The Science Curriculum at St Osmund's Middle School

Curriculum Intent

At St Osmund's Middle School, we want the teaching of science to enable our students to make informed and responsible choices and decisions throughout their lives. In a world where information on social media blurs fact and opinion, it has never been more important that children appreciate the need to look at the empirical evidence, a fundamental aspect of the scientific method. In addition, pupils should be comfortable with the idea that it is OK to say, "I don't know" – science is about living with uncertainty, asking questions and seeking new knowledge. We want to give our pupils opportunities to advance their scientific understanding and to realize how science explains and shapes the world around them. Ultimately, the science curriculum at St Osmund's aims to develop a sense of wonder and curiosity about the world.

Curriculum Implementation

Curriculum Design - Key Stage 2

In the National Curriculum for Science, the programmes of study are set out year-by-year for key stages 1 and 2. Schools are, however, only required to teach the relevant programme of study by the end of the key stage. Within each key stage, schools therefore have the flexibility to introduce content earlier or later than set out in the programme of study. At St Osmund's, the areas of the curriculum taught in Year 5 and Year 6 closely mirror the programmes of study set out in the National Curriculum. This ensures that we are building on the work undertaken in the First Schools which also follow the programmes of study as is it is set out in the National Curriculum. The one exception is that non-reversible changes are taught in Year 6 instead of Year 5. This is done for two reasons. Firstly, it allows a more balanced curriculum, otherwise Year 6 pupils would not study any Chemistry. In addition, it allows teachers a context to revisit the Chemistry subject knowledge that was taught in Year 5.

Curriculum Design - Key Stage 3

Through regular DASP pyramid meetings, we have reviewed the Key Stage 3 National Curriculum and have agreed which elements would be best taught in the Middle Schools and which should be taught at Thomas Hardye School. Pyramid meetings have focused on the changes to the GCSE and the new skills required by students. There has also been much work done to ensure all school are teaching a common Key Stage 3 curriculum. Meetings have been moved around the schools so that colleagues can see how the other departments are set up and share good practice. We have integrated into the Middle School schemes of work the content of the Key Stage 3 syllabus published by AQA, equipping students with the vocabulary, knowledge and understanding needed for success when completing the AQA GCSE science syllabus at Thomas Hardye School. We have invested in new sets of textbooks for Years 7 and 8 which cover in full the content of the Key Stage 3 national curriculum and are approved and recognized by AQA as supporting the specification of AQA's GCSE syllabus. For both key stages, the programmes of study at St Osmund's have been designed so that topics are taught in a sequence which ensures pupils have the necessary knowledge to understand new lesson content. For example, in Year 7, when students study digestion they have previously studied the nature of acids, particle theory and solutions – all of which are used when explaining the breakdown of food molecules in the human body.

Progression through the curriculum

There is clear progression in the breadth and depth of the science curriculum over the course of the four years pupils attend St Osmund's, which builds on the learning pupils have undertaken in the their First Schools and prepares them for the demands of Key Stage 4. A curriculum map has been produced which tracks progression across the DASP pyramid. For example, in the content domain of Chemistry, pupils begin with familiar phenomena such as solids and liquids and as they progress through the curriculum, study more conceptually demanding, abstract models of the atomic and molecular composition of matter and patterns of interaction. Topics refer back to previous knowledge and understanding and then extend it, as exemplified in the content domain of Biology: in their First Schools, pupils place living things into groups such as fish; move on at Key Stage 2 to studying Darwin's theory of evolution by natural selection; are introduced to heredity at Key Stage 3; then learn about single gene crosses with dominant and recessive phenotypes at Key Stage 4. Whilst there is a common scientific method taught through and clearly related to the disciplines of Physics, Chemistry and Biology, the horizontal curriculum structure of the three content domains creates challenges when designing and implementing a curriculum which enables pupils to transfer knowledge to long-term memory. As well as moving from one content domain to another, the programmes of study at the different key stages result in considerable periods of time between similar topics. For example, pupils study the subject knowledge for sound in Year 4 and then in greater depth in Year 8. To address the issue of long gaps between topics we have established links between different modules so that previous learning becomes more embedded as we move from one topic to another and from one year to another. We have built into the curriculum, and continue to develop, opportunities for the revisiting of knowledge: starter activities include questions which require the recall of previous learning; end of module tests include questions about previous topics; homeworks revisit previous learning; and, where possible, children are asked to complete tasks which require synthesis of knowledge from several topics – a higher order task which stretches more able pupils.

