SCIENCE
OCEAN ACADEMY

Purpose:

The purpose of this document is to outline the planning intent and implementation of the science curriculum at Ocean Academy. In response to the Ofsted Science Research Review, our planning and approach has been reviewed to ensure that the science curriculum offers the best education for our pupils. To ensure that all staff understand the high expectations agreed, whilst establishing and maintaining a consistent approach to the teaching and learning of science across our school; ensuring that all learners have exposure to high quality science teaching and learning opportunities. The effective teaching of science requires not just a well-structured and progressive programme but its consistent implementation across the school. Consequently, this will ensure that excellent attainment and progress is achieved by all children, regardless of ability, gender or socio-economic backgrounds.

Underpinning evidence:

1. Ofsted Research review: Science
2. The forgetting curve, Ebbinghaus
3. Cognitive Load Theory, Sweller
4. Principles of Instruction, Rosenshine
5. Metacognition and Self-regulated Learning, EEF
6. Feedback, EEF Teaching and Learning Toolkit
7. Mastery Learning, EEF Teaching and Learning Toolkit

INTENT:

Aim:

At Ocean Academy, it is our aim to ensure that all pupils are best prepared for their next steps in education, working closely with secondary school specialists to ensure that our curriculum will:

- Provide an education that meets and exceeds the breadth and ambition of the National Curriculum.
- Spark the curiosity of all learners to ask questions, think deeply and investigate scientific concepts.
- Immerse all learners in the essential scientific knowledge and vocabulary to ensure that all will remember more, know more and apply more; building on secure schemas of prior understanding.
- Provide opportunities to investigate, question and test scientific ideas and develop their scientific understanding of the world around them.

Sequencing and coherence of the curriculum:

'Careful curriculum design, where new knowledge is broken down into meaningful components and introduced sequentially, can support all pupils to learn scientific concepts.' Ofsted 2021.

At Ocean Academy, following the national curriculum, concepts are planned coherently and sequenced progressively to ensure that new knowledge is systematically integrated into pre-existing knowledge. Centralised learning journey maps, flashcards and planning progressions, all quality assured, ensure consistency of delivery across the school. Furthermore, following our revisit and revise cycle, there are many opportunities for pupils to revisit scientific concepts and build knowledge further over prolonged periods of time.

Each new topic of learning will always start with a prior knowledge check of the curriculum area. This ensures that this knowledge is built upon incrementally, thus making it more likely that misconceptions will be avoided.

The Progression and Overview document has been created to ensure that the curriculum content for Science is sequenced effectively and thoughtfully. The document is used by teachers to ensure that their planning is progressive and contains the essential knowledge of each topic.

Substantive knowledge (scientific knowledge):

Substantive knowledge is '*knowledge of the products of science, such as concepts, laws, theories and models.' Ofsted, 2021.*

At Ocean Academy, our curriculum describes a sequence of knowledge and concepts. While it is important that pupils make progress, it is also vitally important that they develop a secure understanding of each key block of knowledge and concepts in order to progress to the next stage. We recognise the importance of building a secure knowledge of the essential

information and substantive knowledge throughout the national curriculum. Through a flashcard approach following the Leitner system, pupils learn this essential knowledge and vocabulary so that it is stored in their long term memory and can be drawn upon when learning new concepts.

See here an example of a set of flashcards: Year 6 Light Flashcards

Furthermore, to ensure that all pupils receive the agreed science knowledge and that teacher subject knowledge is secure across the school, the essential knowledge has been carefully planned and sequenced across the school. Learning journey maps have been created for teachers and pupils to use. These contain all of the essential knowledge for each area of the National Curriculum. These are published on our website and updated regularly.

Disciplinary knowledge and scientific enquiry (working scientifically):

'Acquiring disciplinary knowledge is an important goal of the national curriculum. Pupils must learn about the concepts and procedures that scientists use to develop scientific explanations… It is therefore important to recognise that disciplinary knowledge, like substantive knowledge, is underpinned by knowledge of procedures and concepts' Ofsted 2021.

At Ocean Academy, disciplinary knowledge is taught. Scientific processes are taught in relation to substantive knowledge and opportunities for pupils to apply their disciplinary knowledge through investigations and enquiry are planned progressively across Key Stage 2. Key disciplinary knowledge and vocabulary are learned and stored in the long term memory. This knowledge is then applied through planned investigations and enquiry.

We have developed a progressive approach to working scientifically to ensure that pupils are able to use their stored domain of substantive knowledge through investigations and enquiries planned across the key stage. Over time, by working scientifically to explore scientific concepts, pupils build their knowledge of:

- Scientific methods;
- Apparatus and techniques;
- Data analysis and presentation;
- Forming scientific explanations with evidence.

Over the Key Stage 2 curriculum, each scientific skill is broken down into the disciplinary knowledge or 'building blocks' to become successful when working scientifically. For example, when completing an enquiry to test the impact of friction on distance travelled, pupils will be taught the following so that they can successfully work scientifically:

- Understanding variables and ensuring a fair test
- Using measuring equipment effectively
- Recording results accurately
- Drawing accurate graphs and tables
- Writing effective conclusions and reflections on their results

Each investigation is broken down to ensure that pupils have the disciplinary knowledge needed to work scientifically.

Disciplinary and substantive knowledge: the importance of interplay:

At Ocean Academy, the school curriculum is organised so that disciplinary knowledge is embedded within the substantive content of science. Disciplinary and substantive knowledge is carefully interwoven so that pupils ask and answer questions by carrying out different types of scientific enquiry.

