

## Using Information and Communications Technology to meet teaching objectives in primary science

### Introduction

The Initial Teacher Training (ITT) National Curriculum for the use of information and communications technology (ICT) in subject teaching is applicable to training in all subjects in both the primary and secondary phases. For primary trainees, the curriculum applies to training in the core subjects (English, mathematics and science) and in their specialist subject(s). For secondary trainees, it applies to training in their specialist subject(s). As a result of the responses to the consultation on this curriculum, the TTA undertook to produce separate exemplification material to relate this curriculum to each subject in both phases. **This booklet relates the ITT National Curriculum for the use of ICT in subject teaching to the teaching of science in the primary phase.**

Trainees and newly qualified teachers may also come across needs identification materials which the TTA has produced to support the New Opportunities Fund initiative. The format and content of the needs identification materials and this document are often similar. For example, the expected outcomes of the needs identification materials are based on the requirement in the ITT National Curriculum for the use of ICT in subject teaching, and much of the content of both documents was derived from the same source. There are, however, important differences between the documents, which reflect the different purposes for which they were written. The needs identification materials have been written to help serving teachers identify their needs in relation to the training available through the New Opportunities Fund. **This booklet has been written to help ITT providers, whether in schools or in higher education institutions, to teach primary trainees how to use ICT in their science teaching.**

Everyone who now joins the teaching profession needs to be able to exploit the potential of ICT to meet their teaching objectives. ITT providers must therefore equip trainees to evaluate examples of ICT, both during their training and in their future employment; to make sound judgements about when, when not and how to use it, and to become confident and competent users of it. The development of the National Grid for Learning (NGfL) makes this even more important, since all teachers need to know how to maximise the NGfL's potential to secure higher standards of achievement from their pupils, to increase their own professional effectiveness, and to reduce their administrative burden.

We hope that ITT providers will use the exemplification material in this booklet as a resource to help them integrate the ITT National Curriculum for ICT into their primary science training, in such a way that trainees learn to use ICT as a significant and integral part of their teaching rather than as an end in itself. Many of the examples illustrate ways to use technology that most trainees will find available in schools now; some illustrate ways to use technology that is not yet widespread.

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**The material is in FOUR sections:**

**Section One**

(pages 3 to 4) explains how ICT can contribute directly to pupils' learning in primary science, and how it can help trainees to organise that learning;

**Section Two**

(pages 5 to 33) sets out the ITT National Curriculum for the use of ICT in subject teaching, with an interleaved commentary to help trainers relate it to the teaching of primary science;

**Section Three**

(pages 34 to 68) gives three case study examples of how primary teachers, having decided on specific teaching objectives in science, reviewed and selected suitable ICT to meet those objectives; these case studies are designed to help trainers engage their trainees with the ITT National Curriculum for the use of ICT in subject teaching as it relates to primary science;

**Section Four**

(pages 69 to 73) lists other sources of examples of the use of ICT in teaching primary science, together with some addresses, to help trainers obtain further useful information and advice.

The booklet is offered as guidance only. It does not offer a course design; nor does it purport to be a comprehensive list of the ways in which ICT can support primary science teaching; nor are ITT providers expected to include all the examples.

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## Section One

### Using ICT in primary science lessons

At the heart of the ITT National Curriculum for the use of ICT in subject teaching are **three key principles** which trainees need to know, understand and be able to apply.

1. Decisions about when, when not and how to use ICT in lessons should be based on whether **the use of ICT supports good practice in teaching the subject**. If it does not, it should not be used.
2. In planning and in teaching, decisions about when, when not and how to use ICT in a particular lesson or sequence of lessons **must be directly related to the teaching and learning objectives in hand**.
3. The use of ICT should either allow the trainee or the pupil to **achieve something that could not be achieved without it**; or allow the trainee to **teach or** the pupils to **learn something more effectively and efficiently** than they could otherwise; **or both**.

This will be important, whether:

- ICT is to be used by **all the pupils**: individually, in groups or as a whole class;
- ICT is to be used by **some pupils only**, e.g. for support or extension work;
- ICT is used by **the trainee**, e.g. using a large screen or display as part of interactive whole class teaching; downloading lesson plans from the NGfL; downloading or book-marking an environmental data file for an interpretive exercise with pupils.

Trainees need to know that practical considerations may also play a part in their decisions about whether ICT should be used. These include the nature of the available resources: for example, science teaching objectives that could be met very effectively if a suite of computers were available in the classroom might not be attainable if there is just one stand-alone computer.

All primary trainees need to know that ICT has the potential to make a **significant contribution to their pupils' knowledge, understanding and skills in science**. It can help pupils to:

- a. ask questions, predict and hypothesise;
- b. observe, measure, record and manipulate variables;
- c. interpret their results and evaluate scientific evidence;
- d. present and communicate their findings in a variety of ways;
- e. consolidate and deepen their scientific knowledge and understanding;
- f. improve the accuracy of their work;

when they use:

- i. **data handling software**, to organise, search and sort information in order to look for patterns and test their predictions, e.g. entering data into a spreadsheet and using this to

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graph automatically the stretch of elastic material related to the mass attached to it, then using this graph to predict the stretch that would be obtained if different masses were used;

- ii. **data logging** sensors to record changing temperature, light and sound data. Data logging software can help pupils to observe changes clearly and measure them easily, and can allow them to spend more time interpreting and explaining their results and making predictions based on them;
- iii. **electronic information sources**, e.g. the Internet, intranets, CD-ROMs and data files, to find information which can develop and extend their knowledge and understanding of science;
- iv. **simulation and modelling software**, to help them:
  - visualise and understand scientific processes and systems, e.g. how the heart works; food chains, or the effects of forces on falling bodies;
  - investigate the effects of changing variables in scientific systems, e.g. food chains, plant growth, life cycles;
  - consolidate and reinforce their conceptual understanding following scientific enquiries, e.g. to investigate further the effects of changing the configuration of electric circuits;
- v. **publishing and presentation software** to communicate their findings using words, photographs, or video and audio material: for example, pupils might use word processing software to prepare a scientific report or multimedia software to present their findings on screen;
- vi. **communications technology** to exchange information with their peers in other schools or to ask a scientific question of an expert in the field;
- vii. **other devices**, for example:
  - **digital cameras, video cameras, audio equipment** to record their findings and communicate them to others;
  - **time-lapse video, film and television programmes** to view evidence that would not otherwise be available or could be hazardous in the classroom;
  - **digital measuring devices** such as stoplocks, thermometers, light meters, sound meters, humidity meters to improve accuracy, access and ease of use.

