field notes

In the school, science was taught for 2 hours a week every other half-term (block teaching).

Practical activities were delivered for 60 to 90 minutes per lesson depending on the age range and planned activity. For example, one teacher taught a year 2-4 class 2 hours science a week, while a year 2 and a year 3-4 mixed each received 1 hour. A second teacher allocated both Early Years and year 1 classes 90 minutes science a week, a teaching assistant working with Early Years while the teacher focusing on year 1.

Teachers began science lessons with a recap quiz to assess prior knowledge, this was completed through pupils looking back in their books. Input was then presented to the pupils on the new content of the lesson, this being longer in Key Stage 2 and shorter in Key Stage 1. Input consisted of a mixture of videos, pictures, discussion and resources made by the teachers, for example cardboard cut outs of planets in upper Key Stage 2 and a larger focus on discussion and pictures in Key Stage 1 and for pupils with SEND. Resources used altered depending on the aim of the lesson and the topic of learning, with many of the resources being hand crafted by teachers or teaching assistants. The activity and practicals were taken from the scheme of planning the school subscribes to. In Early Years Foundation Stage (EYFS) and Year 1, a greater proportion of the lesson time (around 90 minutes) was directed towards practicals using learning through exploration and active discussion and participation, especially the support of provision areas in Early Years. Year 2 and Key Stage 2 had 60 minutes on practical work, beginning with learning and talking about the new concepts, taking time to explore through practical work and then returning to spend time writing what they have learned. As pupils get older, practicals move to using more writing to apply learning.

Reteach was done where there was time in the week. The end of block assessment set out in the planning scheme was not completed due to the need to progress other parts of the curriculum.

Pupils were actively engaged throughout lessons, always asking questions and wanting to know more about the how and why of concepts. Pupils could relay key learning, with support from looking back in their books, discussing with others in the class and when recapping on practicals. Practicals were observed to support the development of learning for children, especially visual representation and hands-on learning. Progress on the topics being covered across the year was not fully in line with expected curriculum. Resources were not observed to be consistently effective for the needs of all learners and with a limited supply of resources they were being reused and not always applied appropriately.

The subject leader explained the executive head of the school allocates subject leadership at the start of each academic year; this is based on skill set and experience. Teachers do not volunteer for the role. To support the role as a subject lead various routes are offered, these being training with the National College to upskill knowledge and role as leader or curriculum leadership training sessions provided through the trust.

School policy and documentation

School policy stated that science was taught for 1 hour a week. The school website promoted the engagement of high-quality science lessons and experimentation to answer questions using scientific enquiry and knowledge.

Planning documents [Appendix 7] provided teachers with a depth of guidance on the key learning, strategies and progress of learning. Planning was not mixed year group [Appendix 7].

Curriculum policy showed in long-term plans that a 2-cycle plan was being used for Key Stage 2 [Appendix 5]. Long-term plans were being used in rotation every other year (2-year cycle), meaning what was taught one year was different the next.

Book looks

EYFS and Year 1 have a class science book including pictures of the practicals that the class teacher organises and annotates. Individual books consist of picture sorting, tick boxes, circling answers and finishing the stem sentences [Appendix 12]. For years 2, 3 and 4 activities vary from finishing sentence stems, writing up independent sentence and paragraphs and drawing labelled diagrams. In year 5 and 6 there is a focus on independent write ups (with stems for pupils with SEND) and detailed and labelled diagrams.

Independent write ups mimic that of scientific research: written predictions, recordings, results, annotated drawings, paragraph explanations, summaries, self-reflections, fact files. The way in which practicals and science lessons are recorded were presented to depend on the needs of the pupils, guidance from the planning, the area and aim of research and the age range.

Discussion

Patterns emerged from the survey and case study that reflect the main barriers described in the literature review, these being teaching content, time constraints and resources. Teaching content and time constraints presented the largest issues with content being too high and time being too limited.

There was no evidence supporting the notion of the use of fun activities in place of practicals, as implied by OFSTED (2021).

Teaching content

In the school, the main barrier to engagement with science practicals is the amount of content across the curriculum teachers are expected to teach every year, as noted by RSC (2022), NASUWT (n.d.) and NEU (2025). Use of a 2 year-cycle plan [Appendix 6] demonstrated the aim to cover more content across mixed age teaching groups. The school aims to cover chemistry, biology, physics and working scientifically, selecting a topic focus for each. Science is taught every other half term in blocks (Weldon (2022), though scheduling is

affected by testing (Skelton, 2020, Baxter, 2011 and Thomas and Albany, 2017). A rotating plan means content is not repeated for the following year group, suggesting they are not gaining a wide range of curriculum learning, for example if year 5 learn about Earth and Space one year, the next year will be a different topic. The DfE (2015: 2013a and 2013b) details the curricular expectations for mathematics, English and science for each year group. It requires that the content taught each year is of high demand and high-quality (OFSTED, 2021; The Key, 2024). This can be challenging in a small school with mixed years classes without a mixed age planning scheme. The planning scheme [Appendix 7] is not already adapted to meet the curricular expectations of the other year group, providing inappropriate challenge (Shurlock, n.d.) to some pupils, for example the year 6 pupils learning year 5 content or vice versa. The class teachers must adjust lessons for age ranges separately to allow more age-appropriate content to be taught, including appropriate practical learning.

