Science

primary subjects

issue one summer 2008

Making every child matter

Every child matters, and science matters to every child – by which we mean being scientific, not simply learning science ideas. Moreover, as doing science means testing ideas against evidence, children's science ideas matter enormously. We begin with some advice for subject leaders on engaging all children with 'real' science, then offer two examples of practical work on life processes.

Children as scientists

Nearly all children respond positively when asked to 'be scientists'. We need to give them the confidence to ask questions, make detailed and relevant observations to obtain evidence, and use that evidence to test their ideas or reveal patterns in what they observe. Once they have enquired practically into a question of their own, communicating their findings will seem natural: this is 'real' science, helping from an early age to build skills that support independent and enquiring minds.

science means testing ideas against evidence

Children have all kinds of ideas about natural phenomena; often, we don't know what these are because we never give them the chance to tell or show us. When children were asked recently[1] to say what the earth is made of, it elicited the most bizarre responses – one child said 'there's a melon inside'! Over 20 years ago, the SPACE Project (*www.cripsat. org.uk/previous/space.htm*) detailed hundreds of children's science ideas, and is still a valuable starting point for enquiry. In this first issue of *Primary Subjects* we'll therefore suggest simple activities on life processes to do with children of any age, to illustrate the basic ways of 'doing science'. Subsequent issues will take up other themes, such as supporting colleagues with a more pupil-led approach to investigations.

Every Child Matters, with its emphasis on enjoyment and achievement as well as health and well-being for all, aligns closely with science teaching. However, the ECM agenda also signals changes to the structure and philosophy of the primary curriculum which have positive, if challenging, implications for science subject leaders, for science is an important context within which other types of learning can be explored. For example, subject leaders must help teachers to 'let go' yet skilfully mediate during science discussions, to allow pupils to investigate their own ideas through the kind of practical work exemplified in the following pages.We have not linked activities to specific key stages or year groups, as they can all be adapted to suit different contexts and levels; nor have we included skills or assessment criteria, because the precise outcomes will depend on identified pupil needs and the Sc1 focus for the unit of work in which the activity is used. For example, a younger year group may need to focus on measuring skills; for older pupils these will be taken as read and the focus may be on presenting data and understanding sample size.

Quizzing the snail: an example of focused exploration

Snails are easy to observe and work with, either outdoors or in the classroom, as long as you put them back where they came from afterwards. And unlike many other small animals, they are not hard to pick up, and they don't run up your arm or squirm on your palm. Put children in front of snails, and they will start to ask questions (the children, not the snails): *'Where are its eyes?', 'How does it move?', 'How does it eat?', 'Is it a boy or a girl snail?', 'How fast can it go?', 'Has it got a nose and ears?', 'Where does it like to live?',* etc. To answer their questions, children have to 'quiz the snail'; which they soon realise means watching it carefully in different situations. For example, to work out how it moves, they simply have to put it on a sheet of clear glass or plastic, and watch it from underneath. Or, to measure its speed, they can put it on a sheet of dark paper (where it leaves behind a clear trail), time its movement for several minutes, then measure the length of the trail by laying string along it. Now they've got the idea – they have to work out a way to answer their own question, and come up with some evidence. That's science.

Taking forward this simple starter activity will not be too difficult, as I predict that by now they will be engrossed with the snails on their 'farm'. But let them raise more questions of their own first. For example, one child asked *'Can it reverse?'* – a great question! And most books on snails don't tell you the answer, so how to find out? (The children found a short, hollow plastic tube not much wider than the snail itself; they put the snail in one end, and sealed the other. Try it yourself!)

Quoit a challenge: surveying plants on your school field

Even very young children can engage in this kind of real research, and it can continue longitudinally from year to year, each group building on the last group's data and progressing to more sophisticated analysis. Give each child a quoit[2]; on the school field, ask them to throw it randomly over their shoulder, then count the number of different plants inside it. They can examine each small patch of 'grass', at first with only their eyes, then with a lens, and just do a simple count – no identification required. They can repeat this up to five times, depending on how long you've got, and take an average of their counts.

Back in the classroom, let them talk about how they knew they were looking at different types of plant, so that they start building up descriptive vocabulary. You can get a great discussion about size and colour as pupils try to work out whether they have found a small, pale 'baby' leaf or a different plant. It's not scary, even if you don't know much about plant identification; they can move onto this later. At this stage, help them think about which are useful observations for distinguishing one plant from another (they soon realise that '*has green leaves*' is not a helpful starting point!) For younger children, the purpose of the activity is to learn to look closely, to describe what they see using increasingly scientific vocabulary and to realise the variety of life under their own feet. Learning to use keys to identify and classify can come later – it works better with older children, who will probably know their 'patch' well already. They can develop a key for themselves, and compare 'their' plants with those in other schools via web links. An excellent example comes from children at St Mary's First School, Swanage, who built up a database about the different heathers and other plants on heath near their school[3].

How old was Tutenkhamun? A pattern-seeking activity

The removal of Tutenkhamun from his tomb in 2007 received lots of media attention, and questions were asked about his age – was he a boy-king, or a small adult? The archaeologists found out by studying the skeleton: your children can be forensic archaeologists too. Ask them to imagine they are detectives who have found a (model!) skeleton – or if one isn't available, let them be archaeologists using secondary data provided for them (from an invented archaeological dig). They decide which parts of the skeleton to measure and then survey some year groups in the school (and maybe the teachers) to measure the same bones and compare sizes, to work out how old the 'the victim' might have been.

This activity moves children on from asking, 'do older pupils have longer legs, or bigger heads?' by providing a context for more constructive questioning. It also focuses their attention on how body proportions change from baby to adult. If an archaeological context is used, you can make links with various historical periods or geographic areas – were people smaller in the past? Which ethnic groups are very tall or very short? Why might this be? Try encouraging the children to measure the height of doors in old and modern houses, for example, or considering differences in diet. What could all this tell us about Tutenkhamun?

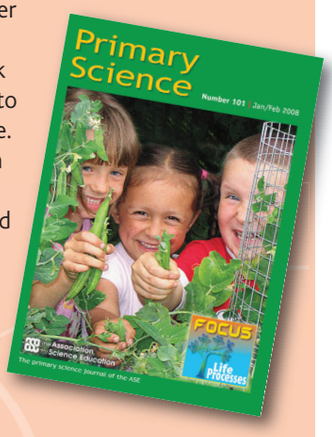
[1] Full story in *Primary Science Review* no 96, *www.ase.org.uk/htm/journals/psr/psr96.php*.
[2] Small rubber ring, usually 20cm in diameter, used in throwing games.
[3] *Primary Science Review* no 83, *www.ase.org.uk/htm/journals/psr/psr83.php*.

Promoting practical science – valuing children's ideas and imagination

The Association for Science Education (ASE) exists to find ways of improving teaching and learning of science. Most of our work involves groups of teachers working together to translate a new idea into practice, or find a way of satisfying an identified need, and sharing the results. ASE is a significant resource for information, interpretation and grounded views.

At the ASE Conference in 2007, Michael Rosen recalled that the thing he remembered about his best science teacher was that she never gave him any answers, appearing just as intrigued as the class and always encouraging them to go out, investigate and find out for themselves.

Cross-curricular planning, individual learning agendas and, in some places, teacher assessment offer an opportunity for you to talk about what we are trying to teach and assess in science. We hope the ASE, through its Primary Committee, *Primary Science* journal and many other publications, will play a big role in supporting your science teaching. Why not be an ASE member? You can join at *www.ase.org.uk*.



