Teaching science:Issues for EAL learners in the EYFS, KS1 and KS2

This guidance is primarily intended for educators working with Early Years Foundation Stage, KS1 and KS2 teacher trainees.

QTS Standards
Q1 Q2 Q10 Q14 Q15 Q18 Q19 Q22 Q25

Science lessons can be, and should be, a huge opportunity for learning by children learning English as an Additional Language. The practical, hands-on nature of the subject can be very fruitful and highly motivating. However, the language demands of discussion of observations and explanations through which much science learning progresses can be problematic for children whose English language is still developing. Science can also be a challenge for some primary teachers, unless they have adequate resources for investigative work. EAL learners can be disadvantaged if there is an over-emphasis on the use of work-sheets which rely on literacy skills that pupils are yet to acquire.

Good practice in science education requires sufficient resources for everyone, or every group, to carry out a practical activity. Group work may support EAL learning, allowing teachers to group children with an early grasp of English with those who have studied it for longer, exemplifying Vygotsky's concept of *social constructivism*. This theory, which promotes learning via scaffolding and the Zone of Proximal Development, provides an underpinning for successful language development. Group work can also provide plenty of opportunity for pupils to adapt their activity, firstly by observing other groups who may be doing something similar or different, and secondly because in well-ordered practical work the teacher has time and opportunity to interact with all the groups

The nature of practical tasks also encourages discussion. Pupils will need to talk to each other about what they are doing in order to perform tasks or investigations. This talk can also be encouraged between groups at plenary sessions where children report back on their individual investigations. Some pupils will require considerable support in order to speak to a whole class; nevertheless, with support this can be an outstanding language learning opportunity.

Practical tasks also offer opportunities for language learning in context. Instead of simply handing out a set of instructions, why not present them on individual cards and allow the learners to sequence them? And, if diagrams exist to support the written instruction, why not separate them and give students the task of matching individual diagrams and instructions? This can be an excellent discussion tool for groups of pupils before beginning an investigation.

An Inclusive Curriculum

Disinterest and underachievement in science can be the result of a child experiencing negative attitudes at a very early age. It is essential that the experiences a child has in the Early Years Foundation Stage (EYFS) are positive and trigger a long term interest in this area of the curriculum. Science should be seen as an exciting, attainable area of learning and it is our responsibility to reinforce this attitude and fight the old, but still prevalent idea that science is an elite discipline that is only open to a small select part of society. By carefully promoting the enthusiasm and confidence for science from early years and through primary school, we will provide a firm basis for future successful learning

The National Curriculum and Practice Guidance for the Early Years Foundation Stage state the necessity to provide an appropriate science based curriculum for all children and to ensure that planning allows for each child to have access to the learning through the promotion of equal opportunities and anti-discriminatory practice In order to create an environment that provides for equality of access to all the children in the class/nursery the relationship between home and school needs to be fostered at every possible opportunity. When entering school/nursery for the first time the child brings with them skills, knowledge and abilities already acquired. In order for the child to continue developing successfully there is a need, on the part of the school, to provide continuity in this learning process, acknowledging the important role the home takes in the child's life.

This can be achieved in various ways, starting with the relationship between home and school. This means much more than having the occasional special celebration evening where 'multi-culturalism' is celebrated, or with a welcome sign in different languages (though, of course, this is a useful start). Hilary Claire in Arthur, Grainger and Wray (2006) describes this attitude in her chapter *Education for Cultural Diversity and Social Justice*

> *It is important to go beyond projects which exoticise minority communities, or highlight the ways in which they are different from the majority. In some schools minority communities*

> *only get a look in through curriculum work in RE, focusing on festivals and specific beliefs. Best practice is not the occasional celebration after which you revert to a monocultural curriculum, but always looking for opportunities to include different ethnicities in the ordinary range of resources and activities.*

This is especially true in science, which can so easily appear as a product of Western, white culture.

Relationships with the home and community can be developed by various means;

- using the parents as part of the learning environment,
- encouraging them to join in lessons when appropriate,
- creating times in the timetable when parents can come into the class and talk to the children about their own cultural and linguistic heritage and in particular making suitable links to the science curriculum,
- asking older people to come in and talk about their own life experiences and connecting that to science and technology work.

A start can be made in life science areas, with discussion of food and diet and in the physical sciences there are discussions to be held and examples provided in areas such as materials and forces, for example the use of different building materials and designs in different climates..

