Research review series: science

Source: Ofsted https://www.gov.uk/government/publications/research-review-series-science

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Summary:

Key stage 2 national sample tests and research carried out by Ofsted into the science curriculum suggest that the performance of pupils in this country may be deteriorating. Despite this, an increasing number of pupils wanting to study science beyond the age of 16.

In light of this, the finding of this review are particularly significant because it identifies features of a high-quality science curriculum as well as some of the barriers that prevent their successful implementation.

Science in the Early Years

During the early years foundation stage, pupils should be learning foundation knowledge of science primarily through 'understanding the world: the natural world'. This should provide a range of opportunities to enable younger pupils to develop a rich vocabulary that 'categorises and describes the natural world'. This subject specific vocabulary should not be too technical but should form the beginnings of scientific concepts that will be built upon in later years. An important point to note is that 'The EYFS should not just be considered as preparation for learning further science in Year 1'.

Curriculum progression

A high quality science curriculum should be systematically planned to 'build increasingly sophisticated knowledge of the products (substantive knowledge) and the practices (disciplinary knowledge) of science'. A curriculum that does this enables pupils to 'know the science' as well as 'know the evidence for it'.

Ofsted view **substantive** knowledge as: 'knowledge of the products of science, such as, concepts, laws, theories and models'. This is specified as the scientific knowledge and conceptual understanding in the National curriculum.

Ofsted view **disciplinary** knowledge as: 'knowledge of how scientific knowledge is generated and grows'. This is the 'working scientifically' section of the National Curriculum and includes pupils knowing how to carry out practical procedures but goes beyond simply doing practical work or collecting data. Once disciplinary knowledge has been introduced, it is important that it is deliberately practised in substantive contexts.

Therefore, substantive and disciplinary knowledge should not be taught separately. Instead, the science curriculum should recognise the important interplay of both types of knowledge ensuring that disciplinary knowledge is embedded within the substantive content. The most

appropriate contexts to teach specific disciplinary knowledge should be explicitly identified in curriculum plans.

An ambitious curriculum should identify the essential scientific concepts for pupils to learn. These should be separated into meaningful 'chunks of knowledge' sequenced over time thus not overloading the limited capacity of human working memory. New knowledge should be integrated with the connected knowledge that pupils already have. Pupils should be taught the relationship between scientific concepts 'over multiple years, without working memory being overloaded' thus building on existing knowledge whilst revisiting connected knowledge. 'Practise makes sure that learned knowledge is accessible and not forgotten.' The ultimate goal is an alteration in the pupils' long term memory.

Connections between different subject areas (particularly maths) should also be identified so that pupils can be taught how to transfer mathematical knowledge in to a scientific context.

The purpose of practical work

The purpose of high-quality practical work is to 'connect scientific concepts and procedures to the phenomena and methods being used'. However, in many primary schools the purpose of practical work is not always clearly defined and run the risk of prioritising 'wow' moments without a clear reference to the curricular goal.

High-quality practical work should only take place after the pupils have enough connected knowledge to interpret or explain their observations and measurements thus linking theory to observation. 'If this prior knowledge is not available, pupils will be participating in discovery learning, and **not** scientific enquiry.'

Reading in science

Research has established that there is a strong correlation between reading achievement and scientific achievement. Reading well-written scientific texts exposes pupils to key subject specific vocabulary and explanations of scientific concepts.

Children in younger year groups who cannot yet read, should learn vocabulary through exposure to storybooks, non-fiction texts, rhymes and poems.