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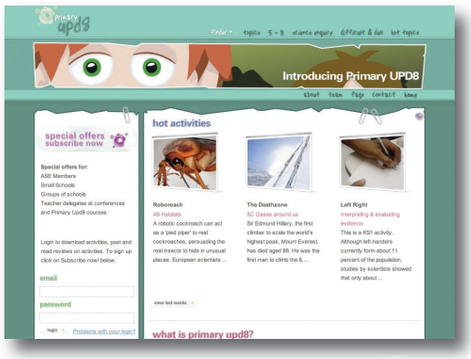
The **Association** for **Science Education**
Promoting Excellence in Science Teaching and Learning

Look out for ... some of our exciting resources

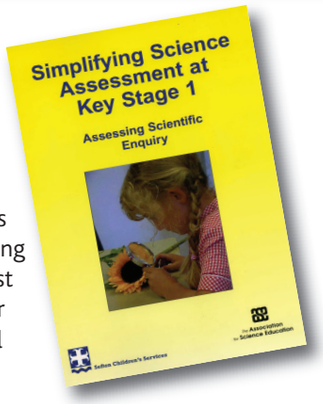
Upd8s

Upd8s support literacy, numeracy and other cross-curricular links; they also make great assembly material. They help you make the science curriculum more relevant and exciting, and teaching 'scientific enquiry' skills more compelling and accessible. In addition they are designed to take advantage of your interactive whiteboard. Go to *www.primary upd8.org.uk* and try the sample activities *Getting Lost* and *Shark Attack*.



Simplifying Science Assessment at Key Stage 1

An enquiry focus at Key Stage 1
Assessing scientific enquiry as part of normal classroom teaching is more effective and less time-consuming than setting up specific assessment tasks. This book is designed to help with the planning process and to provide materials to assist when assessing achievement. For further details telephone 01707 283001, e-mail *booksales@ase.org.uk* or visit *www.ase.org.uk*.



... looking for teaching support, follow up activities and suggestions for lessons?

schoolscience.co.uk

How about a range of interactive resources, lesson plans and articles to inspire and enthuse? Explore the universe or follow in Darwin's footsteps – with hundreds of resources and thousands of pictures, diagrams and animations. Go to *www.schoolscience.co.uk*.

Council for Subject Associations
A Voice for Subjects
CfSA

This pamphlet is part of Issue one of *Primary Subjects*, published by CfSA.

primary subjects
issue two autumn 2008

Science

Supporting gifted and talented children

Dinosaurs, conservation, astronomy, railways and skateboarding – just a sample of the subjects in which children are often world experts. We find it easy to identify these able and knowledgeable scientists. They have heads full of facts, shelves full of books, huge collections of artefacts and a passionate desire to find out more. And they often like to talk about their chosen specialist subject.

But a strong interest and high level of knowledge and understanding about a particular scientific subject isn't the only identifier of ability in science. What about those children who never stop asking questions about why things happen, how things work and what would happen if? Einstein famously commented that the only important thing for a scientist is to never stop asking questions: he would presumably recognise scientific ability in these curious children. Some children demonstrate potential in science through their ability to analyse data and spot patterns; some are meticulous at setting up and carrying out practical work. Others love to find links between different facts and concepts, and to develop their own logical explanations for phenomena. Some children delight in complex problems that require creative solutions; others are fascinated by abstract ideas.

All these children are exhibiting the characteristics of pupils who are gifted in science (*www.qca.org.uk/qca_2184.aspx*) yet none of these characteristics are identified through formal attainment measurements, which rely on literacy and/or numerical abilities. As science subject leader, you need to ensure that all your colleagues know how to recognise able scientists and that they offer opportunities in every class for all children to demonstrate, exercise and develop their scientific strengths and interests.

How do we identify these children?

- Do we make time to listen to children express their interests, knowledge, questions and theories?
- Do we offer them a variety of worthwhile science activities in which they can demonstrate their skills and knowledge?
- How can we be sure that it is science potential we are identifying, and not literacy or numeracy skills?

How do we meet their needs?

- Is the curriculum level and content appropriate?
- Is the pace of the curriculum appropriate?
- Is there the appropriate level of complexity and challenge in the curriculum?
- Are our expectations high enough?
- Is the learning environment one that encourages questioning, speculation, risk taking, independence?
- Which other organisations can we work with to enrich the science curriculum?

Overleaf we offer strategies all teachers can use to enrich their science teaching and challenge able scientists. These focus on broadening and deepening children's learning, increasing the complexity and challenge of the task, and encouraging greater independence, autonomy and reflection. We rarely recommend accelerating children in science. In most primary schools there is no need to teach the key stage 3 Programme of Study. Science is about possibilities, and a rich primary curriculum offers countless opportunities for open-ended investigation, complex scientific thinking and independent research.

'Is it better for a plant to be tall or leafy?'
Y2 pupil

'What sound does a star make?'
Y1 pupil at an observatory

'If I could travel faster than the speed of light, which star would I have to go to so that I could look at the earth and see dinosaurs?'
Y6 pupil during a visit to an observatory

'How heavy is air?'
Y4 pupil

Now you've identified these potential Einsteins, how can you meet their needs?

The most appropriate and manageable strategy for enriching and extending the curriculum for able scientists is by using your school's scheme of work for science and planning for additional breadth, depth, independence and reflection. All children will benefit from the resulting enriched and authentic science curriculum.

Planning for broader science learning

Go sideways, beyond the confines of the National Curriculum or EYFS framework:

- enrich and extend their breadth of experience and knowledge by drawing on information and resources that go beyond the national curriculum
- involve first-hand experience wherever possible, with relevant visits: an observatory, an industrial site, laboratories, and meeting people who use science in their jobs (medics, engineers, conservationists)
- use topical news stories with a science focus to help children move their understanding from the personal to the bigger picture.

Example

Holding a science week, or a science day, is a fantastic way to enrich and broaden your science curriculum. Some schools choose a theme: space, Harry Potter or the local environment; what do scientists do, what is science? Successful science events offer a rich timetable of activities for the whole school, including outings, visiting speakers, science theatre groups, competitions, large-scale investigations, science assemblies and lots of hand on science activities. All children benefit from the experience of a science week; for able scientists it offers a chance to explore ideas and concepts more widely.

Organising a science week

STEMNET (Science, Technology, Engineering and Maths Network) works with local organisations linking business and education, and is an invaluable source of information and contacts when planning a science week. For details of your local STEMPOINT or SEAs contract holder and other useful links go to *www.stemnet.org.uk*.

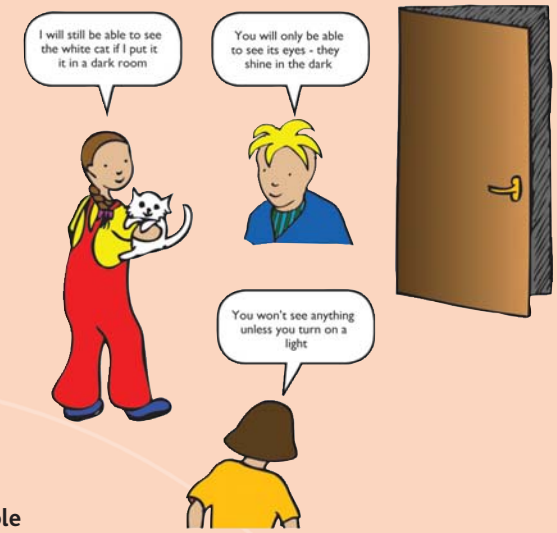
The British Association for the Advancement of Science (BA) offers lots of advice on planning science weeks; visit *www.the-ba.net/the-ba/Events/NSEW/Get Involved/NSEWResources/index.htm*.