The case study revealed teachers feel the content of national curriculum cannot be taught in the time frame, supporting Primary Science Education Consultancy (2023). Insufficient time is available for mathematics and English and interventions in these and other lessons steal time from science. This finding implies Gregori (n.d.) and Severs (2025) notion to be evident in school. When teachers do not have time to cover all the content required, pupils miss out on knowledge and skill development (Hofstein and Lunetta, 2003, pg.38, NMSI, 2024 and Millar and Abrahams, 2009, pg. 59) and opportunities to act on their interest of scientific enquiry and observe 'the natural world' (Osbourne and Dillon, 2010, pg.108). In this research it was evident pupils were not given sufficient time to learn and apply knowledge through practicals and block teaching resulted in blocks of time without engaging in learning science. Together, this suggests, as presented by Nicholson (2021), Newsome (2025) and Johal (n.d.), the need for more cross curricular lessons to deliver as much content possible, while finding ways to ensure it is of high-quality. There are implications for the role of the government in terms of adapting expectations to ensure that teachers can deliver all the expected content appropriately, one example could be creating mixed years planning schemes, supporting teachers to deliver deeper, integrated, age-appropriate learning.

Time

Expectations across 13 taught subjects resulted in the school teaching science on block rotation. Science lessons were taught for 2 hours a week every other half-term. Weldon (2022) labels this 'block' teaching. There is inadequate time to deliver all content across 13 subjects. Science practicals took up 50 to 75% of the allocated science lessons. Although teachers view science as very important, feel confident and enjoy teaching, as well as students enjoying participation, it was observed that the teaching of science was not continuous through the year, missing chances to reinforce pupil confidence, curiosity and deeper learning, verifying OFSTED (2013) and Blue (2022). It was revealed teachers rely on teaching schemes to support content delivery in this limited window. This could result in less stimulating or engaging cookbook style practicals (Clarkson and Wright, 1992). Despite

school commitments to science, the reality was that teachers did not have the time for regular science practicals for pupils, missing consistent meaningful experiences (SCORE, 2008, Brunning, 2023 and Butler, 2019). Teachers must deliver high-quality practicals within available time, which is regularly eroded. End of unit lessons, giving pupils time to apply their knowledge, were not completed so learning was more superficial, as discussed by Fransineanu (2013), Lindblom-Ylanne, Parpala and Postareff (2018) and Rogers (2022). The time for reflection on activities was also limited. Dewey (2011) has argued that this is vital for deep learning.

A lack of 'retention' because content was not being revisited frequently (Rettig and Canady, 1999, Thomas, 2001 and Huebner, 2022, pg.25) might occur. Pupils were observed to find answers to questions by looking back in their books rather than through active recall and understanding. Content that was not well understood was retaught in an additional lesson, allowing for some exploration and deeper learning, contradicting Fransineanu (2013), Lindblom-Ylanne, Parpala and Postareff (2018) and Rogers (2022).

Skills and knowledge expected of pupils developed through practicals will be affected by time shortages (Millar, 2009, pg.7). The school used school trips and provision areas to extend opportunities for engagement with science and practical learning. As pupils already attend full school days (EPI, 2024), a potential route to address time limitations could be more cross curricular learning, for instance a geography lesson with a science practical (e.g. shadows). Teachers reported using cross curricular learning although this was not observed. Planning documents for other subjects did not include science. Less inclusively perhaps, school club activities offer further opportunities for science.

Resources

In both the electronic survey and the school, teachers were confident in their knowledge of science.

The questionnaires suggest some teachers feel practicals are well resourced, though others disagree. All teachers agreed planning documents lacked clarity and planning schemes need adapting further for pupils needs. Observations revealed resources for practicals were not provided to teachers at school and were hand crafted. The lack of funding provided to schools means time that could be used for planning high-quality lessons becomes focused on resourcing practical the best teachers can (Smith, Padwad and Bullock, 2017). To combat this, Adam (2017), Palmer (2024) and Jeschke et al (2021) present the need for teachers to have secure subject knowledge and the skill set to be able to effectively teach and resource science practicals. This was evident, to an extent, within this case study, as teachers delivered practicals and achieved learning goals, though there was a lack of appropriate resources to meet the needs of all learners, drawing back to Smith, Padwad and Bullock (2017). This particularly affects pupils with SEND who rely on tactile experiences (Solter, 2017, Kauffman and Hallahan, 2011, pg.447 and ENCfMaSE, 2003, pg.33) and high-quality