Trainees also need to know that ICT has the potential to offer **valuable support to teachers of primary science** by:

- **assisting them with the preparation of teaching materials**, e.g. when they use word processing software to write high quality teaching materials, then save them ready for rapid adaptation or updating without unnecessary effort;
- **helping them to demonstrate experiments and concepts in science**, e.g. when they use presentation packages and a large screen for whole-class teaching;
- **giving them access to up-to-date material to support teaching**, e.g. statistics about bird migration; weather satellite pictures, or the latest images from space telescopes;

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- **assisting them in planning lessons, assessing pupils' learning and recording their attainment;**
- **giving them access to a network of professional support,** e.g. when they access professional association Web sites for resources, advice and support, and to communicate with other teachers about primary science.

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## Section Two

### Commentary on the ITT National Curriculum

This section sets out the ITT National Curriculum for the use of ICT in subject teaching with a commentary relating it to the teaching of primary science.

The ITT National Curriculum is presented on the left-hand pages, with some minor changes in wording helping to relate it directly to primary science. The non-statutory examples in italics are retained where they are relevant to science, and in some cases supplementary examples have been added.

Opposite many sections of the ITT National Curriculum, there is a commentary offering examples of the way that the curriculum statements might be interpreted for primary science training. No commentary has been offered where the curriculum statements apply equally to all subjects, or where it was thought that no further exemplification was needed.

The commentary sometimes refers to uses of ICT rarely found as yet in current science teaching. However, the use of ICT in subject teaching, like ICT itself, is dynamic and constantly changing. Although some elements of ICT are used by a minority of primary science teachers at present, trainees will still need to be introduced to them and be aware of their educational potential.

The examples included do not purport to be an exhaustive list of the uses of ICT in science teaching.

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**INITIAL TEACHER TRAINING NATIONAL CURRICULUM  
FOR THE USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY  
IN SUBJECT TEACHING**

**PRIMARY SCIENCE**

**A. Effective teaching and assessment methods**

**1. Trainees must be taught how to decide when the use of ICT is beneficial to achieve teaching objectives in primary science, and when the use of ICT would be less effective or inappropriate.** In making these decisions, **trainees must be taught how to take account of the functions of ICT** and the ways that these can be used by teachers in achieving teaching and learning objectives in science. This includes:

**a.** how the speed and automatic functions of ICT can enable teachers to demonstrate, explore or explain aspects of their teaching, and pupils' learning, more effectively;

**b.** how the capacity and range of ICT can enable teachers and pupils to gain access to historical, recent or immediate information;

**c.** how the provisional nature of information stored, processed and presented using ICT allows work to be changed easily;

**d.** how the interactive way in which information is stored, processed and presented can enable teachers and pupils to:

i. explore prepared or constructed models and simulations, where relevant to primary science;

ii. communicate with other people, locally and over distances, easily and effectively;

iii. search for and compare information from different sources;

iv. present information in ways which are accessible in different forms for different audiences.

**Trainees should be taught what the implications of these functions are for achieving teaching objectives in science.** *For example, trainees need to be aware that if pupils use calculators or spreadsheets to remove the tedium of repetitive calculations and enable them to give attention to an emerging numerical pattern or the relationship between successive readings, their skills in mental or*

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written calculation are not being developed and therefore the activity may not suit the particular teaching objectives in hand.

**Commentary on 1.a**

*The speed and automatic functions of ICT can offer a number of advantages to primary science teachers. For example, by using a data logger connected to a computer pupils can, by monitoring and graphing the light intensity, see the effect of moving a light sensor away from a light source or the effects of covering the light source with layers of translucent material. (An example of measuring and graphing light intensity can be found on <http://www.vtc.ngfl.gov.uk/resource/cits/science/prfocus/psinvest/light1.html>). Using the computer, pupils can produce a graph showing how the volume of sound decreases with increasing distance from the source or when the source is placed in a box or wrapped in sound-deadening material. Spreadsheets can be used to calculate mean values automatically, or to draw bar charts or graphs quickly from tables of data.*

**Commentary on 1.b**

*In science, ICT can extend the range of primary and secondary information available to teachers and pupils. For example, the teacher and pupils can gain access, via the Internet, to current space telescope data as well as historical data about space. Pupils can use CD-ROMs to supplement their other information sources, and use the automatic search functions to find information. Information and images from other environments can provide useful resource materials for comparisons of ecology.*

**Commentary on 1.c**

*Primary trainees can take advantage of the opportunities that ICT offers for data to be changed easily. For example, the teacher can demonstrate the variety of graphs including scattergrams, pie charts, bar charts and line graphs that can be produced using data from the same spreadsheet, and can discuss with pupils the most appropriate graphical form for different types of data. The x and y axes on graphs can be switched automatically to help pupils to understand why independent variables should be placed on the x axis and dependent variables on the y axis. Pupils can draft and redraft their writing about science, e.g. updating accounts in the light of new evidence or data.*

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- 2. Trainees must be taught how to use ICT most effectively in relation to science-related objectives, including:**
- a.** using ICT because it is the most effective way to achieve teaching and learning objectives, not simply to motivate pupils or as a reward or sanction for good or poor work or behaviour;
  - b.** avoiding the use of ICT for simple or routine tasks which would be better accomplished by other means;
  - c.** knowing that, where ICT is to be used, appropriate preparation of equipment, content and methodology is required;
  - d.** avoiding giving the impression that the quality of presentation is of overriding importance and supersedes the importance of content;
  - e.** structuring pupils' work to focus on relevant aspects and to maximise use of time and resource;
  - f.** having high expectations of the outcomes of pupils' work with ICT, including:
    - i.** expecting pupils to use ICT to answer valid questions appropriate to the subject matter being taught;
    - ii.** when appropriate, requiring pupils to save work, and evaluate and improve it;
  - g.** making explicit the links between:
    - i.** the ICT application and the subject matter it is being used to teach;
    - ii.** ICT and its impact on everyday applications.

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### **Commentary on 2**

*The use of ICT in science lessons should always support pupils' efficient and effective learning of science, and trainees need to be able to explain why they have chosen to use ICT to help them meet their teaching objectives, while avoiding inappropriate uses.*

*For example:*

- *trainees may ask pupils to write up an experiment using a computer with word processing software, word banks or an overlay keyboard, so that pupils can update tables and other results in the light of data from other groups, but it is usually undesirable to use word processing software simply to copy up previously hand-written accounts;*
- *a data logger connected to a sound sensor can be useful to record a continuously changing series of readings, but it is unlikely to be the best way to record a single sound level;*
- *a computer sensor box attached to light gates can help pupils obtain very accurate timing, but its use may waste time and obscure the significance of the event being measured if the pupils do not understand the concept being taught or if very accurate timings are not required;*
- *the use of either a simple stopwatch or a falling ruler to measure reaction times may be preferable to pressure mats attached to a data logger, because the level of accuracy provided by such methods is adequate to achieve the learning objective.*

*Trainees should know how to structure pupils' work with ICT to maximise their learning and to make best use of available time, for example by:*