The national network of Science Learning Centres run CPD courses on how to enrich the science curriculum, including using industry links and planning successful science weeks. For further information visit *www.sciencelearningcentres.org.uk*.

Planning for deeper science learning

Increase the complexity of the task or the level of understanding:

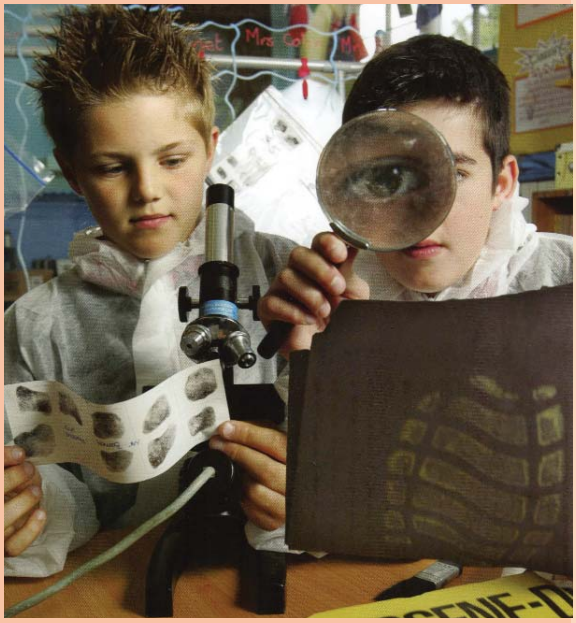
- ask challenging questions that demand higher order thinking skills, such as analysis and synthesis and the application of more complex information
- share in and encourage curiosity and speculation
- offer opportunities to move from concrete ideas, that children can explore practically, to more abstract ideas
- give pupils access to more demanding texts or internet sites
- ask your local secondary school whether they can lend you equipment (or a laboratory) which will enable your children to refine their practical work and achieve greater accuracy.



Example

Concept Cartoons™ are a brilliant way to deepen science learning. They pose seemingly simple questions about everyday scientific phenomena. The questions fascinate children, and challenge them to use higher order thinking skills to work out what they think. Concept cartoons to deepen understanding of key stage 1 and 2 science topics are available from *www.millgatehouse.co.uk*.

Wylde Green Primary School in Sutton Coldfield, Birmingham, planned a crime scene project for their Y5. All the children looked at evidence found at the crime scene. With support and equipment from the Science Learning Centre and local Specialist Science College, some of the children were able to include DNA analysis as part of their forensic investigations.



To see how they did it, and get ideas for planning your own challenging science project, go to Teachers TV (*www.teachers.tv*) and search for Crime Scene Investigation. To find your local Specialist Science College go to *www.schoolsnetwork.org.uk/specialismsandvocational/default.aspa* and click on 'Search for a specialist school'.

Planning for more independent science learning

Help children design and carry out investigations and research with less adult support:

- give children opportunities to investigate ideas unaided; they should pose their own questions, decide how to collect and record data, analyse their findings and come up with their own conclusions
- allow them to choose their own working groups and decide who does what
- enable them to carry on their investigations at home (providing equipment and materials if necessary, with due regard for safety)
- encourage children to take part in activities outside school and allow them responsibility for organising such activities.

Example

After school or lunch time science clubs can give able children the chance to set up and carry out their own investigations independently. There is more time and the investigations do not have to be linked to particular learning outcomes. The BA Crest Star Investigators scheme offers an excellent framework for children aged 5-11 to explore a science topic independently – offering suggestions and support for science club investigations on topics as diverse and interesting as tea, glue, toothpaste and dinosaurs; plus children gain awards for their scientific endeavours.

For more information visit *www.the-ba.net/the-ba/ccaf/CRESTStarInvestigators/AboutCREST StarInvestigators/index.htm*.

In this CREST Star Investigators activity, a brave boy tests out his mended bucket!

Planning for more reflective science learning

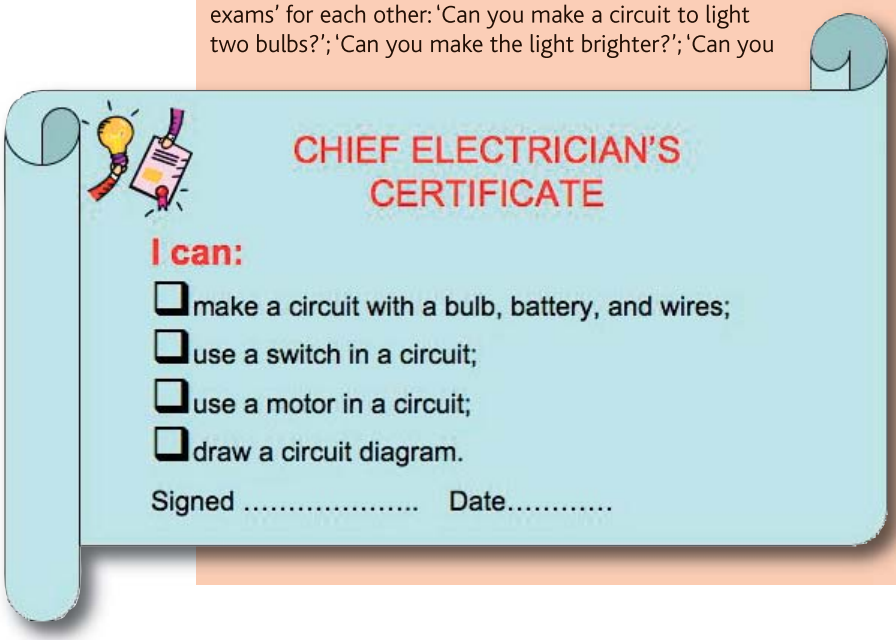
Make understanding explicit and evaluate science investigations and findings:

- challenge children to provide explanations and connections, as well as information
- allow children to develop their own criteria for judging the value of their work and ideas, and those of others
- ask children to plan science activities for younger children.

Examples

Master electrician

Leading primary science consultant Rosemary Feasey recommends that teachers introduce an 'apprentice scheme' into science lessons. For example, when learning about electrical circuits children devise 'apprentice exams' for each other: 'Can you make a circuit to light two bulbs?'; 'Can you make the light brighter?'; 'Can you add a switch?' etc. The children then examine each other, including asking reflective questions such as 'How much effort did you put in?'; 'How challenging was it?', and award certificates of 'skilled electrician' if their required standard has been reached.



Science themed visit

Some Y6 children at Wroxham School in Potters Bar decided to plan a science themed visit for Y1s to a local mill museum. Working with museum staff and their teachers, they identified the potential science concepts, including changing materials, forces, and plant growth and planned practical activities for their younger peers to do at the museum. They focused on big ideas, key vocabulary and science learning outcomes. They evaluated the success of the day and made recommendations to museum staff to help them in their organisation of future school visits.