practicals (OFSTED, 2021 and The Key, 2024) to develop their understanding through stimulating and 'visual' learning (Hodson, 1990, pg.30-33, cited in Abrahams and Reiss, 2016 and The Gatsby Foundation, 2017, pg.16-17) further helping develop communication skills (Goldsworthy, Wastson and Wood-Robinson, 2000). With the appropriate application of resources, it was apparent that pupils with SEND were developing their understanding of the knowledge. Teachers said their pupils understood the science within practicals and that practicals developed understanding, but observation indicated successful practical activities relied on a high level of teacher knowledge. When teachers have secure subject knowledge, they should be able to effectively implement strategies to partake in practicals because they understand the substantive and disciplinary knowledge and the small steps to implement allowing pupils to explore scientific enquiry (Aubrey, 2022, Pollard et al, 2005 and Trainanou, 2007). Teachers were able to remedy pupil misunderstanding in reteach, with their understanding and confidence of subject knowledge using visuals, such as diagrams and discussions, linking back to The Gatsby Foundation (2017, pg.16-17).

Schools need to be provided with appropriate and up to date resources, that suit the needs of all learners, so that teachers and pupils can access practicals and understand concepts in line with expectations. Resources can come from funding schemes, such as Data Harvest (n.d), RSC (n.d.) and See Science (2025). Additionally, ensuring teachers are provided with enough training, guidance and opportunity to develop their understanding of science, ensuring in-depth subject knowledge, so that if funding for resources is not available practicals can be resourced effectively and consistently by teachers. Teachers reported the subject lead and the trust did not always provide support, suggesting more needs to be done. This leads to question whether the suggested training provided was effective for subject leaders and schools. Teachers can also read Homer, Miller and Harrington (2016), Rotherman and Andrus (2021) and Urban (2019) who provide teachers with guidance on how to effectively engage in practicals regardless of availability to resources.

Conclusion

In conclusion, even though this contextualised case study lacks generalisability due to the small sample size, with the support of research it evidences the importance for schools to be given more support to deliver high-quality and regular science practicals. This is essential so teachers can help pupils engage in meaningful scientific enquiry, exploring through a hands-on experience, to develop the necessary skills, mindset and understanding of key scientific concepts. It is important that teachers are comfortable in providing pupils with a wide range of learning experiences with the right resources and without feeling rushed.

Limitations

This study has various limitations. Firstly, the use of a contextualised case study in a small school presents issues with a very small sample size, resulting in a lack on generalisability across the UK. With data being reliable for this school it does not mean it is reliable to

represent the UK as different schools may present different opinions. Finally, there is a risk of researcher bias, because observations were interpreted and recorded from the perspective of the researcher, and validity as participants knew they were being observed and knew that information could be shaped to present a specific view that they wanted the researcher to find.

Future implications

This case study demonstrates the need for schools to have access to a range of resources, CPD opportunities and training, and for teachers to ensure they consistently have secure subject knowledge to effectively implement science practicals. Additionally, the government must consider the amount of content teachers are expected to teach, especially in the time allocated each year and how this can more effectively be executed to ensure pupils are consistently being given opportunities to explore, participate in and learn from and about scientific enquiry. In the short-term, teachers should be proactive in using the time they have got to find ways to engage in cross curricular science practicals (Nicholson, 2021, Newsome, 2025 and Johal, n.d.) and explore ways that funding (Data Harvest, n.d, RSC, n.d.; See Science, 2025) can be given, or partake in personal wider research (Homer, Miller and Harrington, 2016), Rotherman and Andrus, 2021 and Urban, 2019) to support resources selected.

Further research needs to be carried out to further evidence and explore the barriers that teachers face as this case study only represents the views of teachers in one school. Suggested research could be drawn from more schools across the UK and exploring areas that both were and were not voiced in the internet survey, especially those already using cross-curricular approaches or other innovative methods to promote practical science in schools. Allocating a team of researchers to interview and observe teachers across the country can help to quicker and more effectively understand what needs to be actioned by the government and by schools so that teachers feel supported to be able to allocate time positively and to support learning not just in science practicals but across all subjects.

Word count: 6532

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Appendices

Appendix 1: The questions used in the initial electronic survey.

1. To give me an idea of the range of my respondees, what is your nearest city? (This question informs my data of the range of the sample size)
2. Do you feel the Science Programme of Study provides you enough guidance to effectively plan and teach? Yes, somewhat or no.

Please provide an explanation.

3. Do you feel the Science Curriculum in your setting provides you enough guidance to effectively plan and teach? Yes, somewhat or no.

Please provide an explanation.

4. Do you feel that your school policy on science guides and supports teachers to more effectively plan and teach? Yes, somewhat or no.

Please provide an explanation.