- *book-marking useful Web sites, or reviewing the contents of a CD-ROM before they ask pupils to use it to seek information;*
- *asking pupils to comment on relevant aspects of an image seen on a CD-ROM rather than printing the image without comment, or providing structured questions or writing frames to encourage pupils to select and use information from the Internet, an intranet or a CD-ROM rather than allowing them simply to download and print out materials;*
- *judicious use of computer templates to help pupils record experimental method and/or results efficiently, where writing about their work is not a teaching objective for the lesson: for example, teacher-prepared spreadsheets might be used by pupils where it would be unnecessary or time-consuming for each pupil or group to do their own;*
- *using a book-based key to identify trees or plants during fieldwork because that is more efficient than waiting to use a CD-ROM-based key back in the classroom.*

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***Commentary on 2 continued***

*Trainees should have high expectations of pupils' science work when ICT is being used. They should not, for example, be satisfied that a group has used ICT to prepare an attractive graph of their science findings, but should insist that pupils can interpret the data contained in the graph to help answer scientific questions. Similarly, the compilation of a database should not be seen as an end in itself. For example, trainees should expect that pupils compiling a database of attributes of invertebrates should make appropriate and well planned use of the data. Similarly, trainees should not be satisfied where pupils simply copy data from a CD-ROM rather than selecting and adapting relevant information to meet a specified purpose.*

*When appropriate, trainees should ensure that pupils' work can be saved and retrieved efficiently, so that they can evaluate it, update it or improve it, e.g. by allocating pupils an individual folder on the hard disk, or by giving each pupil a floppy disk.*

*Trainees should be aware of, and be able to discuss with pupils, the extensive use made of ICT in science today, and some of the many ways in which ICT is used in various everyday science-related applications, e.g. the automatic monitoring of heart activity in hospitals; remote controls for television and videos; barcode scanning in supermarkets, or automatic doors.*

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- 3.** For those aspects of lessons where ICT is to be used, **trainees must be taught to identify in their planning:**
  - a.** the way(s) in which ICT will be used to meet teaching and learning objectives in science;
  - b.** key questions to ask and opportunities for teacher intervention in order to stimulate and direct pupils' learning;
  - c.** the way(s) in which pupils' progress will be assessed and recorded;
  - d.** criteria to ensure that judgements about pupils' attainment and progress in science are not masked because ICT has been used;
  - e.** any impact of the use of ICT on the organisation and conduct of the science lesson and how this is to be managed;
  - f.** how the ICT used is appropriate to the particular science-related objectives in hand and to pupils' capabilities, taking account of the fact that some pupils may already be very competent, *e.g. because of home access or through participation in extra-curricular ICT activities*, and some may need additional support.

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### **Commentary on 3**

*Trainees need to be able to justify why they have used ICT to meet particular teaching objectives in science, explaining e.g. how use of a simulation involving Antarctic animals provides a contrast and extension to their teaching about food chains in pupils' own locality, or how use of a branching database helps to draw pupils' attention to the similarities and differences between leaves from different trees.*

*Trainees need to know how and when to intervene when pupils are using ICT in science. For example, when pupils are using a temperature sensor in a container of warming ice and water, trainees should ask questions which help pupils to make connections between the graph being produced and the scientific concept being taught: for example, "When do you think the graph will begin to rise? Do you think the temperature will rise even when there is ice in the water? What temperature do you think the water will eventually reach? Why?" If ICT were not used, the pupils would need to concentrate on taking readings, and questioning by the teacher would distract them from that task.*

*Issues of assessment need to be considered when ICT is used in science. Trainees need to ensure that the key scientific learning is being assessed, and be aware of the ways in which ICT can mask pupils' attainment. For example, by using automatic graphing facilities pupils can produce accurate and attractive graphs from sets of data, but may not understand what the graphs are showing or how to interpret what they show. Trainees will want to ensure that they set tasks so that it is difficult for pupils to meet the brief without demonstrating their understanding of the science being taught, e.g. insisting that pupils present the information they have found from a CD-ROM in a way which demonstrates their understanding of it, rather than simply allowing them to print out information. Trainees will need to set clear assessment criteria that focus on the scientific content of pupils' work, e.g. so that a piece of science homework that has been word-processed is not given higher marks than a similar hand-written piece.*

*Many pupils now have access to ICT at home, and may start or finish off science work there. Although this is to be encouraged, trainees should be aware of the possible differences in file compatibility between the software used in school and that on pupils' home computers, and the problems of transfer that may occur. Trainees must ensure that those pupils without access to ICT at home are not at a disadvantage in their science learning, for example by giving them extra access where necessary to ICT facilities in school, e.g. through homework clubs.*

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- 4. Trainees must be taught the most effective organisation of classroom ICT resources to meet learning objectives in science, including how to:**
- a.** use ICT with the whole class or a group for introducing or reviewing a topic and ensuring that all pupils cover the key conceptual features of the topic, *e.g. through the use of a single screen or display;*
  - b.** organise individuals, pairs or groups of children working with ICT to ensure that each participant is engaged, that collaborative effort is balanced, and that teacher intervention and reporting back by pupils takes place where appropriate;
  - c.** make ICT resources available to pupils for research or other purposes which may arise either spontaneously during lessons or as part of planned activity, ensuring that the resource is used profitably to achieve science-related objectives;
  - d.** position resources for ease of use, to minimise distraction, and with due regard to health and safety;
  - e.** ensure that work done using ICT is linked to work away from the screen, allowing ICT to support teaching rather than dominate activities, *e.g. providing sufficient desk/floor space around the hardware to enable the ICT to be used with other materials; providing space to write as well as input from the keyboard; positioning ICT so that pupils are able to sit facing the teacher when required.*

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#### **Commentary on 4**

*Having decided that ICT is an appropriate way of meeting teaching objectives, the trainee will then need to take account of the extent to which the appropriate resources are available, and the way in which the classroom will have to be organised. For example, a large single screen or display or an electronic whiteboard can be used to display a series of graphs and to discuss their interpretation.*

*At other times, if there is just a single computer in the classroom, the trainee might wish to organise pupils to ensure that they all contribute to the work and that the computer is used to best effect: for example, during investigations into a variety of pond animals, the trainee might assign one pupil to be responsible for retrieving relevant information from a CD-ROM on behalf of the group; tasks might be organised so that each group is able to use a spreadsheet at an appropriate point in their work; or, where the use of a CD-ROM is planned, the trainee might ensure that the task set is short and sufficiently focused to allow the planned number of groups access to the computer.*

*Portable technology, e.g. laptop computers, palmtop computers and devices that can store data to be downloaded onto a computer later, offers great flexibility in primary science. For example, such technology can be moved next to the site of an experiment, or taken outside during fieldwork.*