Good practice means providing experiences for the children to think about other areas of inclusion such as disability and gender. There is a need to continually develop the child's own self-esteem and identity. If a child is able to feel secure about their own identity then there is more chance that they will be able to respect children who are different from them and speak a different language, One strategy is to provide opportunities for the children to look at themselves and others in the class, thinking about similarities and differences in skin colour, type of hair, how they looked as babies, their favourite foods etc. By investigating differences and similarities children are able to extend and develop their own sense of identity. The acknowledgement that there are differences in us all and that these differences should be respected rather than ignored or resented should provide a good starting point for children to develop as caring, respectful people. Different languages may prove an additional focal point for children to investigate.

Science and technology are areas of the curriculum where there is often a particular need to allow and encourage inclusion for all. There is a stereotypical image of these subjects that often excludes certain sectors of society and it is therefore necessary to positively reinforce the all-inclusive approach, encouraging all children to take part in the Science and technology sessions. Girls especially are still sometimes seen as being disadvantaged in terms of their Science and technology learning with boys still winning in the race to get to the equipment first and girls preferring (or being persuaded) to take a more passive role.

Practitioners should actively seek to address areas of race, culture and gender. Providing resources of books, CD Roms which look at black and minority ethnic scientists and encouraging local BME scientists or technologists to come in and talk to the class will help to reinforce the anti-racist message. Technology is included here as it is inextricably linked with Science, especially in the Early Years. Hilary Claire in a chapter on *Diversity and Inclusion* in Arthur, Grainger and Wray (2006) argues for planning for a curriculum that is more relevant

> *Aim for a more inclusive approach through all the curriculum subjects not just RE. For example in art, design and technology, children might learn about scientific and technological achievements from outside Europe - the Taj Mahal built by Shah Jehan, the Great Wall of China, Great Zimbabwe, the Egyptian or the Mayan pyramids; sculptors in Mesopotamia (now Iraq) who made the magnificent friezes commemorating their rulers' victories; the bronzes and sculptures of Benin craft-workers in the sixteenth century, the magnificently decorated monasteries carved into the mountains in Ethiopia, built by early Coptic Christians.*

Although these amazing structures are outside the geographical and historical contexts of most primary education, talking about magnificent buildings found outside Britain helps to introduce or underline the idea that there are great things in countries other than the UK. The need for the children to be able to have experience of the achievements of a range of cultures and traditions is paramount if we are to promote an environment where cultural and linguistic diversity are celebrated rather than tacked on to our teaching.

However, simply mixing in examples from around the world is insufficient, and can sometimes be problematic. We need to avoid falling into the trap that all old technology is associated with the East and that new technology is prevalent in the West, such as showing pictures of intermediate technology being used to help 'poor African farmers'.

Early Years Foundation Stage

When children enter the nursery or reception class the environment should reflect the many and varied cultures which comprise the community. If we are to provide an environment that is inspiring for all the children there is a need to resource it from an all-inclusive angle. Provision of appropriate books and ICT resources should reflect the children working there. Ways of incorporating children's existing experiences as part of teaching and learning include:

- encouraging parents and grandparents to come into the Nursery/classroom to talk about their own experiences at school,
- sharing of food ,
- toys that are not just Euro-centric,
- dual-labelling of classroom items in appropriate languages,
- displays about festivals and celebrations of these special occasions.
- images, illustrations and artefacts which reflect diversity
- finding out about, and where possible using, community languages

These are just a few of the many ways of creating a classroom/nursery where all working there can feel they belong. Parents and carers will also feel more positive about a setting that reflects their culture and community and this confidence is likely to be transferred to their children.The section of this website entitled Supporting bilingual children in the Early Years provides extensive guidance and prompts regarding these and other issues across the Early Years Foundation Stage.

Children entering school or nursery for the first time have already acquired a sense of identity and belonging. If the child is to succeed in this next stage of their development there is a need to recognize the importance of the home and the family and to build on the knowledge children already have through contexts with which they are familiar. Working on science activities is often a good time for parents to be invited in to share in the children's learning. This can often be an extremely useful experience for families that have EAL – parents who might not respond to the idea of coming in to learn English may well have a different reaction to coming in to share their knowledge of science, and will develop their language skills as a by-product.

