

Guidance for the Publishing of Science Teaching Resources

Introduction

This document is written for authors and publishers of science teaching resources for school age-pupils. It will also be useful for teachers and other interested parties. It outlines the features which are associated with high-quality resources, in line with domestic and international research.

The term 'teaching resources' covers anything that is published to support the teaching of science. This includes textbooks, workbooks, teacher's guides and other materials, in print or digital form. It could apply to a complete scheme of work covering several years. Equally it could apply to a more focused resource produced with a more specific aim or outcome in mind, including supporting teacher ability and experience.

A description of well-written resources is set out below under the following headings:

1. General principles
2. Scientific content – working scientifically and subject knowledge
3. Practical activities and exercises
4. Representation and design
5. Supporting teachers
6. Assessment and review
7. Authors and editors

Teaching resources have most impact when supported by high quality teacher professional development.

1. General principles

A high-quality science resource:

- 1.1 Should provide primary pupils with activities which provide the basis for the acquisition of key foundational concepts and knowledge; and which help them develop the ability to relate these to phenomena around them.
- 1.2 For secondary pupils it is important that resources provide the basis for a broad curriculum and a sound preparation for the knowledge, understanding and skills required by GCSE specifications.
- 1.3 Should aim to broaden pupils' science knowledge and understanding beyond minimum examination requirements. While textbooks may take a particular approach to science and should take note of examination needs, they should not be narrowly targeted on particular specifications as this may lead to a focus purely on passing the test.

2. Scientific content - working scientifically and subject knowledge

The content of a high-quality science resource:

- 2.1 Is presented in a coherent and connected manner, showing clear progression from one topic to another, as well as how current ideas develop from any previous work.
- 2.2 Concepts are presented and developed in a detailed and systematic way to avoid gaps in teaching scientific subject knowledge.

- 2.3 Resources should take account of, and build on, prior teaching, developing breadth and depth across scientific subject knowledge and working scientifically, as well as drawing cross-disciplinary links.
- 2.4 Materials include a comprehensive science vocabulary for the level being studied. Language is used clearly and concisely ensuring that correct and precise science vocabulary is introduced early and used consistently.
- 2.5 Text and images are accessible with regard to the age and ability levels of pupils at which they are aimed.
- 2.6 When new concepts are introduced, these are related to key concepts with which pupils are already familiar. Explicit connections between concepts and across the science disciplines are drawn out so pupils can start to understand some of the big ideas in science, particularly at secondary.
- 2.7 Resources should assist pupils in making their thinking clear, to themselves and others to probe and address misconceptions.
- 2.8 Resources should support mastery of skills and concepts and provide opportunities for pupils to apply these to a range of problems and contexts to motivate and interest them, helping them to understand the application of science.

3. Practical activities and exercises

High-quality practical activities and exercises:

- 3.1 Ensure understanding of the nature, processes and methods of science is embedded in resources, through a range of accessible and motivating scientific enquiries and investigations which:
 - leads pupils to develop a deeper understanding across science content
 - at both primary and secondary provides demand for the development of practical competencies
 - develops pupils' ability to apply science to a range of contexts and problem solving activities
 - contains practicals explicitly designed to promote understanding and to develop pupils' abilities in recording and measurement
 - requires pupils to predict and explain causes, demonstrating an understanding of underlying mechanisms enabling them to revisit and correct any of their own misconceptions
 - are rigorous in their approach to delivering accurate and up-to-date science that is accessible to all
 - have the scope to provide the breadth and depth that both engages and can stretch and challenge the able pupils
 - provide pupils with the scientific knowledge they need to underpin academic success and to support the application of scientific knowledge and understanding to the world around them
 - activities provide the appropriate level of challenge and include the use of academically challenging and relevant contexts.
- 3.2 Activities require pupils to comment on data, to draw conclusions, make generalisations and offer reasoned arguments. Activities are varied so that they involve pupils in a range of cognitive processes. Teaching resources should support a progression in teaching which includes:
 - consolidation and practice

- investigating, hypothesising, concluding and generalising
 - applying, interpreting and analysing
 - explaining and reasoning.
- 3.3 Resources provide school/home and out-of-school activities that give the opportunity to continue the development of thinking and working scientifically.

4. Representation and design

A high-quality science resource:

- 4.1 Uses clear accounts of science that provide insight into the concepts being taught.
- 4.2 Includes representations of the science in the form of pictures, diagrams and other images may be used to help explain and exemplify scientific ideas.
- 4.3 Ensures illustrations and contexts used are relevant and appropriate to the particular scientific ideas and concepts.
- 4.4 Where there are both textbooks and digital materials, they have a coherent and consistent approach to teaching. Different ways of presenting ideas reinforce one another by exploiting the advantages of each medium.

5. Supporting teachers

A high-quality science resource supports teachers:

- 5.1 Any teacher's guide or other material provided for teachers supports the enhancement of teacher knowledge and pedagogy, providing guidance on effective use of the materials. At secondary, resources support teachers delivering science outside of their own specialism, especially in years 7-9 where one teacher will often teach a class all three sciences.
- 5.2 Resources also provide insight into the science activities the pupils are engaging in, and the key understanding that should be developed. The resources take account of misconceptions and misunderstandings with guidance that enables teachers to anticipate and plan how to tackle these. Where lesson plans or teaching schemes are provided, they are informed by research and ideas of effective teaching. This includes the constructive use of mistakes and misconceptions, and encouraging pupils to think about the application of science to everyday contexts and apply maths and literacy skills to science.
- 5.3 In both primary and secondary phases resources work best when targeted to specific audiences. Resources also work best when complemented by a broad programme of continuing professional development for teachers, focused on high standards and improving outcomes for pupils.

6. Assessment and review

A high-quality science resource supports good assessment practice by providing:

- 6.1 Opportunities for both formative and summative assessment.
- 6.2 Assessments which give both pupils and teachers the opportunity to check pupils' understanding. This applies to pupils' ability to apply understanding in new or unfamiliar contexts. Assessments allow both pupils and teachers to measure progress and inform future learning.
- 6.3 Preparation for formal assessment to familiarise pupils with the form of questions likely to occur in external assessments, but not such that these dominate the assessment within the materials.

7. Textbook authors and editors

A high-quality science resource is:

- 7.1 Authored and reviewed by people with expert knowledge, experience, skills and



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credibility.

- 7.2 Subject to stringent quality assurance measures.
- 7.3 Authored and edited by experts who draw on research evidence and accrued professional experience; people who represent best-practice along with the ability to add flexible value-added elements to a quality baseline.
- 7.4 Materials are trialled and refined in the light of trial data, wherever it is possible to do so.