*Increasingly, primary schools are providing bookable computer suites with common generic software. These can be useful for group and pair work, e.g. adding to or interrogating a database on the school environment, or on materials, following practical work. The trainee, with assistance if available, should then intervene to teach individuals or groups as they work. There will be times, in the computer room, when pupils will be required to attend to the trainee or to work away from the computer, e.g. to try out circuits they have modelled on the computer. Trainees will therefore wish to organise the computer room so that as wide a range of teaching and learning activities as possible can take place there.*

*Primary pupils may have access to computers, either in the classroom, the school library or elsewhere, that have CD-ROM, Internet access and e-mail facilities and can be used for reference. Trainees need to ensure that pupils are familiar with the means and opportunity of accessing data files and CD-ROMs relevant to the area being studied and that, whenever possible, relevant and structured tasks are set that encourage personal guided research, including the use of ICT, on the areas being studied.*

*When ICT is being used by a few pupils in the classroom, the trainee needs to ensure that other pupils are not distracted by those using ICT, e.g. that pupils use headphones to access a CD-ROM when the topics they are studying include commentary, sound effects or music. Pupils using ICT need sufficient space to use it alongside other resources where necessary. For example, groups of pupils may need space to carry out an experiment, or may need to use a large sheet of initial work on branching keys and refer to it when entering their data onto a branching database, or may need to have shells, leaves or books next to them when they are working.*

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- 5. Trainees must be taught to recognise the specific contribution that ICT can make to teaching pupils with special educational needs** in mainstream classrooms based upon the need to:
- a. provide access to the curriculum in a manner appropriate to pupils' needs;
  - b. provide support specific to science.

- 6. Trainees must be taught how to choose and use the most suitable ICT to meet teaching objectives, by reviewing a range of generic and science-specific software critically**, including how to:
- a. assess its potential for helping to meet teaching objectives;
  - b. judge its suitability for the age of pupils, their stage of development, and their prior experiences, taking account of language, social and cultural background;
  - c. evaluate the success of its use in relation to teaching objectives.

- 7. Trainees must be taught how to contribute to the development and consolidation of pupils' IT capability** within the context of science through:
- a. explicit discussion and, where necessary, teaching of the IT skills and ICT applications which are used in science;
  - b. using ICT terminology accurately and appropriately, and explaining to pupils any ICT terminology which arises from the application of ICT to science;
  - c. using ICT in ways which provide models of good practice for pupils, and insisting that pupils employ correct procedures when using applications.

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**Commentary on 5**

*Trainees should be taught ways in which ICT can support learning in science. For example, reluctant writers can be encouraged to complete reports using overlay keyboards, templates and word banks. Conceptual understanding can be reinforced by re-ordering sentences. Sensors can give more pupils the opportunity to collect their own experimental data: for example, pupils who find thermometers difficult to read or manipulate may be able to use computer sensing devices or digital thermometers. Pupils with hearing impairment might be given greater access to the Sound sections of the programmes of study by the use of visual demonstrations of the properties of sound, or through the use of oscilloscopes or sound-level meters; trainees will need to be aware that oscilloscopes show sound as a transverse, rather than a longitudinal wave. Digital thermometers and force meters can also assist pupils who have difficulty reading linear scales accurately, although this does not replace the need for them to learn such a skill.*

**Commentary on 6**

*Primary trainees need to be familiar with a range of science-specific software and sources of information relevant to the teaching of primary science. They should learn to evaluate an ICT-based resource with the same care that they use in choosing any other resource, that is, in terms of its potential to enhance pupils' learning in science. They should be taught how to develop and use criteria to assess the suitability of software to meet teaching objectives: for example, a multi-media encyclopaedia may be a rich source of information and have appealing graphics, but its content and vocabulary may be pitched at too high a level. Trainees may decide to use a resource whose content is pitched at older pupils, but should then support its use with glossaries or additional explanation or both. In this case, trainees should take particular care to establish that pupils are engaged and understand what they are being taught. Trainees should be aware of sources of reviews such as the Primary Science Review, Web sites and journals.*

*Trainees also need to guard against the possibility that the use of ICT may distract pupils from the focus of a lesson. For example, the use of attractive CD-ROM with video and sound may be motivating for pupils but may distract them from the simple task of finding the names of common British amphibians, and it may be more efficient to refer to a book.*

**Commentary on 7**

*In some cases, especially where pupils need to employ IT skills which are solely or primarily used in science, primary science trainees may need to focus on and develop pupils' IT skills to ensure that science teaching objectives can be achieved effectively. For example, they may need to teach pupils how to use data logging packages. They may need to teach pupils how to use the graphing facility of a data handling package so that pupils can draw bar charts or line graphs to compare the distance travelled by, or the speed of, toy cars, or the distribution of leaf size on a small tree.*

*Pupils will need to be taught the technical terms associated with the ICT: for example, when using a data file for work on invertebrates counted on the school field, pupils may need to be taught that a "file" is the total amount of information input; a "record" is information about an individual location and a "field" is a single piece of information about a particular find.*

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**8. In order to understand how to monitor, evaluate and assess their teaching and pupils' learning in science when using ICT, and to evaluate the contribution that ICT has made to the teaching of science, trainees must be taught:**

**a. how to monitor pupils' progress by:**

- i. being clear about teaching objectives and the use of ICT in achieving them;
- ii. observing and intervening in pupils' ICT-based activities to monitor and support their progression towards the identified objectives;
- iii. asking key questions which require pupils to reflect on the appropriateness of their use of ICT;

**b. how to recognise standards of attainment in science when ICT resources are used, including:**

- i. recognising how access to computer functions might change teacher expectation of pupil achievements;
- ii. identifying criteria by which pupils can show what they have learnt as a result of using ICT-based resources from the Internet or CD-ROM, and insisting that pupils acknowledge the reference sources used in their work;
- iii. how to determine the achievement of individuals when the "product" is the result of a collaborative effort, through observation, record keeping, teacher intervention and pupil-teacher dialogue;
- iv. how to ensure that assessment of ICT-based work reflects pupils' learning and the quality of their work within science rather than just the quality of presentation or the complexity of the technology used;

**c. how to use formative, diagnostic and summative methods of assessing pupils' progress in science where ICT has been used, including how to set up ICT activities with targeted objectives for assessment and make provision in those activities for all pupils to demonstrate achievement, conceptual understanding and learning through the use of ICT.**

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### **Commentary on 8**

*Focused intervention by the trainee is very important when pupils are using ICT in learning science to monitor and support pupils' progress towards identified teaching objectives. Through their interventions trainees can, for example, ensure that pupils remain on task; introduce and reinforce relevant vocabulary; monitor and assess pupils' understanding, or teach specific aspects. They should also pose questions that require pupils to reflect on the appropriateness of the way in which they are using ICT, as well as its suitability for a particular task, e.g. asking them to consider the advantages of using a light sensor for recording daily light variations over using an ordinary light meter, or the advantages of using a temperature sensor over a thermometer when recording the way an insulated baked potato cools.*