It is important in the Early Years Foundation Stage for Knowledge and Understanding of the World to be a very practical experience. As it notes in the Practice Guidance for Early Years Foundation Stage '*Children should be involved in the practical applications of their knowledge and skills*' and practitioners should '*plan activities based on first-hand experiences that encourage exploration, experimentation, observation, problem solving, prediction, critical thinking, decision making and discussion*'. Language rich opportunities indeed. Getting a sense of the material that you are dealing with provides a foundation for further exploration of how it behaves and eventually for the development of concepts. For example when children are playing with water they are investigating what happens when it is poured into different containers or down tubes and funnels. They are finding out what happens when it is spilled onto a flat or a sloping surface and how it can be absorbed by paper or fabric. They might be feeling ice and watching it melt or looking at the steam coming out of the kettle or the condensation on the window. This exploration can be extended when they use paint that is mixed with water or make flour and water paste that has different properties from its ingredients. All these experiences are likely to be accompanied by talk in small groups perhaps facilitated by practitioners. When that talk is repetitive, as is often the case, then the opportunities exist for learning and reinforcing appropriate language.

Scientific activity is a very positive way of acquiring language skills. In the early years children will be describing, questioning and perhaps making predictions as well as extending their vocabulary. For example, during the physical process of deciding which objects float and which sink, children may acquire two important words (float and sink) and understand their intrinsic meaning. Interactive displays can be provided, containing key words written in community languages and provided with an English translation. A feely-bag of materials with different textures can be supported with community language translations of words for rough, smooth, hard, cold etc. Reporting back could be visual as well as verbal. Using digital cameras for children to photograph and download pictures, and then talking about their results as pictures are displayed on a large screen, is an excellent example of such activity.

Much of the communication at this stage will be oral and EYFS staff play a crucial role in encouraging language development. In the early stages much of this language will be descriptive and practitioners need to model this through their interactive talk. Another aspect of language development is through the use of questions. When children are ready some speculative and open-ended questioning can be introduced to encourage further investigation. 'I wonder what will happen if…' or 'What do you think might happen when....?' invite children to offer ideas and try different experiments without feeling that they are wrong. Further questioning, such as 'how can we find out?' will encourage discussion and exploration.

Rhymes and songs, good quality stories, games and suitable software all have a role to play in developing language skills alongside scientific understanding. During a recent science festival there was the opportunity to theme a day on "The Lighthouse Keeper's Lunch".(Armitage, 1977) The day began with a reading of the story, then the children were divided into groups to experience such activities as moving loads with pulleys, exploring gulls' wings, building

electrical circuits and investigating lights. The practical nature of the activities benefited all children, including many with EAL and some with very limited English.

Not all such activities need to be complex. An investigation of wheels and axles can be stimulated by singing "The wheels on the bus" or an investigation into magnetism can begin with a game of magnetic fishing. Encouraging children to explain their understanding of magnetic attraction provides insight into their experience and view of science.

Key Stage 1

Building on skills acquired in the Early Years Foundation Stage, children can be encouraged in their acquisition of science concepts and of language. Some children, including some with English as an additional language, will not have experienced the learning through play approaches of the nursery and need to have direct and practical experiences. They need time to explore and to investigate and to develop their interest in the world around them. Yet it is often at Key Stage 1 that an artificial distinction between work and play is introduced.

While the EYFS recording of children's understanding is often done through observation, at Key Stage 1 pupils themselves are given more responsibility for presenting and discussing evidence of their learning. This needs to be done in ways which are meaningful to children, for example using digital cameras, videos, drawings and charts and diagrams as well as the more formal requirement to write. In all of this talk is integral but also needs to be focussed so that children know what it is they need to talk about.

Using the 'talk partner' model children at various levels of language acquisition can be linked up to ensure that more confident English language users can work alongside less confident ones. Discussion about investigations carried out or about to be carried out can be presented in an informal and less threatening manner thus encouraging development of confidence. There is also scope for children who share a first language to discuss their ideas in that language.

In a topic about healthy eating children in Year 2 were asked to talk about their favourite foods and to use paper plates to draw these. They represented the preferences of the whole class by building up a bar chart together. Each child was asked to draw or name their favourite food on a small square of paper. These were physically added to the relevant column on the bar chart so that all children could participate in the development of the chart. The teacher and children could add a commentary as the bar chart was created, using phrases such as, '….. likes apples. That goes in the fruit column….' 'My favourite food is…..' 'We can see there are 5 children who like….' Pupils were actively involved in the data analysis through visual and verbal communication and the children with EAL, in particular, had a clear picture of the process of constructing a bar chart. One boy came confidently up to the board with his square declaring, 'I know exactly where this goes because…..'