To watch the project video visit *www.cultureandschoolseast.org.uk/video/trail_m*.
A DVD of the Mill Green Project is available from *info@mlaeastofengland.org.uk*.

Science news

Getting practical: making science teaching come alive!

Primary Science at the ASE Annual Conference
Reading University, 8-10 January 2009

Many primary workshops, talks and resources to view throughout the three days. ASE Primary Science Committee is promoting the practical theme for its Saturday special events. Paul McCrory presents the Primary Science Lecture *Letting the fun in science out*, an interactive presentation exploring the importance of emotionally engaging pupils in science. The hands-on theme continues with a chance to meet *Problem Pup* who, in the hands of Debbie Eccles and Kate Blacklock, will guide foundation stage pupils through their earliest science investigations. Come and try some investigations with the PSC writing team for a new ASE publication, in the workshop *Beyond fair testing*. ESEU launch the very practical *KS2 Rock, soil and the Earth working in your classroom*.

The Primary Science Quality Mark[1] workshop introduces you to a new way to celebrate a school-wide commitment to excellent science teaching and learning. For relevant and exciting cross-curricular links, Allie Beaumont explores the nature of creativity, with science at its heart.

Come for one, two or three days; come alone or bring your colleagues! For further details contact ASE.

[1] The Primary Science Quality Mark is a pilot project started in January 2008 by the ASE, SLC East of England and Barnet LA. Its aim is to develop and celebrate a school-wide commitment to excellent science teaching and learning. 13 schools are taking part in the pilot, with national rollout planned for early 2009. There have been 100 enquiries from interested schools and local authorities. To benefit from the pilot assessment materials please contact Sarah Taylor at *sarahtaylor@ase.org.uk*.

The Association for Science Education
Promoting Excellence in Science Teaching and Learning

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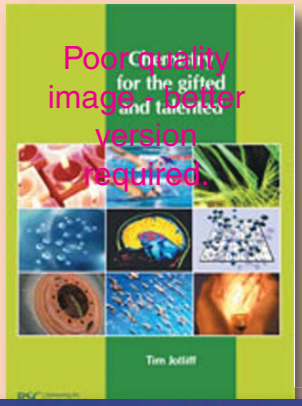
ASE resources to supported G&T learners



Reach for the stars: Workshops for G&T eight year-olds
This is an article from the February 2007 issue of *Education in Science*, the online companion to the *Education in Science* journal: www.ase.org.uk/reach_for_the_stars_eis_feb_2007.pdf

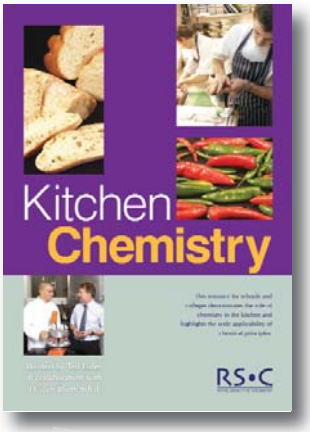
Science for High Fliers
Guidance and activities to extend and enrich the QCA key stages 1 and 2 scheme of work for science, for pupils whose standards exceed national expectations.

Science Challenges
For Y5 and 6 pupils who have a secure understanding of scientific ideas and processes. The activities require the application of pupils' scientific knowledge and skills in challenging contexts.

For further details telephone 01707 283001, e-mail **booksales@ase.org.uk** or visit **www.ase.org.uk** (discount for ASE members).

Royal Society of Chemistry resources to support gifted learners

Kitchen Chemistry has some investigative material suitable for primary pupils; visit *www.rsc.org/education/teachers/learnnet/kitchenchemistry.htm*. *Chemistry for the more able* is mainly for secondary schools but contains some activities suitable for able top primary/lower secondary pupils; visit *www.rsc.org/Education/Teachers/teacherfellow.asp*.



Join us!

Join ASE and come to the Annual Conference, discounts for members!

Safety: Reasonable care has been taken to ensure that the science activities in this publication do not suggest practices which may be dangerous. However, the Association for Science Education has not tested the activities so teachers are advised, before undertaking them, to consult *Be Safe!* (3rd edition, ISBN: 978-0-86357-324-8, published by ASE) and any other model risk assessments they are required to use by their employer.

Council for Subject Associations
A Voice for Subjects
CfSA

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Science

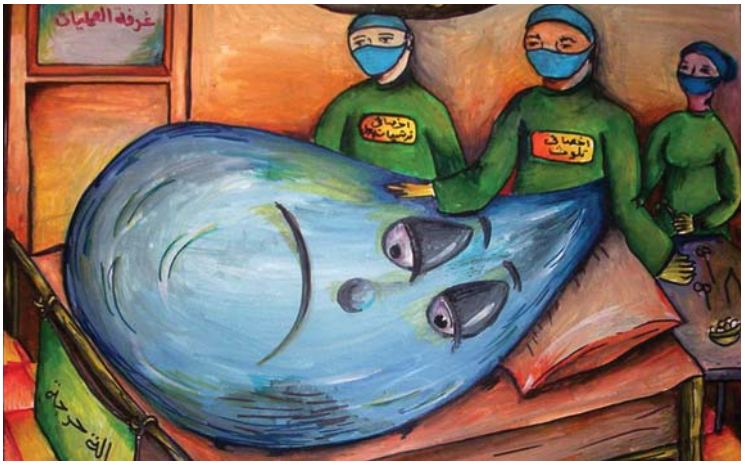
engaging with globalisation

Our pupils are growing up in an increasingly global context. There is a global dimension to all aspects of their daily lives - their clothes, food, music, holidays and the careers they choose - and many of these have direct links with science.

Globalisation does not fit tidily into a national curriculum box or neatly tick off a science programme of study statement. In QCA's big curriculum picture, *www.qca.org.uk/libraryAssets/media/Big_Picture_ 2008.pdf*, it is found in curriculum aims and whole curriculum dimensions. The challenge for the science subject leader is to link globalisation with familiar and interesting contexts, threading it through existing themes or units of work and establishing the links that make it part of, rather than an addition to, the subject. On the following pages you will find specific science curriculum links and resources; here we look at the links between globalisation, science and broader aspects of school life.

Linking science and globalisation

Science aspects of globalisation link to other requirements and initiatives. The requirement on schools to promote community cohesion *www.teachernet.gov.uk/wholeschool/communitycohesion* is now included in Ofsted inspections, and 'community' in this context includes school, local, UK and global. Introduced initially through citizenship/PSHE, there are implications across all subjects. Whether linking science with Black History Month (see *www.planet-science.com/outthere* for examples of African American Scientists), considering the needs of people in developing countries when choosing a charity for which to raise money (see *www.africanrelief.org.uk* for examples of food and water provision) or looking ahead to the 2012 Olympics, opportunities can be found to link relevant contexts for science with global citizenship.



Globalisation also has obvious links to sustainability, an area that many schools are actively promoting. Although one of the eight doorways of the sustainable schools framework (*www.teachernet.gov.uk/sustainableschools*) is global dimension, themes such as **food and drink**, or **energy and water**, also provide opportunities to look beyond the local environment. Eco-Schools (*www.eco-schools.org.uk*) also has a section on global perspective, which provides examples of how global elements can be introduced into daily school life.

Wider access to and use of the internet, with English as an international language, has increased the opportunities for schools to use resources from around the world, share information and establish school partnerships and exchanges. Primary science, with its emphasis on investigating and trying to explain the world around us, can provide a wealth of images and data to stimulate those international conversations.

