Key Stage 3
National Strategy

Science

Strengthening teaching and learning of energy in Key Stage 3 science

Additional support pack

Contents

Overview

This pack contains additional materials, background notes and guidance to accompany the CPD unit *Strengthening teaching and learning of energy in Key Stage 3 science*. As the Key Stage 3 science consultant or tutor, you will use these materials to support your follow-up work with science teachers and departments after delivering the CPD unit as part of the Key Stage 3 National Strategy for science.

The CPD unit *Strengthening teaching and learning of energy in Key Stage 3 science* will be used as either a core or an optional training unit. The overview section in the tutor's notes for the unit outlines different ways of structuring the CPD, for example as a series of twilight sessions (page 10). Combining the unit with these additional materials provides a range of ways in which the main messages of the CPD can be embedded into science departments.

From the yearly QCA standards reports on the Key Stage 3 Year 9 national tests, it is apparent that pupils have progressed less well in their understanding of the concept of energy than in any of the other key ideas of science at Key Stage 3. Two areas will promote progress in pupils' understanding of the concept of energy. These are:

- challenging the misconception that the models of energy transformation and energy transfer are different scientific ideas;
- supporting teachers and pupils when they use the terminology of energy transfer from Year 8 as a foundation from which to develop an understanding of energy conservation in Year 9.

This additional support pack is designed to be used flexibly to further strengthen the teaching and learning of energy in Key Stage 3 science. It will be used to support the dissemination of main messages from the CPD unit. Follow-up may take place in schools or in science network meetings after the training. Some materials are suitable for work in groups while others may form the focus of work with a pair of teachers. More sustained improvements in teaching take place when teachers collaborate in taking 'risks' by trying out new teaching strategies.

Some of the materials may be used in conjunction with activities from the main unit to tailor training to the needs of a department or a group of teachers. They could also be used to support a group of teachers from different schools in working together to develop the teaching of energy.

The layout of materials in this pack differs from that usually employed in science CPD units, in that handouts are interspersed among the tutor's notes for each session. This has been done to facilitate ease of photocopying. As there is no participant's pack, consultants will need to photocopy handouts as required.

Synopsis

Session 1

This session contains further examples of pupils' responses about aspects of energy designed to illustrate common misconceptions or imprecise use of terminology. A second task is an extended version of task C from the main unit that considers more learning objectives taken from topics in the QCA scheme of work for Key Stage 2. The task is developed by asking teachers to consider which links to prior teaching are helpful to emphasise and which may promote pupils' misconceptions.

Session 2

The task in this session develops task G from the main unit by considering progression in the key idea and relates the yearly teaching objectives to the content and teaching order of topics in a scheme of work.

Session 3

The first task in this session asks teachers to modify some teaching resources to achieve a consistent use of terminology. The session also contains further examples of energy terminology taken from a published science scheme. The final task asks teachers to consider why pupils experience difficulty in answering questions related to energy in the Year 9 national tests. Further examples of Year 9 national test questions from 2003 are included.

Session 4

The activity included in this session extends task K from the main unit by providing further examples of modified lesson objectives, outcomes and activities in Year 8, relating to the topics 'Sound and hearing' and 'Heating and cooling'. An additional activity uses the resources from session 3 to explore how teaching materials can be modified to support lesson objectives, activities and outcomes.

Session 5

There are no additional materials or activities in this pack to extend session 5 from the main unit.

Appendix

The last section of this pack contains resources that are not linked to any particular session in the CPD unit but that can be used flexibly to support individuals or groups of teachers.

Main messages

You will find it helpful to know the main messages from the CPD unit *Strengthening teaching and learning of energy in Key Stage 3 science* as you start to consider how to use the additional materials included in this pack.

- Energy is a key scientific idea which is first taught explicitly at Key Stage 3; it permeates science at this age range and thereafter.
- There are a number of common misconceptions that pupils can hold about energy – for example, that energy is 'stuff', or that it is 'used up', or that it 'makes things happen'. An awareness of pupils' misunderstandings and misconceptions and the appropriate use of teaching models can help overcome these.
- It is important that teaching about energy as a key scientific idea is started early in Year 7 in a way that is made explicit to pupils.
- The yearly teaching objectives set out a progression in the key idea of energy that moves from **teaching** pupils about energy in Year 7, to **using** ideas about energy in Year 8, to **applying** energy ideas in Year 9.
- Transformation of energy and energy transfer are two ways of teaching (teaching models) about the key scientific idea of energy; they do not describe two different scientific ideas.
- The two ways of teaching (teaching models) about energy are characterised by associated terminology; it is important to use terminology consistently so that pupils do not become confused.
- It may be acceptable to use two ways of teaching (teaching models) about energy in Year 7, to enable pupils to move from concrete understanding about energy to a more abstract understanding; in addition, textbooks and examination questions use the terminology interchangeably.
- The energy transfer teaching model offers advantages over the transformation of energy teaching model in the development of pupils' understanding of conservation of energy as a useful scientific accounting system. The Key Stage 3 science advice is that energy transfer should be the teaching model consistently used during Year 8 and Year 9.
- Pupils need opportunities to develop their understanding of energy in a range of topics, such as ecology, heating and cooling, light, sound, chemical reactions and electricity.
- During topics that use or apply the idea of energy, specific energy-related questions can be asked and lesson objectives modified so that pupils have as many opportunities as possible to reinforce their understanding of energy.
- Focused and explicit questioning about energy in a range of different contexts or topics, such as heating, light and sound, is a good way to challenge pupils' understanding of energy.
- Blocks or tokens can be used to enhance the effectiveness of Sankey diagrams in the teaching of conservation of energy as an accounting system.
- Pupils' understanding of efficiency and dissipation of energy can be developed by the effective use of Sankey diagrams.