5. Does your subject lead provide support and guidance to teachers on planning and teaching?

- Yes
- Sometimes
- No

6. If your school is part of a trust, is there a science curriculum provided that you must use to plan and teach from?

- Yes
- No
- Not part of a trust

7. How many hours a week do you get dedicated to planning science?

8. How many hours a week do you get dedicated to teaching science?

9. How much of that time is dedicated towards teaching science through practical work?

10. Do you consider your science provision/practicals to be well resourced in your school?

- Yes
- Sometimes
- No

11. Does your school allow pupils to widely explore and engage in scientific enquiry?

- Yes
- Sometimes
- No

12. Does your school promote the engagement of science outside of timetabled sessions?

If yes, please explain how.

13. If your school uses provision areas, is there an opportunity for pupils to engage in scientific enquiry.

If yes, please explain how.

14. How does your school promote science learning in their ethos and values?

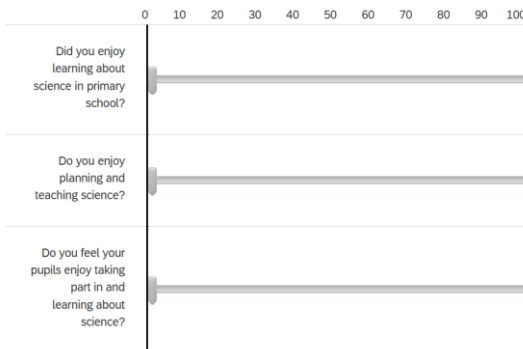
15. Using the scale, where would you measure the importance for science in the two contexts?

0 being not very important, 50 being semi-important and 100 being super important.



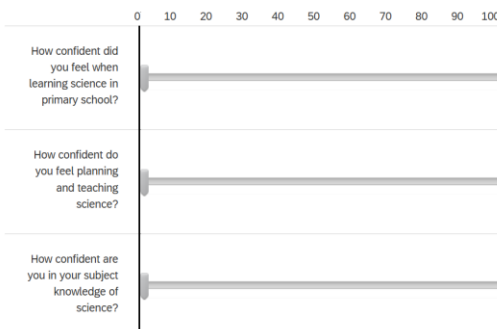
16. Using the scale, where would you measure enjoyment in correlation to the question asked?

0 being not very enjoyable, 50 being semi-enjoyable and 100 being super enjoyable.



17. Using the scale, where would you measure confidence in correlation to the question asked?

0 being not very confident, 50 being semi-confident and 100 being super confident.



18. If pupils are finding it challenging to understand information, what do you to remedy this?

19. How do you motivate pupils with engagement and do you feel this motivation helps them to more effectively understand and acquire knowledge?
20. Do upcoming tests influence/impact how time is spent towards science, that week?
- Yes
 - Sometimes
 - No
21. When planning practicals, do you link learning with the interests of the children?
- Yes
 - Sometimes
 - No
22. When planning practicals, do you aim to ensure the result is accurate to what science suggests it should be?
- Yes
 - Sometimes
 - No
23. Do you teach at a religious school?
- If yes, does this influence the planning and teaching of science?
24. Does your school provide you with additional CPD opportunities to support your science teaching?
- Yes
 - Sometimes
 - No
25. Do you feel your pupils understand the science within the practicals they do/it develops their understanding?
- Yes
 - Sometimes
 - No

Appendix 2: The questions used in the questionnaire.

1. What year groups/what class (1, 2 or 3) do you teach?
2. Do you feel the Science Programme of Study provides you enough guidance to effectively plan and teach? Yes, somewhat or no.

Please provide an explanation.

3. Do you feel the Science Curriculum in your setting provides you enough guidance to effectively plan and teach? Yes, somewhat or no.

Please provide an explanation.

4. Do you feel that your school policy on science guides and supports teachers to more effectively plan and teach? Yes, somewhat or no.

Please provide an explanation.

5. Does your subject lead provide support and guidance to teachers on planning and teaching?
6. Is the science planning (The Education People) provided by the trust?
 Yes
 No
7. Do you feel that the planning (The Education People) provides you with enough information to effectively plan and teach?
8. Do you consider your science provision/practicals to be well resourced in your school?
9. Does your school promote the engagement of science outside of timetabled sessions?

If yes, please explain how.

10. How does your school promote science learning in their ethos and values?
11. Using the scale, where would you measure the importance for science in the two contexts?

0 being not very important, 50 being semi-important and 100 being super important.



12. Using the scale, where would you measure enjoyment in correlation to the question asked?

0 being not very enjoyable, 50 being semi-enjoyable and 100 being super enjoyable.



13. Using the scale, where would you measure confidence in correlation to the question asked?

0 being not very confident, 50 being semi-confident and 100 being super confident.



14. If pupils are finding it challenging to understand information, what do you do to remedy this?

15. How do you motivate pupils with engagement and do you feel this motivation helps them to more effectively understand and acquire knowledge?