Posters based on the SAW Drinking Water activity painted by pupils from El-Nasr Girls' College, Egypt

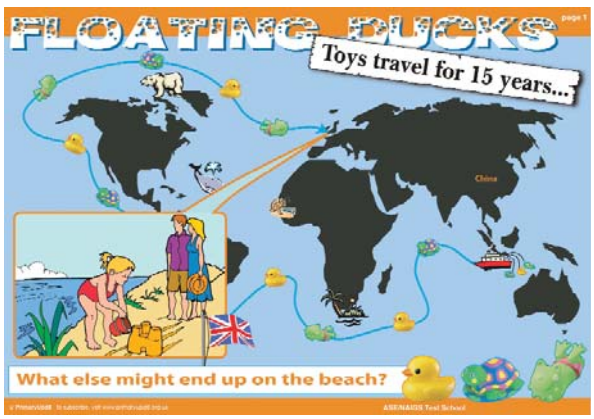
Global issues in the primary classroom

Once you start to look, there are plenty of opportunities to include a global dimension in common themes and units of work. Many can be easily extended to move from personal and local examples to comparisons with other countries and bigger issues; for example, by extending work on recycling to investigate what happens to the contents of clothing and shoe banks, and how people here and overseas benefit from the donations (see *www.lmb.co.uk/shoefriend.html* for examples).

The challenge of introducing the global dimension and raising awareness of the wider world to younger pupils is to find ways of helping them connect with the different experiences and circumstances of others. From Early Years familiarisation with the local community as a learning environment through to key stage 2 eco-schools projects and penfriend exchanges, the way into these large global issues is via the personal actions they can take and the smaller issues that affect how people in other countries live.

Several of the activities on *Primary upd8* (*www.primary upd8.org.uk*) use contemporary contexts to introduce big issues and encourage children to look outwards. *Crossing the River (KS1)* presents children with a real-life problem from Colombia, where a collapsed bridge means the only way to get to school is to wade across a dangerous river. Children test ideas about forces and materials in raft-building investigations and make comparisons between solutions to the Colombian problem and the ways in which they travel to school.

Another key stage 1 *Primary upd8* activity, *Floating Ducks*, in collaboration with the British Association, also has a global perspective. It follows the routes taken by thousands of rubber ducks that have floated around the world after falling from a container ship. It is the first activity to be accepted for accreditation as part of the BA's Crest Awards (*www.the-ba.net*).



CREST Star Investigators

This is a UK-wide award scheme that enables children to solve scientific problems through practical investigation. The activities focus on thinking about, talking about, and doing science. They are designed to be used primarily outside of class time (e.g. in a science club), though some are suitable for use in the classroom.

An easy place to start thinking globally is through the topic of food. Issues such as food miles, increased prices for imported staples and food shortages in many parts of the world feature in child-oriented TV programmes.

Even the youngest pupils can start to learn, through growing food, tasting and cooking activities, visits to shops and farms, and use of picture and video resources, about food from plants and animals and where food comes from. Introducing less familiar foods, such as tropical fruits and recipes from other cultures, including those represented in the school, develops awareness of differences and early understanding of habitats and adaptation as children consider which food plants need hot weather to thrive and why British gardens feature apple and pear trees rather than lemons and oranges. For older pupils, this can extend into the consideration of food miles and the impact of our imported food on both the countries producing it and global energy consumption. Science and Plants for Schools (SAPS) has ideas for simple food miles activities, as well as high quality images of fruits and vegetables from around the world. Go to *www-saps.plantsci.cam.ac.uk/primintro.htm* and follow the links to *People and Plants*.

Simple plant investigations in key stage 2 can also be given a wider perspective. Data about seeds or plants grown at different temperatures, with different amounts of water or using 'polluted' or salty water, have added relevance when linked to the consequences of tidal waves, floods, droughts and industrial development or the possible effect of climate change on the food crops grown here and elsewhere. The *Primary Upd8* activity, *Can Science Prevent Famine?*, supports this approach by considering how drought has affected the maize crop in Southern Africa. Using data from Malawi, younger key stage 2 pupils plan an investigation that allows them to compare their own findings about the need for water. Also from *Primary upd8*, the *Price of Rice* activity provides more complex data about the rapid price increase for Year 5/6 pupils to consider, presenting their explanations for evaluation by their classmates.

A Science Week Chall the dirty water?

enge: how can we clean

Older pupils could also try activities from Science across the World (*www.scienceacross.org.uk*), which provide a secure environment and specific projects for sharing information with children in 138 countries. *Eating and drinking* starts with something dear to many children's hearts, ice cream, providing opportunities to present data and find patterns, going on to making a food diary, and extending into comparisons with children in other countries, leading to consideration of some cultural and geographical factors that affect what we eat and opening children's eyes to similarities and differences in diet. *Food Glorious Food* prompts consideration of the place of food in our lives and culture as well as promoting the use of local produce. The issue of food miles is visited again in the third activity for key stage 2 pupils, *Plants and Me,* which also considers the use of plants for medicines, clothes and building materials.

In several other areas of science, global issues can provide a new context for investigations already included in your scheme of work. Making clean water becomes much more than an exercise in separating materials when linked through other aspects of science, geography and PSHE to the urgent need for clean water in many developing countries and the issue of diseases spread in dirty water. Water Aid (*www.wateraid.org/uk)* provides background information and resources.

From an animated diagram of a wave energy turbine (schoolscience.co.uk)

Work on thermal insulation or electricity becomes global in the context of producing and saving energy and climate change. Change the usual investigation about keeping the teacher's tea warm to investigating how to insulate a house, or simulating the effects of double and triple glazing. It is a short step from identifying electrical appliances around the school to considering which ones are wasting energy and putting simple energy saving measures in place. At *www.schoolscience.co.uk* there are links to a range of resources produced by the energy industry, including *Energy Home* (key stage 1), *Energy Town* and *Energy Chest* (both key stage 2). Energy and global warming is also addressed for upper key stage 2 pupils in *Beat the heat* from *Primary upd8*, an interactive game where pupils develop their understanding of gases and climate change by analysing information and evaluating scientific evidence about carbon dioxide emissions.

Science news

Primary Science

Issue 99 of the ASE's journal for primary members, *Primary Science*, took the theme of 'Primary Science Across the World'. For more information about membership of ASE, contact:

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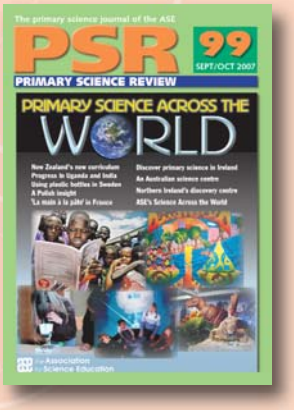

Primary Upd8

Primary upd8, a joint initiative from ASE and the Centre for Science Education, offers downloadable whiteboard presentations (with teacher notes for guidance) that use topical events to create uniquely engaging science lessons. Topics cover news items from around the world and can be used to share data with partnership schools. New activities are added regularly to the website, which is dedicated to engaging pupils and developing their scientific capability as global citizens.

Two new *Primary Upd8* activities are being developed which will be accessed via the *Primary upd8* or Evolution Megalab (*www.evolutionmegalab.org*) websites. Evolution Megalab is a Europe-wide data gathering and sharing initiative. In addition, a test version of the Evolution MegaLab will be launched in 2009, on the 200th anniversary of the birth of Darwin, as a hands-on activity for the general public.