*The focus of assessment in science must always be related to the identified science teaching objectives. For example, if a graphing package has been used to explore the relationship between the temperature of water and the time taken for a sugar cube to dissolve, the assessment of pupils' achievement should be based on their understanding of this relationship and not on their ability to use the graphing package. Trainees should use a variety of strategies and interventions during the lesson to assess pupils' progress and understanding. They should ensure that pupils save sufficient of any ICT-based work for assessment to be carried out.*

*Trainees will need to be alert to the ways in which ICT can affect the assessment process. Assessment criteria should distinguish between outcomes that are the result of an automatic function of the computer (e.g. functions that enable the automatic production of graphs, bar charts or pictograms) and those which reveal pupils' knowledge and understanding of science. Pupils' understanding of scientific information downloaded from the Internet or from CD-ROM might be assessed. Trainees might, for example, require pupils to interpret and present the information gained from the use of ICT resources for a specific purpose rather than simply printing off information, e.g. asking pupils to produce a summary on the life cycle of a frog from a CD-ROM or from Internet sites; questioning pupils about the content of a pictogram they have produced using ICT.*

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- 9. In addition, trainees on courses providing for pupils aged 3-8 and 3-11 must be taught the importance of introducing pupils in nursery and reception classes to the use of ICT and to recognise the contribution ICT can make to this age group, including how to:**
- a.** encourage pupils to become familiar with ICT and positive users of it;
  - b.** ensure that all pupils have opportunities to use ICT, and that their experience takes account of any home use or other previous experience of ICT;
  - c.** identify and teach the skills necessary for handling input devices effectively, *e.g. switches, mouse, keyboard*;
  - d.** use ICT to support the development of language and literacy, through the use of programs which develop reading and writing, *e.g. to reinforce letter/sound correspondence*, and encourage pupils to engage with stories, songs and rhymes presented on the screen, as well as through the use of high quality educational broadcasts;
  - e.** use ICT to support the development of numeracy through the use of computer programs and robots which develop and reinforce the use of mathematical language, and the recognition and exploration of numbers, simple mental operations and patterns;
  - f.** use ICT to support pupils' creative development through the use of computer programs which encourage them to explore and experiment with pattern, shape, pictures, sound and colour;
  - g.** encourage pupils working collaboratively with ICT to share responsibilities for making decisions and reaching conclusions, *e.g. as they progress through a simple computer adventure game*.

**10. Opportunities to practise**

Trainees must be given opportunities to practise, in taught sessions and in the classroom, those methods and skills described above.

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### **Commentary on 9**

*Trainees on age 3-8 and 3-11 courses should be familiar with the those aspects of the “Early Learning Goals” that are relevant to science, and especially those contained in the section on children’s knowledge and understanding of the wider world.*

*Some ICT-based activities undertaken in the nursery or reception class can be clearly identified as being designed to develop pupils’ scientific knowledge, understanding and skills, and this will be reflected in the teaching objectives. Many other activities, however, will have a much less explicit scientific content, but will nevertheless have the potential to provide foundations for later learning in science: for example, a matching or sorting program on the computer will start to develop the skills pupils need for simple classification.*

*Many young pupils will already be familiar with a wide range of ICT from their everyday lives, e.g. telephones, fax machines, tape-recorders, television, video recorders, cameras and computers. Trainees will need to consider how they might extend and build upon pupils’ familiarity with ICT, as well as introducing them where appropriate to technology with which they might be less familiar, in order to develop their knowledge and understanding of science. For example, ICT might be used to enable pupils to look closely at scientific phenomena that it might be difficult for them to observe directly: for example, after a visit to a pond to look at frogs, a video might be used to show pupils a frog catching a fly. ICT might also be used to help very young pupils with aspects of investigation or experimentation, such as keeping records. For example, they might use a tape recorder to record or identify the sounds made by different musical instruments, a camera to take a series of photographs of a growing bean seed, or a word bank to help them to add labels to photographs or to write simple sentences. Whenever ICT is used with young pupils, trainees will need to consider its appropriateness, not only to meet the identified teaching objectives, but also for the age of the pupils who will use it, e.g. the robustness of the hardware, the simplicity of a computer program, or the level of language used in a video commentary.*

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**B. Trainees' knowledge and understanding of, and competence with, information and communications technology**

**11. In relation to the ICT content set out in paragraphs 12 to 19, trainees must be given opportunities to:**

- a.** evaluate a range of information and communication technologies, and the content associated with them, *e.g. television and radio, video, computers, the Internet, cameras and other equipment*, justifying the selection and use of ICT in relation to aspects of their planning, teaching, assessment and class management, including for personal professional use, *e.g. in downloading on-line materials for teaching or writing reports*;
- b.** understand and use correctly the specialist terms associated with the ICT used in science which are necessary to enable them to be precise in their explanations to pupils, to discuss ICT in relation to science at a professional level, and to read inspection and classroom-focused research evidence with understanding.

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**12. Trainees must demonstrate that they are competent in those areas of ICT which support pedagogy in every subject, including that they:**

**a. can employ common ICT tools for their own and pupils' benefit, e.g. word processing, e-mail, presentation software, data handling, and can use a range of ICT resources, at the level of general users (rather than as network or system managers), including:**

- i. the common user interfaces, using menus, selecting and swapping between applications, cutting, pasting and copying files, and cutting, copying and pasting data within and between applications;
- ii. successfully connecting and setting up ICT equipment, including input devices, e.g. a mouse, touch screen, overlay keyboard, microphone and output devices e.g. printers, screens and loudspeakers;
- iii. loading and running software;
- iv. file management;
- v. seeking and using operating information, including from on-line help facilities and user guides;
- vi. coping with everyday problems and undertaking simple, routine maintenance, with due consideration to health and safety;
- vii. understanding the importance of passwords and the general security of equipment and access to it;

**b. know and understand the characteristics of information, including:**

- i. that information must be evaluated in terms of its accuracy, validity, reliability, plausibility, bias;
- ii. that information takes up memory and that there are implications when saving and compressing files;
- iii. that information has to be stored somewhere;
- iv. that ICT systems can present static information or changing information;
- v. that information can be directly and dynamically linked between applications;
- vi. that applications and information can be shared with other people at remote locations.