16. Do upcoming tests influence/impact how time is spent towards science, that week?

- Yes
- Sometimes
- No

17. When planning practicals, do you link learning with the interests of the children?

- Yes
- Sometimes
- No

18. When planning practicals, do you aim to ensure the result is accurate to what science suggests it should be?

- Yes
- Sometimes
- No

19. Does your school provide you with additional CPD opportunities to support your science teaching?

- Yes
- Sometimes
- No

20. Do you feel your pupils understand the science within the practicals they do/it develops their understanding?

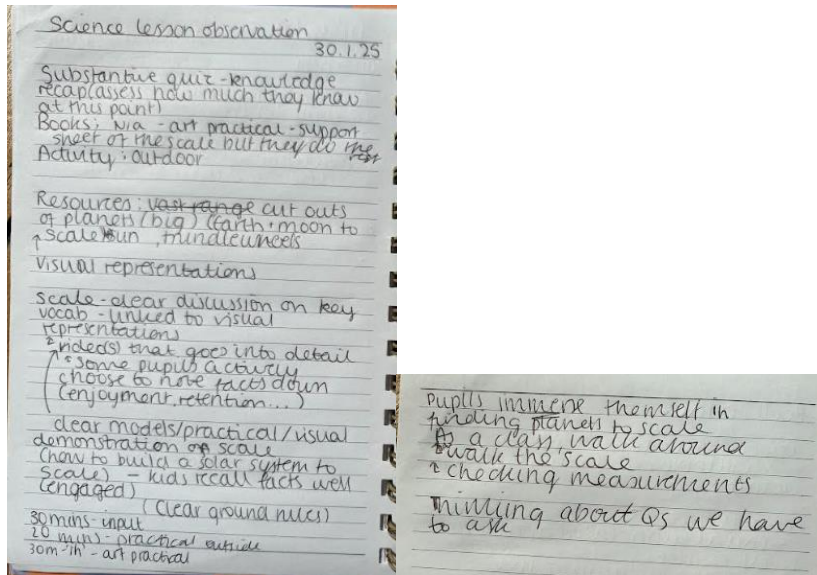
- Yes
- Sometimes
- No

21. Do you feel your pupils enjoy taking part in and learning about science?

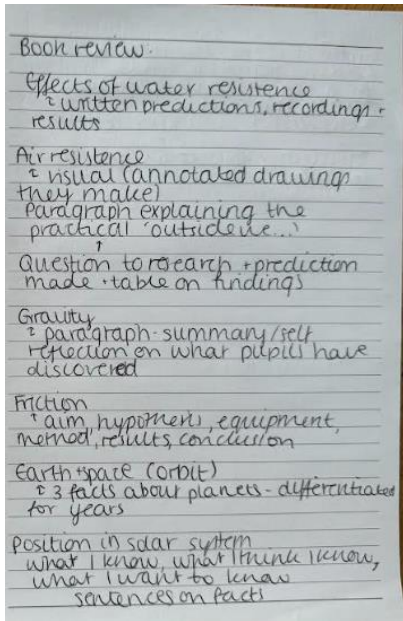
- Yes
- Sometimes
- No

22. When putting learning into books, how do you determine the expectations on writing/displaying learning?

Appendix 3: Field notes from observing the year 5 and 6 science lesson.



Appendix 4: Notes from the year 5 and 6 children's book looks.



Appendix 5: School policy – Long term plans (Cycle planning).