Free downloads

Free downloadable samples of the some of the *Primary upd8* activities featured in this booklet are now available at *www.primaryupd8.org.uk* – available via the homepage.

School science

Visit *www.schoolscience.co.uk* for a wide range of free resources, lesson plans and articles for and about primary science.

schoolscience.co.uk

Science across the world

Register free at *www.scienceacross.org* to join 7,000 teachers in 138 countries whose students are collaborating on school science topics. Children can:

- find other schools across the world working on the same topic, in the same language and at the same time
- exchange topics with their selected schools (or download examples from the library)
- complete, send and compare their exchange forms with others.

SCIENCE ACROSS THE WORLD

'The pupils gained a new experience, deepened their knowledge about the world around them and became more aware of harmful and healthy food.'

Iryna Tavrydzka, Ukraine

Photo Opportunities

This pack, published by ASE in partnership with Oxfam, is designed specifically to support teachers in bringing a global dimension to the delivery of primary science. Comprising 12 A4 colour photographs, each with a set of teaching activities, and an A1 colour poster, it is suitable for children aged 4–11.

Global Dimension to Science resources

Developed by the ASE and DEA, the 'Global Dimension' area of the ASE website (*www.ase.org.uk*) offers links to sources of guidance and support, learning activities and resources, including:
Global Dimension (*www.globaldimension.org.uk*)
Oxfam Education (*www.oxfam.org.uk/education*).

For further details of this and other ASE publications, please telephone 01707 283001, e-mail *booksales@ase.org.uk* or visit *www.ase.org.uk*.

Safety: Reasonable care has been taken to ensure that the science activities in this publication do not suggest practices which may be dangerous. However, the Association for Science Education has not tested the activities so teachers are advised, before undertaking them, to consult *Be Safe!* (3rd edition, ISBN: 978-0-86357-324-8, published by ASE) and any other model risk assessments they are required to use by their employer.

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Council for Subject Associations
A Voice for Subjects
CfSA

This pamphlet is part of Issue three of *Primary Subjects*, published by CfSA.

Science

A voice for subjects

Learning outside the classroom

Council for Subject Associations
A Voice for Subjects

Summer 2009 **PS4**

Year 3 colour safari

The playground pond dip

'Out-of-classroom learning makes a unique contribution to a child's education, and offers many varied benefits to them, not least developing a sense of place and wonder about the world around them. By taking part in these experiences throughout their time at school, children learn lessons that complement those taught within the classroom. At the same time, they also have fun and get some exercise in the fresh air.'

From 'Out-of-Classroom Learning' foreword by Barry Sheerman MP

The outdoor environment presents many opportunities for science, both as a rich and varied context for enquiry and a source of real world illustrations of the ideas that children meet in the classroom.

We can take science outside the classroom to

- provide a wider range of first-hand multi-sensory experiences and stimuli
- stimulate questions and generate meaningful enquiry
- provide opportunities to apply knowledge and understanding in concrete contexts
- make connections with the world around us
- learn about places in and beyond the immediate locality
- motivate and engage pupils
- extend available space and facilities.

Rather than asking *'Why take science outside the classroom?'* maybe we should be asking *'Why not?'*

How might we use the outdoor classroom?

- to observe living things, materials, natural phenomena and human influences and draw simple conclusions
- to sort, classify and identify
- to monitor changes
- to carry out experiments
- for large scale activities (modelling the solar system)
- for noisy activities (exploring sound travelling)
- for messy activities (water rockets)
- for physical activities (raising your heart rate).

Looking beyond the obvious

When someone says 'outdoor science' do you think at once of plants, habitats, invertebrates and pond dipping? The outdoor classroom is certainly the perfect place to identify and explore living things but what about the non-living world outside your window? Rocks and soils may spring quickly to mind, maybe shadow sticks and also… er… hmm…

Did you think of:

- using playground equipment (in school or the local park) to explore and describe the effects of forces – from simple push and pull, slide and turn to testing ways of reducing and increasing the friction on a slide or the grip you have on the monkey bars
- investigating thermal insulation outdoors in the context of animal homes and hibernation (where does the 'animal' keep warm the longest?), or clothing for different weather conditions
- looking at materials and their uses: how many different types of rock or brick can you find on the buildings in your street? What has happened to the iron railings in the places where the paint is peeling off?
- observing, on a frosty day, where on the buildings and playground the frost melts quickly and where it lasts for longer – and trying to find out why.

Many aspects of science can benefit from the use of the outdoor classroom. It's not just about living things.

Keen to get outdoors?

Welly walks for science learning

Science trails using mobile ICT

The weather is fine, the sun shining and the children keen to get outdoors. There are numerous websites offering support and advice at all levels, from free downloadable activities to helping schools build relationships with local experts who visit and work with the school. There are local, national and global initiatives covering every aspect of science and with a range of cross-curricular opportunities. The list of places to visit is only constrained by time and budget and, with preparation, health and safety issues should not restrict the opportunities for worthwhile learning experiences for the children and fun for all involved.

Science trails and welly walks

Our weather cannot be guaranteed to be sunny and bright every day, but science trails and welly walks can be regular school activities, covering very short distances whilst taking quite some time and fulfilling curriculum links.

Carol Fradley introduced welly walks to her school. She noted that:

'Much of the science curriculum could be approached by simply going outside; most walks we went on started with a question to answer.'

She began one walk by asking:

'Today we are going on a welly walk to find out about the wind. How can we find out which part of the playground is the windiest?'

'The best part of welly walks is that everybody enjoys them, especially adults.'

'The children love them, participate fully and willingly and write a few notes to say what they have seen and done.'

A science trail is another way to direct pupils' explorations of the outdoor classroom, linked to many areas of science. Rather like a 'welly walk', a teacher may lead the activity, directing children's attention to specific events, objects or living things and questioning them about what they observe. Using questionnaires or ICT (hand-held mobile devices, or PDAs), older pupils can work independently. Photographs are used to direct pupils to specific locations, but effective questions require children to engage with what they find in the environment. They make observations, identify something or draw conclusions by answering questions; for instance, when considering how rocks and manufactured building materials have been used in the school building.

To find out how PDAs are used for science trails at Ripple Junior School in Barking, see the April 2007 issue of Education in Science: www.tinyurl.com/cfsascience1

ICT
CROSS-SUBJECT LINK

Why don't you go outside and…

- make a sundial
- visit a graveyard to look at the weathering of rocks
- make a key
- have a healthy eating picnic (and find a way to stop the ice lollies melting)
- watch a worm wriggle
- grow vegetables
- do a litter survey
- hunt for snails
- play with snow
- listen
- **DO SCIENCE!**

Snail hunts for Darwin

In 2009, the scientific community will be celebrating the 200th anniversary of the birth of Darwin. ASE is involved in developing primary resources www.primaryupd8.org.uk to study variation and adaptation in banded snails as part of the Evolution MegaLab Europe-wide project www.evolutionmegalab.org Teachers and children will be able to take part in snail hunts and add their data to the international scientific database.

Investigating life in the river

On the beach

Jane Adams, Headteacher at Kilkhampton Junior and Infants School took primary science beyond the classroom as part of the National Trust Guardianship Schemes (see www.nationaltrust.org.uk). A visit to a local beach was planned, with four activities and cross-curricular links (photography, poetry, rock pool safari and study of man's impact on the environment).