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**Commentary on 12.a**

*Trainees will need to be aware of, and able to exploit, graphing and graphics software to produce materials for pupils. They should also know how to use generic software applications to prepare and adapt materials for pupils of different prior attainment.*

*In particular, science trainees will need to know how to connect, configure and use data logging peripherals. When using ICT over extended periods, for example recording temperature change over a 24-hour period, trainees will need to be able to configure computer hardware so that it will continue to function over that period, and so that features such as those designed to save power by automatically switching off computers are disabled.*

**Commentary on 12.b**

*Trainees will need to be aware that data is dynamic, and may need to be updated at regular intervals. Data which is not maintained regularly may be unreliable or of less value in science. Data collected and stored in one day or year may be used for future comparisons: for example, a local hedgerow survey from a previous year may be compared with the current year's results. Trainees and pupils also need to be aware when data is **current** (i.e. is being logged and presented simultaneously) and when it is **historical** (i.e. has been logged at some point before it is presented). They will need to know what difference this may make to the way in which the information can be interpreted.*

*In such cases it may be necessary to create backups of such data, or to lock files so that historical data is not lost through pupils or colleagues changing the original file.*

*Some applications of ICT in teaching science involve the sensing and presenting of information on light, temperature, etc. Trainees will need to know how to import such raw data into, for example, presentation software or spreadsheets, so that they can present the data for pupils to interpret. They also need to know how to import images or information gathered from other sources, e.g. the Internet, into the school's software.*

*Trainees will need to understand how to access information from different sources and exchange information with others electronically, e.g. using fax, e-mail or conferencing.*

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**13. Trainees must demonstrate in relation to primary science that they:**

**a. know how to use ICT to find things out, including, as appropriate for primary science:**

- i. identifying sources of information and discriminating between them;
- ii. planning and putting together a search strategy, including framing useful questions, widening and narrowing down searches;
- iii. how to search for information, including using key words and strings and logical operators such as AND, OR and NOT, indexes and directories;
- iv. collecting and structuring data and storing it for later retrieval, interpretation and correction;
- v. interpreting what is retrieved;
- vi. considering validity, reliability and reasonableness of outcomes;

**b. know how to use ICT to try things out, make things happen and understand how they happen as appropriate for primary science:**

- i. exploring alternatives;
- ii. modelling relationships;
- iii. considering cause and effect;
- iv. predicting patterns and rules recognising patterns, and hypothesising;
- v. knowing how to give instructions;
- vi. sequencing actions;
- vii. defining conditions, e.g. "if this happens, do that...";
- viii. understanding how feedback works and the difference between things that do and do not rely on feedback;

**c. know how to use ICT to communicate and exchange ideas as appropriate to primary science:**

- i. presenting ideas, including: identification of audience and purpose; deciding the best means with which to communicate;
- ii. exchanging ideas, including identifying the most appropriate medium, and information.

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**Commentary on 13.a**

*Trainees should know how to question the results of data logging and remote sensing technologies, to ensure that the results given are reasonable. They should be able to assess the validity and accuracy of electronic sources of scientific information such as that available from the Internet, taking account of the source, e.g. realising that some materials may have been provided by organisations with promotional aims.*



**Commentary on 13.b**

*Trainees should understand the difference between models and simulations.*

*The use of ICT to model and explore variables is applied extensively in science. Trainees will need to be able to apply ICT to create their own spreadsheet models and know how to use them to predict and ask and answer "what if" questions. They should understand the way in which the variables in models can be simplified in order to make the underlying concept more accessible.*

*Trainees should be familiar with a range of pre-prepared simulations suitable for use in science, and understand the advantages and limitations of these for presenting and explaining scientific concepts.*



**Commentary on 13.c**

*Trainees should be aware of the way in which ICT can be exploited as a communication tool for presentation. They should know how to produce written and graphical materials for use as teaching materials, and how to use ICT for direct teaching, e.g. using large display screens or interactive whiteboards.*

*Trainees need to understand the ways in which ICT can enable materials to be presented in different ways, to enable pupils of different prior attainment to grasp the scientific knowledge, understanding and skill being taught.*

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- 14. Trainees must demonstrate that they know** those features of ICT which can be used, separately or together, to support teaching and learning in science, including:
- a. speed and automatic functions** – the function of ICT which enables routine tasks to be completed and repeated quickly, allowing the user to concentrate on thinking and on tasks such as analysing and looking for patterns within data, asking questions and looking for answers, and explaining and presenting results, *as appropriate to primary science*, including how ICT can be used to:
    - i. measure events at long or short time intervals in order to compress or expand events which would normally take very short or long periods of time, and illustrate them to pupils at speeds appropriate to their pace of learning;
    - ii. measure and record events which might otherwise be impossible to gather within a classroom environment;
    - iii. explore sequences of actions and link the sensing of events with the control of actions;
  - b. capacity and range** – the function of ICT, *as appropriate to primary science*, to access and to handle large amounts of information; change time scales, or remove barriers of distance; give teachers and pupils access to and control over situations which would normally be outside their everyday experience, including:
    - i. the range of forms in which ICT can present information;
    - ii. the range of possible appropriate ICT sources, including local sources such as CD-ROM, and remote databases such as the Internet and the National Grid for Learning;
    - iii. how to judge the accuracy of the information and the credibility of its source;
    - iv. how ICT can be used to gain access to expertise outside the classroom, the school and the local community through communications with experts;
  - c. provisionality** – the function of ICT which allows changes to be made easily and enables alternatives to be explored readily, and *as appropriate to primary science*:
    - i. how to make best use of the ability to make rapid changes, including how to create text, designs and models which may be explored and improved in the light of evaluation;
    - ii. how to judge when and when not to encourage exploration and change using ICT;
    - iii. how saving work at different stages enables a record to be kept of the development of ideas;
  - d. interactivity** – the function of ICT which enables rapid and dynamic feedback and response, *as appropriate to primary science*, including how to determine the most appropriate media to use.

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### **Commentary on 14**

*Trainees will need to understand how ICT can benefit their teaching. For example, by sampling regularly and at short time intervals, data loggers can capture experimental data that would have been difficult to obtain otherwise, and can help to reveal important trends in the data, which can be used to illustrate scientific principles.*

*(An example of using a data logger to record change in temperature in a classroom over a 24-hour period can be found at <http://www.vtc.ngfl.gov.uk/resource/cits/science/prfocus/psinvest/day1.html>)*

*Trainees should be aware of the range of relevant scientific information available from ICT sources, and be able to assess the validity of the information. They should know how to access information from CD-ROM, intranets and the Internet, and be aware of the opportunity to gain access to information from science experts.*

*Scientific exploration is frequently based on an iterative approach to finding out and solving problems. Trainees should understand how the functions of ICT support this type of approach, e.g. using simple models of biological relationships, such as the factors which promote or hinder plant growth. Hypotheses can be tested quickly and easily, allowing ideas to be explored in a variety of situations. Trainees should also understand when this approach is not appropriate, e.g. that the effect of restricting light or water on plant growth might be better demonstrated by growing real plants under a variety of conditions.*

*Trainees should know how the function of ICT which provides immediate feedback can be used in science: for example, during data logging experiments ICT enables connections to be made immediately between physical observation and the emerging on-screen graphical data.*

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**15. Trainees must demonstrate that they are aware of the potential of ICT to enable them to prepare and present their teaching more effectively, taking account of:**

- a. the intended audience, including matching and adapting work to subject matter and objectives, pupils' prior attainment, reading ability or special educational needs; recognising the efficiency with which such adaptations can be made using ICT;
- b. the most appropriate forms of presentation to meet teaching objectives.