Writing	Read and listen to whole books.	Evolution and inheritance
Narrative	Communication	Animals and humans
Write stories set in places pupils have been.	Engage in meaningful discussions in all areas of the curriculum.	Look at nutrition, transportation of water and nutrients in the body, and the muscle and skeleton system of humans and animals.
Write stories that contain mythical, legendary or historical characters or events.	Listen to and learn a wide range of subject specific vocabulary.	Chemistry
Write stories of adventure.	Through reading identify vocabulary that enriches and enlivens stories.	Rocks and fossils
Write stories of mystery and suspense.	Speak to small and larger audiences at frequent intervals.	Compare and group rocks and describe the formation of fossils.
Write letters.	Mathematics	Physics
Write plays.	Practise and rehearse sentences and stories, gaining feedback on the overall effect and the use of standard English.	Forces and magnets
Write stories, letters, scripts and fictional biographies inspired by reading across the curriculum.	Listen to and tell stories often so as to internalise the structure.	Look at contact and distant forces, attraction and repulsion, comparing and grouping materials.
Non-fiction	Write instructions.	Look at poles, attraction and repulsion. ¹⁶
Write recounts.	Write persuasively.	Working Scientifically
Write explanations.	Write explanations.	Across all year groups scientific knowledge and skills should be learned by working scientifically. (This is documented in the Essentials for progress section.)
Write non-chronological reports.	Write non-chronological reports.	Physics
Write biographies.	Write biographies.	Electricity
Write in a journalistic style.	Write in a journalistic style.	Look at appliances, circuits, lamps, switches, insulators and conductors.
Write arguments.	Write arguments.	Look at circuits, the effect of the voltage in cells and the resistance and conductivity of materials.
Write formally.	Write formally.	Art & Design
Poetry	Poetry	Use experiences, other subjects across the curriculum and ideas as inspiration for artwork.
Learn by heart and perform a significant poem.	Learn by heart and perform a significant poem.	Develop and share ideas in a sketchbook and in finished products.
Write haiku.	Write haiku.	Improve mastery of techniques.
Write cinquain.	Write cinquain.	Learn about the great artists, architects and designers in history.
Write poems that convey an image (simile, word play, rhyme and metaphor).	Write poems that convey an image (simile, word play, rhyme and metaphor).	Computing
Reading	Reading	Design and write programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
Read and listen to a wide range of styles of text, including fairy stories, myths and legends.	Read and listen to a wide range of styles of text, including fairy stories, myths and legends.	Use sequence, selections and repetition in programs; work with variables and various forms of input and output; generate appropriate inputs and predicted outputs to test programs.
Listen to and discuss a wide range of texts.	Listen to and discuss a wide range of texts.	Use logical reasoning to explain how a simple algorithm works, detect and correct errors in algorithms and programs.
Learn poetry by heart.	Learn poetry by heart.	
Increase familiarity with a wide range of books, including myths and legends, traditional stories, modern fiction, classic British fiction and books from other cultures.	Increase familiarity with a wide range of books, including myths and legends, traditional stories, modern fiction, classic British fiction and books from other cultures.	
Take part in conversations about books.	Take part in conversations about books.	
Learn a wide range of poetry by heart.	Learn a wide range of poetry by heart.	
Use the school and community libraries.	Use the school and community libraries.	
Look at classification systems.	Look at classification systems.	
Look at books with a different alphabet to English.	Look at books with a different alphabet to English.	
	Science	
	Biology	
	Plants	
	Look at the function of parts of flowering plants, requirements of growth, water transportation in plants, life cycles and seed dispersal.	

mixed plans

A section from cycle A from Year 3 and 4

Writing	Read and listen to whole books.	Look at teeth.
Narrative	Communication	All living things.
Write stories set in places pupils have been.	Engage in meaningful discussions in all areas of the curriculum.	Identify and name plants and animals.
Write stories that contain mythical, legendary or historical characters or events.	Listen to and learn a wide range of subject specific vocabulary.	Look at classification keys.
Write stories of adventure.	Through reading identify vocabulary that enriches and enlivens stories.	Look at the life cycle of animals and plants.
Write stories of mystery and suspense.	Speak to small and larger audiences at frequent intervals.	Chemistry
Write letters.	Practise and rehearse sentences and stories, gaining feedback on the overall effect and the use of standard English.	States of matter
Write plays.	Listen to and tell stories often so as to internalise the structure.	Look at solids, liquids and gases, changes of state, evaporation, condensation and the water cycle.
Write stories, letters, scripts and fictional biographies inspired by reading across the curriculum.	Debate issues and formulate well-constructed points.	Physics
Non-fiction	Mathematics	Light
Write instructions.	Count and calculate in increasingly complex contexts, including those that cannot be experienced first hand.	Sound
Write recounts.	Rigorously apply mathematical knowledge across the curriculum, in particular in science, technology and computing.	Look at sources, vibration, volume and pitch.
Write persuasively.	Deepen conceptual understanding of mathematics by frequent repetition and extension of key concepts in a range of engaging and purposeful contexts.	Working Scientifically
Write explanations.	Explore numbers and place value so as to read and understand the value of all numbers.	Across all year groups scientific knowledge and skills should be learned by working scientifically. (This is documented in the Essentials for progress section.)
Write non-chronological reports.	Multiply and divide using efficient mental and formal written methods.	Art & Design
Write biographies.	Use the properties of shapes and angles in increasingly complex and practical contexts, including in construction and engineering contexts.	Use experiences, other subjects across the curriculum and ideas as inspiration for artwork.
Write in a journalistic style.	Describe position, direction and movement in increasingly precise ways.	Develop and share ideas in a sketchbook and in finished products.
Write arguments.	Use and apply measures to increasingly complex contexts.	Improve mastery of techniques.
Write formally.	Gather, organise and interrogate data.	Learn about the great artists, architects and designers in history.
Poetry	Understand the practical value of using algebra.	Computing
Learn by heart and perform a significant poem.	Science	Design and write programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts.
Write haiku.	Biology	Use sequence, selection and repetition in programs, work with variables and various forms of input and output; generate appropriate inputs and predicted outputs to test programs.
Write cinquans.	Animals and humans	Use logical reasoning to explain how a simple algorithm works, detect and correct errors in algorithms and programs.
Write poems that convey an image (simile, word play, rhyme and metaphor).	Look at the digestive system in humans.	Understand computer networks including the internet; how they can provide multiple services, such as the world wide web, and the opportunities they offer for communication and collaboration.
Reading		
Read and listen to a wide range of styles of text, including fairy stories, myths and legends.		
Listen to and discuss a wide range of texts.		
Learn poetry by heart.		
Increase familiarity with a wide range of books, including myths and legends, traditional stories, modern fiction, classic British fiction and books from other cultures.		
Take part in conversations about books.		
Learn a wide range of poetry by heart.		
Use the school and community libraries.		
Look at classification systems.		
Look at books with a different alphabet to English.		

