

Subject specific information - science and EAL

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EAL development is clearly about learning and using English, but it is important to note that learning English as an additional language is not the same thing as learning English as a mother tongue. Mother tongue English-speaking pupils join school with a more or less developed (age-appropriate) capacity to use the spoken language and with a working knowledge of local culture. Pupils learning EAL may be at various stages of learning English and their spoken and written English may be at different points of development; they may be unfamiliar with local cultural norms and expectations. This guidance aims at providing some general pointers which teachers may find helpful as they develop their practice.

The DfES recognised three distinct groups of EAL pupils who are at particular risk of underachievement:

- New arrivals with little or no previous educational experience
- Pupils who are acquiring English with limited exposure to first language
- More advanced bilingual learners (pupils with a number of years' exposure to English) whose specific needs have been overlooked

(‘Aiming High: Guidance on the assessment of pupils learning English as an additional language’ DfES 2005)

A fourth group can also be added to this list - pupils who arrive from overseas with good educational backgrounds but who have varying levels of proficiency in English, and who need to catch-up quickly in terms of developing their use of English for academic purposes. For these pupils the issue is often the transfer of academic skills and knowledge from their first language(s) into the medium of English.

General issues

Vocabulary development

An area common to all groups of pupils learning EAL is that of vocabulary development. The approach for identifying key words in Science advocated by the National Strategy places scientific vocabulary into three categories:

- names of objects, for example: artery, granite
- processes, for example: evaporation, respiration, digestion
- concepts, for example: energy, force, atom

(Access and engagement in science 2002 pg 9)

However, pupils learning EAL may also have to distinguish between words which have similar meanings (synonyms) such as: membrane and skin, friction and resistance, and also consider the use of words which have a specific meaning in science, but also have a different meaning in everyday English e.g. cell, wall, tissue, producer, consumer and so on. Idiomatic

expressions, where the learner should be understanding the metaphorical rather than the literal meaning, also need close attention. Below are some of the key issues regarding vocabulary which need to be borne in mind when teachers plan lessons:

Issue	Example	Suggested teaching strategy
The word has a different meaning in everyday English.	power, cell, tissue, moment, consumer	Ask pupil to make up two different sentences, each representing the word with different meaning: a) The prisoner is in his cell. b) The cell is connected in the circuit.
Make explicit word roots whenever, and wherever possible.	hydro (water) poly (many) therm (heat)	Get pupils to list not just the word and its meaning but also the root and its meaning.
Use of idioms and pupils' understanding of the difference between the literal and the metaphorical.	Headline / title to a piece of text on GM foods: "Food under the microscope"	When reviewing content prior to a lesson, note down any idiomatic expressions and draw attention to these.

It's clearly important to introduce new teachers to strategies which serve to de-mystify vocabulary and help pupils to develop their knowledge of specialist, technical and common core words. For a fuller analysis of the topic area of vocabulary and more useful ideas on word roots, grouping words and words and definitions see 'Access and engagement in Science. Teaching pupils for whom English is an additional language' (2002: 9-12) and 'Key Stage 3 National Strategy literacy in science' folder (2002: 7-43), which also contains many useful examples of strategies for word level work. Although the Strategy quite rightly places a lot of emphasis on the development of subject specific words in Science, it is crucially important that science educators think beyond the notion of key words, and consider the wider issues regarding vocabulary development as mentioned above.

Use of the mother tongue (first language)

Making use of the pupils' first language can be very useful in accelerating their understanding and engagement with learning science. Pupils who are both new to English and literate in their first language should be actively encouraged to use a bilingual dictionary and list vocabulary as appropriate.

New science teachers should be encouraged to find out from either the specialist teacher for EAL in their school or from any LA central support team what is available locally in terms of the following:

- translated lists of key scientific vocabulary
- safety procedures for working in a science classroom
- multilingual labels for science equipment and signs indicating hazardous materials.