ENGLISH

CROSS-SUBJECT LINK

'My creature looks like it comes from outer space but it's in this book. Cool.'

'Oh, the water went over my wellies … it was SO cold!'

'We all felt that we had got to know our children better.'

Adults were inspired by the children's fascination with their environment and noted that special needs children had been totally engaged, whilst children nervous in team activities were seen to be agile and confident leaders moving in and around rock pools.

Starting in your own back yard, the full article, can be downloaded from PSR issue 91, Jan/Feb 2006, at: www.tinyurl.com/cfsascience2

Earth Science

Rockwatch is the club for young people interested in things geological – rocks, fossils, minerals and landscape: www.rockwatch.org.uk/aboutus.html Also, try www.soil-net.com

And for teachers: Earth Science Teachers' Association: www.esta-uk.org and the Earth Science Education Unit: www.earthscienceeducation.com

Support for astronomy

Visit www.schoolsobservatory.org.uk

Wildlife and birds

Find your local wildlife trust at www.wildlifetrusts.org or learn about wild birds with the RSPB: www.rspb.org.uk/youth

The Countryside Foundation for Education (CFE)

provides a unique opportunity for urban children to explore a whole new area of learning, through becoming aware of what goes on in the countryside: www.countrysidefoundation.org.uk

Lichen hunting

Trees, flowers and plants

Science and Plants for Schools (SAPS) website www.saps.org.uk

Canterbury Environmental Education Centre (CEEC) has teacher resources and links to other environmental education centres and eco-centres: www.naturegrid.org.uk/children.html

Ideas for food and farming

Think Food and Farming is the exciting legacy project building on the successes of the Year of Food and Farming: www.thinkfoodandfarming.org.uk The site includes information on farm and countryside visits and links to other sites, including:

- the Growing Schools website www.growingschools.org.uk
- the Farming and Countryside Education (FACE) website www.face-online.org.uk
- the Soil Association, supported by the Organic Action Plan Group of Northern Ireland, has produced Down on the Farm, a short animation to explore current issues around food and farming: www.soilassociation.org

City parks and farms are a way for urban schools to keep their carbon footprint small and avoid long travelling times and distances.

Read about innovative use of a school garden at www.tinyurl.com/cfsascience4

Other useful sites

Field Studies Council – www.field-studies-council.org

Fieldwork Knowledge Library – www.fieldworklib.org

Institute for Outdoor Learning – www.outdoor-learning.org

ASE resources to support outdoor learning

The ASE's Outdoor Science Area

supported by the activities of our Outdoor Science Working Group, is working as part of the Real World Learning Partnership. The partnership was founded in 2003 to influence decision makers, support teachers and increase participation in out-of-classroom learning. Members include the Field Studies Council, RSPB, Royal Geographical Society, Geographical Association and National Trust.

Out-of-Classroom Learning, published in 2006, includes practical information and guidance for schools and teachers. All schools have been sent a copy of this booklet and it is also available at: www.tinyurl.com/cfsascience3

schoolscience.co.uk

School Science
www.schoolscience.co.uk – visit the site for a pdf guide to science-related visitor attractions in the UK.

Issue 101 of *Primary Science* (Jan/Feb 2008) has a focus on Life Processes and features articles about science outside the classroom, including gardening clubs, the Eden Project, the importance of introducing children to fungi, a visit to Paignton Zoo, environmental research in a local river, and the always popular pond-dipping.

Nature Detectives, an ASE publication with the Woodland Trust, is available from ASE Booksales: www.ase.org.uk/htm/book_store price £12.00.

Primary Project Box Online – Lesson plans, resources, and links from all five units of the Primary Project Box are now available online: Our classroom and our school, Inside outside, Our wider world, Our changing world, and Our future world at www.subjectassociations.org.uk/content.asp?ID=148

Other resources

Sunshine, Shadows and Stone Circles (2008)
www.science3-18.net (search on 'sunshine' and 'shadows'). A book for teachers interested in learning and teaching about light and shadows, sundials, day and night and children's understanding of the Earth and Sun. Stone circles are given a storyline treatment with clear interdisciplinary bridges from science to learning in mathematics, history, landscape, mythology and language. A CD ROM containing video teaching sequences and colour images accompanies the book.

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department for children, schools and families

CfSA Council for Subject Associations A Voice for Subjects

Science

A voice for subjects

Get ready for the London 2012 Games

Council for Subject Associations
A Voice for Subjects

Autumn 2009 **PS5**

The London 2012 Olympic and Paralympic Games provide a unique opportunity for schools across the country to engage in scientific activities, from investigating different diets for different sports, through the content of high energy drinks, to the exploration of forces acting in different events.

The variety of events is immense and we could not hope to cover everything so this leaflet will focus on sailing. Three of the four areas of the science Programme of Study will be addressed: scientific enquiry, forces and materials. A school could spend a dedicated science week on developing and completing these activities, and/or incorporate them into a cross-curricular topic, drawing upon the ideas from the whole of this issue of Primary Subjects.

Iain Percy and Andrew Simpson of Great Britain, Afonso Domingos and Bernardo Plantier Santos of Portugal and Fredrik Loof and Anders Ekstrom of Sweden compete in the star class race at the Beijing 2008 Games *(Clive Mason/Getty Images)*

Science activities on the theme of sailing

Whatever the focus, science co-ordinators will need to provide guidance on the progression of scientific knowledge and skills that will be developed, from Foundation Stage to Year 6.

A clear summary of progression in scientific enquiry is provided on the standards website:
www.standards.dfes.gov.uk/schemes2/science/using?view=get

The table below outlines how progression in *Physical processes* and *Materials and their properties* might look for a topic based on sailing:

Age group	Physical processes	Materials and their properties
EYFS	– pushing forces – floating	– water play: flow and movement – balls in water
Year 1 & 2	– floating/sinking – comparing forces	– similar materials, floaters-sinkers – making floating objects sink
Year 3 & 4	– upthrust – air/fluid resistance	– materials for function – size and shape of materials
Year 5 & 6	– direction of force – speed of movement	– most effective materials for movement and speed

A teaching programme for each year group will involve activities that stem from this progression of scientific knowledge and skills.

The ideas outlined below are just some of the possible teaching activities that could take place and should be a trigger for further ideas generated by the school workforce.

Age group	Learning objectives
Foundation Stage	– experience the feel of the upward force of water – know that some things float and some things sink – observe that a downward force is needed to make a boat sink
Year 1 & 2	– investigate materials for floating and sinking – know that a floating object can be made to sink
Year 3 & 4	– describe some of the factors that increase air and water resistance – know that water resistance slows down objects moving through water – describe or show in the way they perform the task how to vary one factor, while keeping others the same – record observations, comparisons and measurements using tables and bar charts
Year 5 & 6	– know about the most effective ways to move boats through water – select suitable equipment and make a series of observations and measurements that are adequate for the task – link design features to distance moved and/or speed

Activities

Foundation Stage

Activity 1

Resources: a water trough; a large hollow ball.

Use a large hollow or inflatable ball in a water trough. Put the ball in the water and ask the children to describe what is happening. Ask what they need to do to make the ball stay under water. What happens when they let go? Children will be generating their own ideas of what is happening based on everyday experience and what they observe and feel.

- What are you doing to the ball?
- What can you feel?
- Can you make the ball go under water?
- What happens when you let go?