A section from cycle B from Year 3 and 4

mixed plans

Appendix 6: School policy – Science curriculum.

Intent

In the White Rose Federation, we encourage our pupils to have a curious mind and ask questions about the world around them. Our Science curriculum uses experimentation to answer the big questions about our world using the five lines of scientific enquiry: observation over time, research, pattern seeking, fair testing and grouping and classifying. Using the progression framework allows us to ensure that pupils are gaining the skills in chemistry, biology and physics to host their own experimentation to answer the questions that they pose about a range of scientific themes. We ensure that working scientifically is built up throughout the key stages by ensuring children are familiar with science terminology, continue asking questions about their surroundings, building arguments and explaining concepts.

Our aim is that our high-quality science curriculum allows children to be inquisitive about the world around them: how it functions, why actions occur, what makes things react. Whether it is exploring rocks from the moon or understanding how circuits work to make an electrical moving train, we aim to provide children with a range of experiences that will challenge their minds and spark a passion for the sciences.

The national curriculum for science aims to ensure that all pupils:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics.
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them.
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Implementation

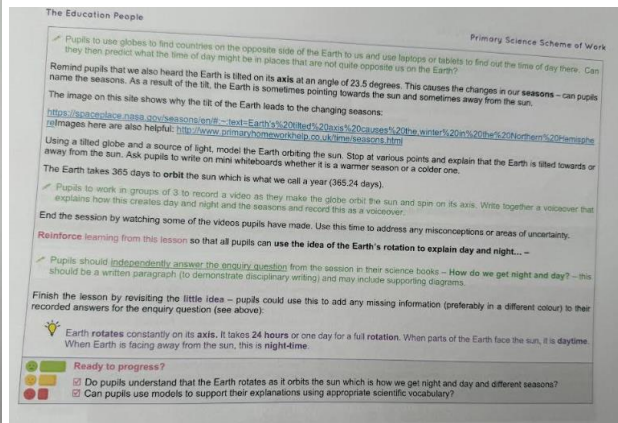
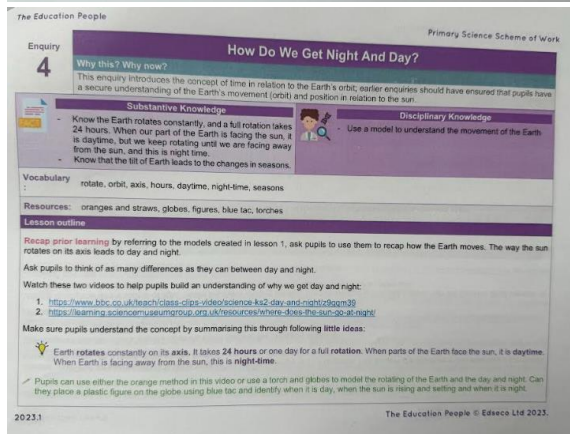
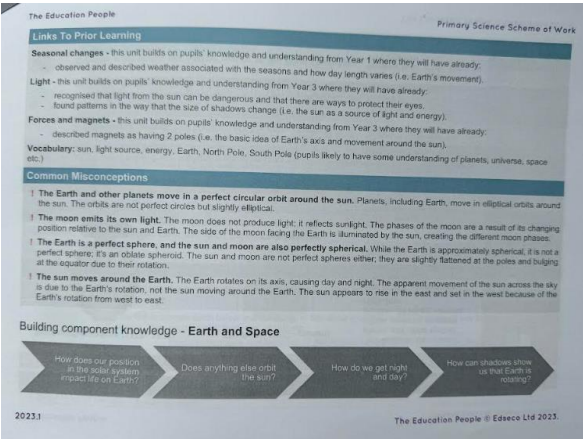
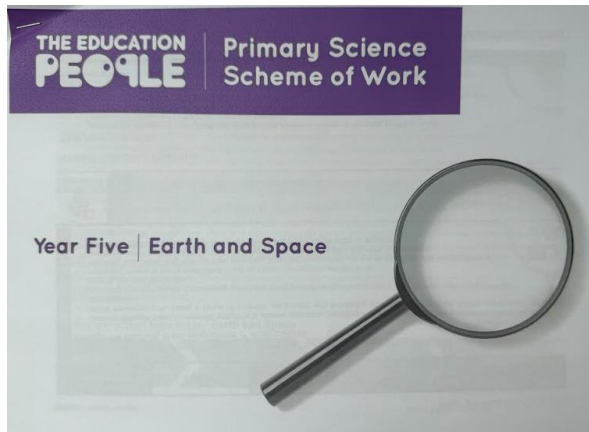
Pupils in the White Rose Federation participate in weekly high-quality science sessions for one hour per week. Our teachers and teaching staff use The Kent Scheme as a guide to both plan their lessons and to assess pupils accurately. Our curriculum has been carefully mapped out to ensure that our pupils are exposed to a wide range of scientific themes with opportunities to build upon skills, knowledge and understanding gained in previous learning. Year 1 and Year 2 follow a stand-alone one-year cycle, Year 3 & 4 follow a two-year cycle, as do Years 5 & 6. Lessons are adapted and differentiated to ensure that all pupils can thrive, with challenge provided to those pupils demonstrating and applying greater depth skills, knowledge and understanding.