**16. Trainees must demonstrate that they:**

- a. know and understand the ICT requirements of the pupils' National Curriculum in relation to primary science;
- b. are familiar with the standards as set out in the pupils' National Curriculum for IT, relevant to the primary phase, and know the level of IT capability they should expect of pupils when applying ICT in science.

**17. Trainees must demonstrate that they know how each of the following is relevant to primary science:**

- a. **Generic procedures and tools**, including:
  - i. understanding the key features and functions used within science;
  - ii. using ICT to prepare material for pupil use;
- b. **reference resources**, including:
  - i. how to search reference resources;
  - ii. how to incorporate the use of reference resources into teaching;
- c. **the ICT specific to science:**
  - i. the major teaching programs or "courseware" and how to ensure that material is matched to the pupils' competences;
  - ii. where content and activities are presented in sequence to teach specific topics;
  - iii. where teaching activities are combined with assessment tasks and tests.

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**Commentary on 15**

*Trainees should be able to use ICT to develop and adapt teaching materials taking account of the needs of the teaching groups involved. This could mean, for example, developing spreadsheet templates with differing levels of interaction for pupils depending on their ability, or improving visual impact by incorporating photographs, digitised images, charts or graphs, or using animation or video, or downloading materials from the NGfL and adapting them for use in their school.*



**Commentary on 16**

*Trainees need to be aware of explicit references to ICT in the National Curriculum for Science Programme of Study. They also need to understand the contribution that science can make to developing pupils' IT capability, particularly in the areas of measuring and modelling, and consider how this can be achieved within science lessons.*

*Trainees should also be aware of pupils' own IT capability to ensure that pupils are able to understand and apply the IT skills and concepts that they may be expected to use in science lessons.*



**Commentary on 17**

*Trainees need to understand how word processing software and spreadsheets can be used in science teaching, e.g. in writing reports, organising data, graphing and modelling.*

*They should also know how to use these tools to prepare material for pupils' use, e.g. instruction sheets and worksheets using word processing software; data collection templates using a spreadsheet.*

*Trainees should know how to use common information resources, access information and incorporate this information into teaching material. This may mean, for example, using a search engine on the Internet to find information, for example about health issues related to smoking; downloading the information; using cut and paste techniques, and developing a set of instructions for pupils from this material. Trainees will need to be aware of copyright issues when using source material in the classroom.*

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**18. Trainees must demonstrate that they are aware of:**

- a. the current health and safety legislation relating to the use of computers**, and can identify potential hazards and minimise risks;
- b. legal considerations including those related to:**
  - i. keeping personal information on computers, as set out in the Data Protection Act;
  - ii. copyright legislation relating to text, images and sounds and that relating to copying software;
  - iii. material which is illegal in this country;
- c. ethical issues including:**
  - i. access to illegal and/or unsuitable material through the Internet;
  - ii. acknowledging sources;
  - iii. data confidentiality;
  - iv. the ways in which users of information sources can be (and are) monitored;
  - v. material which may be socially or morally unacceptable.

**19. Trainees must demonstrate that they know how to use ICT to improve their own professional efficiency and to reduce administrative and bureaucratic burdens, including:**

- a.** using ICT to aid administration, record-keeping, reporting and transfer of information;
- b.** knowing about current classroom-focused research and inspection evidence about the application of ICT to teaching science, and where it can be found;
- c.** knowing how to use ICT to join in professional discussions and to locate and access teaching plans, material and other sources of help and support, including through the National Grid for Learning;
- d.** knowing how ICT can support them in their continuing professional development.

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**Commentary on 18**

*Trainees should be aware of the wider issues relating to the use of ICT in the classroom. These will include the safe use of ICT equipment in science activities, and the implications of the Data Protection Act when collecting personal information in electronic form (e.g. for a topic on 'Ourselves'). They must also understand and respect copyright and the need to acknowledge the sources of information.*



**Commentary on 19**

*Trainees should be aware of key sources of research and inspection evidence about ICT in science teaching. They should know how to use ICT, for example to participate in on-line discussion groups or conferences, to access science support agencies and subject associations via the Virtual Teacher Centre and other routes, and to find information and case studies of how ICT can be used in science. (Some useful case studies can be found at [http://www.vtc.ngfl.gov.uk/resource/cits/science/prfocus/pri\\_ind.html](http://www.vtc.ngfl.gov.uk/resource/cits/science/prfocus/pri_ind.html)) They should also be familiar with the etiquette associated with e-mail and conferencing. ICT can also offer trainees unique support in keeping their own subject and pedagogical knowledge up to date through access to appropriate Web sites, satellite broadcasts and communications with "experts". Section Four of this booklet lists some addresses where trainers and trainees can obtain further useful information and advice on all these areas.*

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## Section Three

### Three case studies

This section provides a case study example from each of the three sciences, chosen to help trainers raise and discuss with their trainees issues such as:

- how to start with teaching and learning objectives in primary science;
- how to consider the potential contribution of ICT to achieving these objectives;
- how to determine why ICT should, or should not, be used;
- where ICT *is* used, how to justify its use in terms of improvements in teaching and learning.

In using these case studies, trainers could, for example:

- select an aspect of the way in which ICT is used in the lessons, and explore alternatives;
- delete the sections explaining the teacher's decisions about ICT, ask trainees to suggest what the thinking might have been, and then discuss the text of those sections;
- consider with trainees how the teaching approach might have differed if different ICT resources had been available.

The case studies also illustrate how the use of ICT can support and enhance high quality primary science teaching, but cannot replace it. The organisation of resources and the identification of assessment methods are both considered in the teacher's planning of the unit of work.

The case studies also provides a context for discussing aspects of the ITT National Curriculum for the use of ICT in subject teaching such as:

- the advantages of preparing, adapting and saving teaching materials using ICT;
- the use of e-mail for collaborative work between schools;
- the potential of ICT for developing pupils' writing skills in science lessons;
- the use of keyboard overlays with young pupils in science;
- the ways in which computer-based branching keys might be used with young pupils;
- the importance of teacher preparation when ICT is being used in science;
- the use of spreadsheets to collect data;
- the use of digital cameras and word processing software for recording in science;
- the advantages and disadvantages of using graphing software in science;
- the advantages of using large display screens or monitors for whole-class teaching;
- the use of digital measuring instruments;

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- the use of simple data loggers;
- the different ways in which ICT can present data and the appropriateness of each for the teaching objectives in hand;
- the effective use of ICT-based reference material in science lessons;
- when and when not to allow pupils to use calculators and spreadsheets to calculate in science;
- how and when ICT-based simulations might be useful in science;
- the teacher's role when pupils are using ICT in science.