Development of English and Mathematics

Science is a discipline that relies heavily on students' ability to learn and understand subject specific vocabulary. There is a strong focus on vocabulary and students are taught and given opportunities to communicate their ideas and understanding using appropriate terminology. The schemes of work identify the key words required for every lesson, as well as detailing opportunities for students to describe and explain their ideas and understanding in writing. Resources modelling the construction of explanations are also provided within the departmental schemes work. In addition, students undertake tasks in which they need to extract information from text. The empirical nature of science ensures that the science curriculum at St Osmund's provides many opportunities for pupils to develop their skills in mathematics. A regular component of their scientific enquiry work is the collection, analysis and communication of data. Students are taught how to present their data using tables, bar graphs and line graphs, as well as how to calculate the mean and median average, identify anomalous results and identify lines of best fit, and evaluate the level of certainty than can be applied to their conclusion taking into consideration the reliability of their measurements. At Key Stage 3, students are also expected to use and manipulate algebraic formulae to calculate density, moments, pressure and speed.

Engagement and meeting the needs of all learners

At St Osmund's pupils are given regular opportunities for hands-on exploration through scientific investigations. In addition to more scaffolded tasks, children are given opportunities to answer their own questions and test their ideas. Scientific investigations are used to develop a sense of excitement

and curiosity about natural phenomena, support physical development of skills, foster social attributes such as collaboration, and help shape the understanding of scientific concepts. As well as regular hands on practical experiences, pupil engagement and conceptual understanding is also facilitated by the use of teacher demonstrations which allow pupils to relate explanations to physical examples. Regular revisiting of previous learning in starter activities, assessment tasks and homework is designed to fill in gaps in subject knowledge that some pupils may have. All pupils in Key Stage 3 have online access to a digital textbook, as well as lesson notes, interactive onscreen activities and self-assessment resources, which supports the curriculum covered in the classroom. To aid understanding, where possible, ideas and concepts are contextualised with familiar everyday observations. For example, a lesson requiring pupils to know how to calculate the turning effect of a force would be introduced by asking pupils to suggest why handles aren't placed in the middle of a door, and in a lesson about density students would be asked to consider why the ice that they can see floating in the glass of water in front of them doesn't appear to fit with the particle model of solids and liquids and should be at the bottom of the glass. The resources provided for lessons in the science departments schemes of work and the end of module assessments contain tasks and questions which are progressively more cognitively demanding in terms of increasing levels of conceptual understanding and the context of application. For example, less demanding closed question require pupils to recall subject specific vocabulary, whereas, in order to challenge more able pupils, later questions may require the application of knowledge in an unfamiliar context and an extended written response.

Support for inexperienced and non-specialist staff

All science teachers are supported by detailed lesson plans and resources. As well providing possible activities, lesson plans include learning objectives, key vocabulary, common misconceptions and information on health and safety. Staff are also supported by an experienced science technician. In addition, common misconceptions are identified and discussed in subject meetings and staff are encourage to access the free online courses provide by Stem Learning.

Curriculum Impact

Addressing Misconceptions

When pupils communicate misconceptions, teachers will challenge but not necessarily immediately provide the correct explanation; instead they will allow opportunities for children to develop their ideas through discussion and enquiry. Misconceptions can occur due to children inventing rules to explain the patterns they see around them. Sometimes these rules can lead to incorrect ideas and assumptions. It is not easy for children to forget their own explanations of the world, which are based on their observations and have made sense to them for years, and to replace these with explanations which may make less sense to them. To construct new learning successfully, teachers address prior learning and elicit misconceptions through discussion and reviewing the writing and diagrams produced by pupils in their exercise books. Student talk in pairs, small groups or as a whole class is encouraged and enables children to challenge misconceptions as they reason with each other and consider differing points of view.

Assessment

At St Osmund's, science teachers assess pupils' knowledge and understanding through discussion in lessons and regularly reviewing the work completed in exercise books, as well as using end of module assessments. Having identified areas of the curriculum which need revisiting or clarification, teachers provide either verbal or written feedback. When appropriate, teachers will respond to pupils' work by

writing questions in their exercise books which seek to correct, consolidate or extend pupils' understanding of scientific concepts. As well as addressing misconceptions, teachers identify incorrect spellings of scientific vocabulary. Pupils are given time in lessons to write a response to teachers' questions, practise their spellings and improve their work. Regular lesson observations, questioning of pupils, scrutiny of work produced in pupils' exercise books and the data from departmental end of module tests are used to monitor the quality of science teaching and pupils' progress and achievement. End of module tests are designed to assess all learners through progressively more demanding questions, ranging from scaffolded questions which require recall of key terminology to open-ended questions that require the application of knowledge in unfamiliar contexts and extensive written answers. In addition, all end of module tests have been modified so as to require pupils to revise, and respond to questions about, the curriculum content of previous topics. The data from end of module tests is collated and analysed to assess the performance of different groups of students. Responses to questions are used to review the effectiveness of the teaching of elements of the curriculum and, where necessary, used to modify schemes of work and future teaching. Comparison of standards locally and nationally is achieved via subject meetings within the DASP pyramid and the completion of a standardised assessment by Year 5 and Year 8 pupils which measures how they are performing against the national average