Impact

Within the White Rose Federation, we want our pupils to be inquisitive and seek methods of exploration for their questions. By the end of each key stage, pupils are expected to know, apply and understand the skills and knowledge needed to conduct scientific investigation on a range of scientific themes such as testing friction on car wheels or understanding how buoyancy works to ensure a boat floats. Our science curriculum encourages deep thinking and work using questions as the starting point and considering different avenues for further research.

We hope to inspire children to have a love for chemistry, biology and physics that provides children with the foundations for understanding the world that they can carry with them throughout their educational journey. Children can learn and explore the career opportunities within science through the range of experimentation and scientific investigation that they conduct in their learning.

Appendix 7: Year 5 planning document overview page and enquiry/lesson example.



Appendix 8: Ethical clearance from ethics form.

Section 7: Declaration

Declaration – I have read the ethics policy and guidance and the general data protection regulation information alongside abiding by the practice in place within my research discipline. The information supplied here is accurate to the best of my knowledge.

Student Signature

Name

Date

Honor Reed

Honor Reed

03/12/24

Staff Signature for approval

Name

Date

Katy Bloom

Appendix 9: Headteachers consent.

QTS6004M Research Project Permission form

Student name: Honor Reed


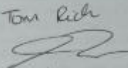
SE3 School: Chapel Haddlesley CE Primary School

Headteacher permissions:

I have read this student's ethical clearance form and give my permission for the conduct of this small-scale research project.

Additional parental passive consent is ~~not required~~ has been obtained (please delete as applicable)

Headteacher's name: KASTY NORTHWAY Tom Reed

Headteacher's signature:  

Date: 13/11/25 30/1/25

Students:
This completed form must be scanned or photographed and uploaded to the permission submission area on Moodle prior to commencing your research project and by 27 January 2025 at the latest

Appendix 10: Consent question in internet survey.

Information and Consent

Exploring perceptions of primary science practicals.

This survey will help me gather information on how schools interact with science as a subject and the use of practicals. As teachers, it is important to gather information from you so I can gain insight into how teachers, across the country, feel towards the process of engaging in science.

Answers to these questions will inform part of my dissertation, as a Primary Education Undergrad. It should take less than 10-15 minutes to complete.

Ethical approval has been granted by YSJU for this research to be conducted.

Confidentiality will be maintained throughout the process, your name and your schools name will not be required and all responses maintain anonymity. To gain a deeper understanding of my respondees an initial question will ask for your nearest city, though I can ensure this will remain confidential.

By clicking yes and going forward you are consenting to the participation in my research.

- Yes
 No

Appendix 11: Consent question in questionnaire.

Information and Consent

Exploring perceptions of primary science practicals.

This survey will help me gather information on how, as a school, you interact with science as a subject and the use of practicals. Answers to these questions will inform my dissertation, as a Primary Education Undergrad. It should take less than 10 minutes to complete.

Ethical approval has been granted by YSJU for this research to be conducted and consent has been given by the head of school for this research to proceed.

Confidentiality will be maintained throughout the process, I will ask you to provide me the year groups/class (1, 2 or 3) you teach only to inform my results of how science looks within the year groups.





By clicking yes and going forward you are consenting to the participation in my research.

- Yes
 No

Appendix 12: Activity sheet for year 1 science lesson.

What material is best at absorbing water?

My predictions

Material	Do you think the material is absorbent?	
 Paper towel	Yes	No
 Foil	Yes	No
 Dish Cloth	Yes	No
 Tissue	Yes	No

Fair Test

So that our experiment is fair, the things we will keep the same are...

-
-
-

What we found out (conclusion)

The most absorbent material was _____.

I know this because _____.