When the bar chart from a parallel class was compared to their own they could readily understand, describe and analyse the differences and similarities between them and use appropriate language such as, 'Our class preferred……..but they liked…..' and ' More children in class…than in class…..like……' Teachers need to model this language so that children are able to move from the everyday to the more specialised and scientific language.

The use of different genres can prove useful in helping the less confident language user to work through fairly complex scientific concepts in a supportive manner. To be part of a small group presenting to the rest of the class, using drama or mime may feel less daunting to an EAL learner than standing up and explaining their findings to the rest of the group.

A teacher with a Year 2 class consisting of a large proportion of EAL learners decided to use drama to develop an understanding of animal behaviour as well as writing skills. Children were read "Tyger, Tyger" and then mimed the actions of a tiger in various conditions (looking for food, sleeping, chasing prey). The children's creative writing developed far beyond anything they had produced previously, and their descriptions of the differences between tigers and other animals were significantly improved. The children had used the drama experience to develop their writing and language skills because of the practical nature of the activity. In a sense the drama served to scaffold the children's understanding of an animal's behaviour

Key Stage 2

The recommendations of the Rose Review may give teachers more scope to teach some of the difficult concepts that pupils will encounter in Key Stage 2 in ways that are more creative and appropriate to the stage of development of the children. The formal requirements of writing in a scientific genre and the use of analogy and of models to try to explain some of the concepts make this stage of the science curriculum increasingly challenging. There is also more reliance on secondary sources, for example in electricity and magnetism, forces, circulation and Earth in space where children investigate the effects rather than the phenomenon itself.

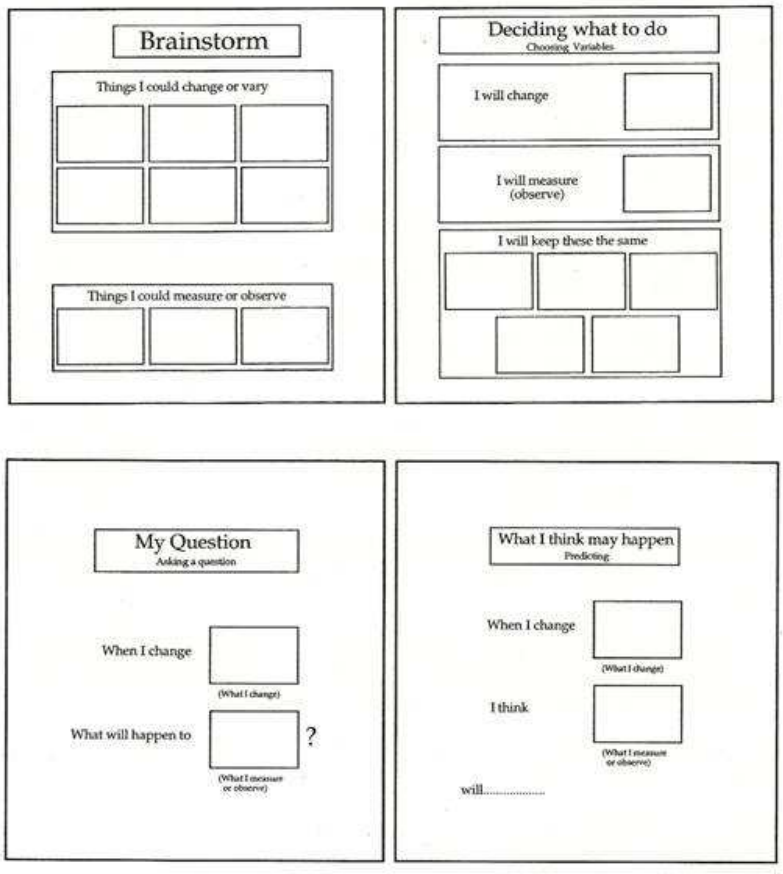
Electricity is a topic that pupils will have encountered in Key Stage 1 through building simple circuits. In Key Stage 2 they begin to investigate switches and the effect of wiring bulbs in series. It is useful at this stage to introduce electric current through a model using a plunger-type soap dispenser and water. This demonstrates how energy is pumped around the system. In the first instance pupils need to be able to describe what they see. They will use their