Many such materials are readily available, either as part of the local school or LA provision or in the form of commercially produced materials. An example of the former is 'Key Stage 3:

Science Terms' (Bexley Council) which has science terms translated into twelve languages; and of the latter, the series 'Bilingual Science Words for School Use' (Refugee Council 2004) which publishes separate booklets in Arabic, Kurdish, Persian, Somali and Tamil.

However, it is important to make new science teachers aware that the role of the mother tongue should not just be limited to word level work involving scientific terminology. Two other areas where translation can play a key part are

- pupil understanding of and response to national test questions on sc1
- reducing misconceptions in science.

A formal response to SC1 investigations is now a part of the KS3 Tests, and can pose a significant challenge to new arrivals whether they have received science education or not. This is mainly due to the fact that many pupils may not have had experience of doing practical, investigative science prior to arrival; and in those cases where they have, the purpose of the investigative work may be around demonstrating processes with little opportunity to handle or examine data in a critical light. Science departments may well have as one of their teacher resources a dedicated booklet giving lots of examples of SC1 type questions with accompanying answers. Arranging for EAL pupils to sit down with a trained adult or 6th Form helper who shares the same language and work through the questions can give pupils a valuable insight into tackling this kind of question. Other support materials which help pupils with this kind of work on variables and experimental design can be found in the Mini boosters section of the Science Intervention materials (DfES 2004), which focus on aspects of scientific enquiry including accuracy and reliability, evaluating a practical technique, what 'evidence' means and making sense of graphical data.

Similarly with the recent focus on scientific misconceptions in the science strategy (DfES 2002), a very useful strategy if resources permit is to have the misconceptions cartoons translated for the pupils, either as written translations or simply orally via other pupils or adult helpers who share that language. Audio recordings and computer programmes/files too can help here in terms of individual access. Translating these cartoons can provide invaluable information regarding the ideas pupils hold about important concepts in science.

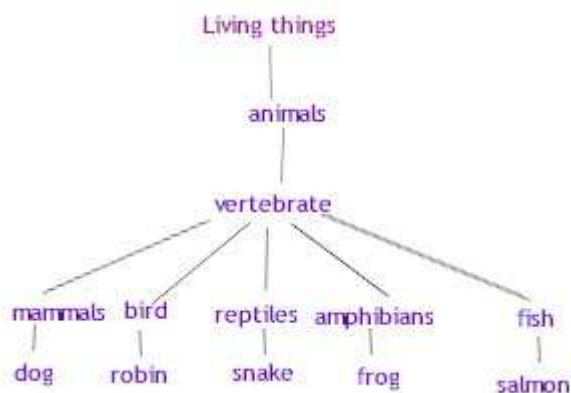
The five key scientific ideas (cells, interdependence, particles, forces, energy)

Given the requirement in the science framework (DfES 2002) to introduce all five key scientific ideas early in Key Stage 3, it is important to make new teachers aware that EAL pupils arriving at times other than the normal entry point in Year 7 may need additional support in explicit instruction and concept checking of these five areas. The Intervention materials (DfES 2004) provide lots of useful visual and game-type materials (e.g. loop cards) which can support with pupil understanding and access of the key scientific ideas. However, potentially the most useful set of materials for EAL pupils here are the two sections 'Explanation' and 'Sentences'. These are usefully laid out in the form of sentence tables and are similar in design to the kinds of support materials which an EAL teacher might design for their pupils. Both of these sections provide an excellent resource for pupils who are already in the process of developing their English, but could also be used to challenge those well-educated, newly arrived pupils with little English. Similarly, the sections on reading, writing and talk in the Literacy folder (DfES 2002) provide useful guidance on further language development work.

Using visuals

In any guidance outlining effective strategies for including EAL pupils in lessons, the use of

visuals always figures prominently. The use of visuals helps to contextualise the learning situation and science is a subject which readily lends itself to their use. Included here also is the notion of key visuals such as graphic organisers which can help to show the underlying knowledge structures of the content being taught, such as in the example below of a classification tree for living things:



It is important to emphasise that visuals have more than just one application: They can be used equally for explanatory, evaluative or generative purposes. Their most common function is 'explanatory' - they are used to help the understanding of the content and support the language message. An example would be a diagrammatic representation in a textbook of how electricity is generated in a nuclear power station. This typically involves a series of five diagrams showing the process of fission from energy to steam to turbines to generator.