IMPLEMENTATION:

Teacher directed instruction:

'Analysis of pupil responses and outcome data from PISA 2015 reveals that teacher-directed science instruction is positively associated with science performance in almost all countries. Teacher-directed instruction (as defined by PISA) involves the following:

- *the teacher explains scientific ideas*
- *a whole-class discussion takes place with the teacher*
- *the teacher discusses our questions*
- *the teacher demonstrates an idea'*

Ofsted 2021.

At Ocean Academy, the approach of using teacher-directed instruction is used to help pupils develop a broad understanding of specific scientific concepts which builds upon prior knowledge and explicitly addresses misconceptions. It allows pupils to be provided with distinct guidance whilst they explore and learn key concepts. This is accomplished through the use of whole-class discussions and teacher-led demonstrations. By allowing students to actively engage in the learning process, they become more involved in the content and gain a deeper understanding of the material

Practical work and investigation:

'Millar stresses that practical work should form 'part of a broader teaching strategy'. This means that there needs to be sufficient time after or before the practical for pupils to interpret and explain the observations and measurements made, or that are about to be made.

Ofsted 2021.

At Ocean Academy, we believe in the importance of providing time before practical investigations to ensure pupils learn substantive knowledge, as this allows them to build on prior knowledge and ask questions about their understanding. It also helps them to acknowledge the purpose of the investigation and how it links to the curriculum. After any practical work, it is crucial to allow time for pupils to reflect on the experience, make links between their learning and the activity and discuss what they have learned. This helps to further cement their understanding and allows them to apply their knowledge to other areas of science.

'Millar also identifies that practical work plays an important role in teaching specific disciplinary knowledge. Often, this involves learning to use laboratory apparatus to carry out specific procedures, or about specific aspects of scientific enquiry.'
Ofsted 2021.

Furthermore, we believe that it is essential for children to understand how to work scientifically before leaving Ocean Academy, as doing so helps them develop the critical thinking skills needed to approach scientific problems in a logical and methodical way. This helps them understand and interpret scientific evidence and develop the ability to think logically and creatively to solve problems. This knowledge also gives them the skills they need to participate in scientific experiments and research projects independently, which are essential skills for success in secondary school science classes. Flashcards containing vocabulary directly related to terms used when working scientifically (independant, dependent and control variables, hypothesis etc.) are used throughout the school to embed this further.

Consolidation:

'Sufficient curriculum time is allocated for pupils to embed what they have learned in long-term memory through extensive practice before moving on to new content.'
Ofsted 2021.

At Ocean Academy, the curriculum allows science knowledge to be consolidated and built upon. This can be done by providing pupils with an interdisciplinary approach to learning, where concepts from multiple scientific disciplines are connected and explored. Additionally, pupils are also provided with opportunities to review and deepen their understanding of previously learned material. This is achieved through the use of flashcards and planning in time to lessons to revisit key concepts. Finally, teachers at Ocean Academy provide pupils with opportunities to make connections between their new knowledge and what they already know, helping them to form an overall understanding of scientific concepts. For example, before a Year 6 lesson about the human circulatory system can begin, prior understanding of the digestive system (Year 4) and skeletons and muscles (Year 3) will be checked.

Communication in science:

'Another study found that pupils who watched teachers' demonstrations outperformed those who watched video and reading interventions.The authors suggest this effect was partly due to the high-quality questioning that took place.'
Ofsted 2021.

Teacher-led demonstration is a powerful tool for improving children's understanding of science. Demonstrations allow children to observe and engage with an experiment, process or concept in a visual and interactive way. This can help to make learning more interesting, engaging, and meaningful. High quality questioning is also essential for helping children to

increase their understanding of science. Asking questions that require children to think more deeply about a concept can help to build upon their existing knowledge and help them to make connections between ideas. For example, a teacher may ask open-ended questions such as "What do you think will happen next?" or "What do you think are the most important variables that could affect the outcome of the experiment?". By engaging children in meaningful conversation about the topic, the teacher can help to improve their understanding. The teacher sheets provided outline the potential questions and demonstrations best suited for each scientific topic for each year group.

Feedback, assessment and marking:

'One study found that formative assessment in science is most effective for pupils when it is embedded within a lesson sequence, occurring at the same time as new knowledge is taught.'
Ofsted 2021.

In science lessons at Ocean Academy, formative assessment involves teachers asking questions to check pupils' understanding and providing students with opportunities to make predictions, answer questions or complete short activities. This helps teachers gauge pupils' understanding of the material and identify areas of weakness or gaps in prior knowledge. Formative assessment also provides feedback to help pupils better understand the material and adjust their approach to learning. This is particularly useful when analysing phase 3 answers to assess whether or not a child has met the expected level for that learning objective.

SEND and inclusion:
Throughout this document, the methods used to ensure all children, including those with additional needs, have been made explicit. All planning ensures that pupils with SEND or physical impairment can achieve just as well as their peers. The school works closely with the SENDCO and external agencies through regular consultations to understand the specific needs, individual goals and incorporate these into the planning and delivery of science lessons. All lessons are adapted to ensure that all children can access the learning and work with their peers.

Monitoring and Evaluation of Teaching and Learning:
We regularly monitor teaching and learning across the school to make sure that all of our pupils make the best possible progress from their starting points.

Aims of monitoring and evaluation:

- To make secure judgements of teaching and learning across the school
- To monitor and evaluate the progress of students
- To evaluate the performance of individual teachers against the Teacher Standards and check that high standards of professional performance are established and maintained
- To identify training needs across the teaching and support staff and drive the CPD programme

SLT and subject leaders will monitor and evaluate the impact of teaching on student's learning through:

- Learning walks
- Book looks
- Review of termly assessment data
- Gathering input from pupil voice and staff voice

Review:

This policy is subject to yearly reviews by the subject leader and SLT.
Upon review, amendments will be made in line with the Academy Improvement Plan and shared with all staff.