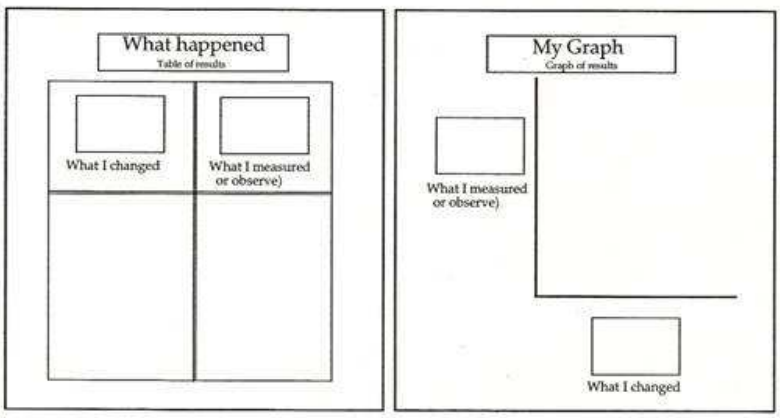
own, everyday language in small groups and the teacher can then help them to articulate their understanding by using more scientifically accurate language. It will be important to discuss why this language is more appropriate and to clarify the special use of terms that they may have come across in a different context. Words such as cell, circuit, break and conductor have everyday meanings that can confuse pupils, particularly those with EAL. If teachers are alert to these common sense meanings they can raise questions such as; When else can we use the word circuit? Do the different meanings of the word have anything in common? How could we tell what sort of circuit a person was talking about?

Once pupils have an understanding of electric current through the use of a model they are likely to have greater success in building more complex circuits including switches and several bulbs. If they make parallel rather than series circuits during their investigations they are also likely to be able to explain why bulbs behave differently in these cases. This can be done in a variety of ways, including oral explanations, diagrams, formal presentations or through drawings. Some children display good artistic ability and this can be built on to help children grasp basic scientific ideas.

There is a whole range of concept cartoons which have been developed (Keogh and Naylor, 1993), the purpose of which is to stimulate discussion about scientific concepts. The concepts and misconceptions are delivered in a cartoon fashion and can be an invaluable asset to a class which has children who are learning EAL. The pictures are amusing and non-threatening and can be used as an additional aid to confidence boosting and understanding. There are often excellent cartoonists amongst KS2 children and this could prove a vehicle for understanding and for sharing this understanding in a manner that is appealing to the young learner. EAL learners are often able to join in fully; the cartoon being the essential part of the work, replacing a collection of words.

At Key Stage 2 the curriculum requires more formal recording of experiments and children need to become familiar with scientific ways of writing. This requires teachers to model the appropriate language, style and vocabulary. Writing frames, such as the ones below, are useful. These make the requirements clear while giving an increasing degree of freedom in completing the report to reflect the specific experiment.





(from Goldsworth and Feasey, 1994)

The move from oral, everyday to more formal, written language is difficult for many children, particularly those with EAL and needs to be made explicit. Whereas in practical and oral communication pupils will tend to use pronouns and deictic markers such as 'it', 'there' and 'them', in the more formal language of writing they will be expected to use nouns and prepositional phrases instead. They will also be required to use connectives to clarify the process and the reasoning behind experiments. It is helpful if pupils with EAL have the opportunity to practice these forms orally, for example in structured presentations, as well as hearing them modelled.

In Year 6 the English curriculum introduces the passive, which is a common feature of scientific discourse. One way of raising the issue is to illustrate it through a discussion of famous scientists and how clear they need to be in order to communicate their ideas. It will be important in selecting examples to avoid the over emphasis on dead, white, European, males which can be very alienating.

In Key Stage 2 pupils will also be moving towards more independence, building on their earlier experiences. They progress more quickly if they have some degree of control over their own learning. To help them achieve this it is helpful to provide a classroom environment where a child is able to locate resources rather than be provided with a set of equipment that may prove too prescriptive. It is useful to make sure that wherever possible resource boxes are labelled both in text and pictures, thus ensuring that children learning English can access the equipment they need.

Conclusion

The value of science and technology are evident and have particular benefits for bilingual learners. They are subjects which lend themselves to practical investigation and to discussion and exploration. They hold an intrinsic interest for many young children who are curious about the world and who have and search for a range of explanations about how the world works. In this way science and technology incorporate and build on existing knowledge and understanding. They also have the potential to develop social, cognitive, practical and linguistic skills.

But equally science and technology can be conceptually and linguistically demanding and so require careful thought and preparation. Some of the strategies suggested above can be of immense benefit to EAL learners and ensure that learning and language development will continue simultaneously. Trainees will also find many useful pointers to issues of language within science in our accompanying Subject specific information for initial teacher educators - Science and EAL

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