However, visuals can also be used for 'evaluative' purposes; for example, a student with little English is given the same five diagrams cut up and not in order, and asked to sequence the pictures to see whether they understand the underlying principle. Finally, visuals can be 'generative' in the sense that they can be used to guide pupils into producing language in an active way - for example, through some carefully crafted statements such as true/false pairings or information gap fill exercises, a pupil can be guided into interrogating a visual and into producing language around that topic. Further ideas on using visuals can be found in the 'Access and engagement in science' booklet (pages 5 – 7) which provides an interesting section on using models in science.

Reading Strategies

Both the Literacy Folder and the guidance on EAL for science teachers (DfES 2002) provide good advice on strategies to promote reading in science through the use of DART type activities (Directed Activities Related to Text). However, one crucially important distinction between literacy and EAL lies in the potential for extending the use of a DART activity with EAL pupils. Essentially many of these activities involve discussion and active participation of pairs or groups of pupils finding, categorising, ranking, marking or deconstructing parts of a text. For example, in a task where the objective is to learn the parts and functions of plant and animal cells, pupils might be involved in either colour coding these in a text (e.g. colour all the names of the parts in yellow, etc), or deconstructing the text by filling in the information slots in a grid:

Name of part	Function	Location	Properties

In many cases, the activity ends when the information has been transformed in some way (e.g. as in the grid exercise above) or when the pupils have finished the analysis activity (marking or labelling text). However, when using these extended active reading tasks it is very important to offer the opportunity to EAL pupils to rework their ideas in their own words and sentences, thereby reformulating the information they have been engaged with. By giving them a model sentence based on the above grid (e.g. the nucleus controls all the activities in the cell), they are then invited to make up similar statements about other parts. Activities such as these provide an opportunity for them to think about their ideas and express them using scientific language and also provides a context within the mainstream environment for EAL pupils to be working on and at language as often as possible.

Specific issues

Pupils with little or no prior schooling

Pupils with EAL will vary in terms of their knowledge of science. Mid-term arrivals joining schools at times other than the normal point of entry (i.e. Year 7) may come with high levels of scientific knowledge. Equally pupils may have experienced an interrupted education, or had little formal schooling. Pupils with little or no prior schooling potentially pose the greatest challenge as for this group the issues are not just about learning science but also about learning about school. Some may not be literate in their mother tongue and not used to the more academic aspects of the school environment. In such circumstances new science teachers could usefully check:

- Whether any induction teaching programmes for new arrivals are running in the school, and if so whether these include any science content
- Common approaches to safety issues in the laboratory and how these are to be communicated to pupils who do not speak English
- Access to interpreters / translators
- Key staff within the school whose role it is to induct and work with new arrivals

Apart from checking teaching materials which may already have been developed within the school for pupils with little prior education, there are also commercially produced materials that can help support these pupils. Materials such as 'Science Access' (1999), produced for lower ability pupils, can help in the early stages of their learning. Often these materials have been designed in such a way as to 'unpack' the task or content by breaking down the steps in the learning. In addition, the materials include vocabulary lists and definitions, equipment glossaries with accompanying pictures and advice for pupils on different types of graphs and when to use them.

However, it is vitally important to let new teachers know that whilst such material can form an initial starting point, unlike other lower ability pupils with special educational needs, EAL pupils may well make rapid progress and have no further need to access the curriculum via such materials. It would also be important to note that some commercially produced schemes used in schools as set texts (e.g. Heinemann 2003) offer a foundation edition which matches the core books spread by spread enabling both books to be used at the same time in mixed-ability classes. The reduced reading demand can be beneficial for some pupils in the initial stages of their learning of English.

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