Activity 2

Resources: a water trough or bowl; a variety of objects made from different materials.

The children should have access to a variety of objects made from a range of materials. The focus is to explore what does and does not float. Encourage children to describe the objects they are using in order to develop language. After some experience of playing with the different objects and materials, children should be given new objects and asked to predict which will float or sink.

- Sort out all the things that float. (Make a set of things that sink.)
- Do you notice anything similar about the things that sink?
- Can you make sinkers float and floaters sink?

Years 1 and 2

Activity 3

Resources: a water trough; a collection of materials and/or toy boats for floating and sinking (for example, ice-cream tubs, margarine tubs or toy boats, beads, marbles, stones or conkers.

ENGLISH

CROSS-SUBJECT LINK

In the context of a story, such as Noah's Ark, children explore loading toy boats and/or boat shapes they have made from different materials with animals or stones to explore types of materials and forces acting. Encourage children to talk about what is happening as they place the materials into the water while adding objects that push the boat down. Again ensure that they use appropriate language through questioning. Children will start to realise that some materials are better than others for making a 'boat shape' and that something needs to be done to make the boat sink.

- Can you sort which will sink and float? – make sets
- How many 'animals' (stones) will it hold before sinking?
- Will it carry more if you load it differently?

Activity 4

Resources: two pictures, one of a dilapidated boat and one of a streamlined race boat; different materials to make boats; a set of argument cards (see below); equipment generated through group discussion of their own ideas.

Discuss with the children how they can help to build a boat to make Great Britain (GB) win the race. Provide a picture of two different boats – one which does not look very good, is made out of a really silly material and is falling to pieces and the other that looks rather slick. Ask the children which they think would be most likely to win the race.

Use a set of six argument cards, to predict which will be the most useful for building a boat. Each of the cards displays a set of materials and a different viewpoint about the suitability of their properties for boat building.

Argument cards

- I think plasticine will work the best, because it's very flexible and easy to shape.
- Boats are made of metal, so I think the tinfoil will be the best material to use.
- Paper is not very heavy, so this will help the boat to move faster.
- I think wood should be used because it floats well.
- Boats need to be very strong, so we should use brick or stone.
- Plastic will be the best, because it is waterproof and boats need to be waterproof.

Deal out the cards randomly to six groups of children. Ask them to justify the claim on their card and test their chosen materials – making observations during trial runs and modifying their ideas as necessary. Groups then feed back findings and final designs are made. The activity culminates in a competition between the different boats.

- What happens to materials when you place them in water?
- What happens to the water in a large bowl when a heavy object is added?
- How can you make it more stable?

Years 3 and 4

Activity 5

Resources: a range of materials for making sails.

Ask the children to provide reasons why each material, from the range provided, would be good or not good for a sail, for example, which would be waterproof, or good for catching the wind. Children then investigate their chosen materials, exploring different variables.

- Which materials are waterproof?
- Which material has the greatest air resistance?
- What is the best shape for a sail?

Activity 6

Resources: pictures of six or eight sailing boats with variations of hull design, shape and size and different sails.

Ask the children to discuss the pictures of the different sailing boats and predict which would move best through the water and therefore win the race. This activity provides an opportunity to investigate the effects of changes to both sail and hull size and shape.

- Do heavier/lighter boats travel further?
- Can you make a boat that moves for one metre?
- Which are the best hull shapes for moving through water?

They can then devise variables to be tested, for example, hull size and shape, alongside mast size and sail size and shape. Children split into investigative teams to test two variables – one based on the sail and one on the hull.

Years 5 and 6

Activity 7

Resources: provide children with six role-play arguments about the best way to propel a boat, including balloons (wind power), elastic band propellers, sails with a straw, or battery-operated motors.

DESIGN & TECHNOLOGY

CROSS-SUBJECT LINK

Children investigate different methods of propulsion and make their prototype boats, leading to a final competition.

- What do you think is pushing it or pulling it?
- How would you move a heavy object? (rollers, levers, pulleys)
- Is the weight of your boat important?

Activity 8

Resources: three buoys at distances A–B = 4 metres, B–C = 5 metres and C–A = 3 metres; materials used by other year groups to design boats, hulls and sails.

Children work in groups to design a boat, using information provided by all the other year groups, which will travel around a triangular course. Designs will take into account sail and hull materials, size and shape and the method of propulsion.

An extension activity could be to design and make a pulley system to lift the sails, including how to measure the force needed to achieve this.

Resources

Get Set

www.london2012.com/getset

This website is the first port of call for young people and teachers wanting to find out more about the London 2012 Olympic and Paralympic Games. There are videos and images on Get Set about sailing and rowing.

ASE's *Primary Science*

The March/April 2008 issue 102 of *Primary Science* focused on Science and Sport and features articles about the benefits of being physically active, the science of sailing, developing children's fitness and where sport and science relate to dialogic teaching and the 'Every Child Matters' agenda. Members of ASE can view this issue online at www.ase.org.uk

SATIS Revisited

www.satisrevisited.co.uk

Difficult decisions – would you cheat to get on the school team?

This unit provides a rationale for teaching about ethical issues in science for students aged 14–16, but can also be used with primary children.

The activity focuses on distinguishing scientific from ethical questions. Group discussion features the rights and wrongs of the use and abuse of drugs to enhance sporting performance. SATIS Revisited units consist of bright stimulus visuals, student activities including research, discussion, role-plays, quizzes and board games, and background information sheets. Activities are free to download.

Activities from ASE

Between now and 2012, ASE will be providing many activities relating to the 2012 Olympic Games on their Primary upd8 and Upd8 websites (www.primaryupd8.org.uk and www.upd8.org.uk).

Although Upd8 is developed with links to the Key Stage 3 and 4 curricula, there are some activities that primary teachers can adapt for use with younger children.

Sports Day Superstar – Primary upd8
This activity is about how friction is important for running on surfaces. Different footwear is used for different playing surfaces. Which footwear would the children choose to win the running race? See www.primaryupd8.org.uk

Choosing trainers
www.upd8.org.uk/activity/254/Choosing-trainers.html

Students consider what makes a trainer comfortable and analyse and evaluate data to compare the cushioning effects of cheap and expensive trainers.

When will women overtake men?
www.upd8.org.uk/activity/108/When-will-women-overtake-men.html

Men run faster than women, but will that always be the case? Pupils extrapolate graphs to predict when women could outrun men.

Royal Society of Chemistry – Chemistry and Sport

www.chemistryandsport.org/resources

RSC | Advancing the Chemical Sciences

Chemistry and Sport contains a variety of curriculum-linked teaching resources based on a range of different sports. Locate the resources for primary schools using the search on the left hand side of the web page to find resources for 7–11 year olds. Resources are available based on the events calendar (but can also be found in the archive). Keep an eye out for the Olympic section, which will be available shortly.

One of the current resources consists of questions on chalk and how it is formed – and how it is used to prevent weightlifters' hands from slipping on the weights. This could equally be applied to gymnasts. Most of the questions could apply to upper primary level. Teachers need to register to download the resources, which are all free.

Institute of Biology

The IoB www.iob.org is developing activities based around Olympics 2012 for primary schools, which will be available soon.

Safety: The ASE has not tested the activities, so teachers are advised to consult *ASE's Be Safe!* (3rd edn) and any other model risk assessments they are required to use by their employer.

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