The case studies also illustrate how several aspects of the ITT National Curriculum for the use of ICT in subject teaching might be taught in an integrated way in primary science training, with ICT issues routinely introduced into discussions about science between trainee(s) and tutor(s). For example, although these case studies show the effective use of ICT in relation to just a few teaching objectives in primary science, trainees and their tutors, in discussing them, could consider many of the areas required by the statutory curriculum for the use of ICT.

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## **CASE STUDY 1: YEAR 4 PUPILS STUDY THE ENVIRONMENT AND INVERTEBRATE ANIMALS IN THEIR SCHOOL GROUNDS**

This is an example where pupils in a Year 4 class of varied ability and experience studied the environment and the invertebrate animals in their school grounds. The teacher used **QCA Scheme of Work unit 4B – Habitats** (<http://www.standards.dfes.gov.uk/schemes/science/sci4b>) to structure her work. She decided she did not have enough time to work on food chains, but planned to cover most of the other objectives from the QCA unit of work which are listed below.

### **Teaching Objectives for a unit of work (Year 4)**

For pupils to learn:

- i. to identify different types of habitat;
- ii. that different animals are found in different habitats;
- iii. to make predictions about the types of organisms that will be found in a habitat and to indicate whether their predictions were valid;
- iv. to observe the conditions in a local habitat and make a record of the animals found;
- v. that animals are suited to the environment in which they are found;
- vi. to group organisms according to observable features;
- vii. to construct and use keys to identify local plants or animals;
- viii. to decide what evidence to collect and design a fair test;
- ix. to make reliable observations about the animals and their habitats;
- x. to identify the food sources of animals in different habitats.

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### **Pupils' National Curriculum references**

This case study focuses on the following areas of the pupils' National Curriculum for primary science at KS2:

#### **Experimental and Investigative Science**

Pupils should be taught:

- 1.a** to turn ideas suggested to them, and their own ideas, into a form that can be investigated;
- 2.b** to make careful observations and measurements;
- 3.a** to use tables, bar charts and line graphs to present results;
- 3.b** to make comparisons and to identify trends or patterns in results;
- 3.d** to indicate whether the evidence collected supports any prediction made.

#### **Life Processes and Living Things**

Pupils should be taught:

- 4.a** how locally occurring animals and plants can be identified and assigned to groups, using keys;
- 5.a** that different plants and animals are found in different habitats;
- 5.b** how animals and plants in two different habitats are suited to their environment.

### **Background information and notes**

- i. This unit was carried out by a mixed ability class of Year 4 pupils. They had had experience of using computers across the curriculum throughout the school from Year 1 onwards.
- ii. The setting was a suburban school with a small playing field, some rough grass (referred to as the school's nature area), flower beds and several trees. The work was completed in the first part of the summer term and lasted for half a term.
- iii. There were two computers linked to a colour printer in the classroom, and the school had a separate ICT area equipped with ten computers linked in a network and a large screen for demonstration to the whole class. The teacher had some experience of working with computers and was supported by the school's ICT co-ordinator. The teacher was also supported by the school's science co-ordinator in planning this work. The school had a policy for the use of computers which was in the process of change in the light of the QCA scheme of work for Information Technology. The teacher wanted to give pupils experience of using the computer to create bar charts and line graphs, as suggested in QCA Scheme of Work for Information Technology Unit 4D (<http://www.standards.dfee.gov.uk/schemes/it/itx4d>), but decided that it would be better to use spreadsheets rather than databases for this purpose.

### Sequence of work in order to meet stated teaching objectives

N.B. The unit of work is set out in logical steps. These do not necessarily correspond to lessons.

#### ***Step 1 – teacher preparation***

The teacher was fairly familiar with invertebrates, but decided to remind herself about some basic information e.g. *In what ways are slugs and snails similar and dissimilar? What do worms eat? Which group of invertebrates do woodlice belong to?* She mainly used reference books but supplemented this with electronic information sources, notably CD-ROMs, and to a lesser extent the Internet (where she searched for 'earthworm', 'woodlouse' and 'snail'.) She reconnoitred the school grounds some weeks before the start of the unit of work, and left pieces of old carpet, scrap wood and several bricks in the school nature area to provide habitats for invertebrates.

The teacher also discussed the project with a colleague who was doing a similar unit of work at another school. They agreed to set up e-mail communication between the pupils in their classes.

#### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher found that the Internet and CD-ROMs did not provide as much useful information as the book sources she used. In addition, the books were portable and she was able to use them outside. She hoped the e-mail link with another class would give pupils another audience for their work and enable them to obtain information from a contrasting habitat.

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### ***Step 2 – pupils look at different habitats and record what they see***

The teacher briefly explained to pupils that a habitat was the place where an animal or plant lived. The teacher and pupils made a general reconnaissance of the school grounds using maps and plans to mark down the locations of different habitats, e.g. cracks in paving slabs; soil in shrub border; soil under hedge; under an old piece of carpet; under a tree. The teacher supervised the use of a digital camera at each location.

Back in the computer area, pupils worked in groups at the networked computers using word processing software to write about two of the habitats they had seen. The teacher showed two pupils how to save each digital camera image as a separate file on the hard disk of one of the computers. The teacher drew a plan of the school grounds on a large sheet of paper, with the pupils' accounts of each habitat incorporating the appropriate images displayed in the correct place on the plan.

### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher felt the use of the digital camera to record images of each habitat was extremely helpful. The images could be used immediately pupils returned to the classroom and could easily be printed out or incorporated into written work. The images focused pupils' attention on the area and gave an instant record to stimulate their written work. The teacher felt that if pupils visited the habitat at a different time of year, they would be able to compare the habitat at different seasons more easily using the stored images.

The teacher decided to ask pupils to word process this work because the accounts could be extended later as the habitats changed and as more animals were found in each one. Digital images could easily be incorporated into pupils' work. In addition, the use of word processing software provided an ideal way to facilitate collaborative writing.

### **Commentary on specific teaching points**

While they were outside, the teacher asked pupils questions that drew their attention to features of each habitat, e.g. *Is this area sunnier than the last one? Does the soil here feel different to that under the hedge?* The teacher was keen for pupils to see that even one small area could contain several habitats. In this initial stage she did not want pupils to collect or even look for animals, since she wanted them to focus on the physical environment. She asked pupils to use as many descriptive words as possible about each habitat they looked at.

Back in the ICT room, pupils were initially supervised in the task of downloading the digital camera images by a classroom assistant who supported one of the pupils with behavioural difficulties. The teacher intervened while pupils worked, helping them to remember the features of the different habitats and find suitable words to describe them. Once the pupils and teacher were happy with the habitat descriptions, pupils printed the correct digital camera images to complement their writing. Later, most pupils combined the camera image with their writing in a single file. The teacher asked two lower-attaining pupils to help save files to disk, since this was a routine but high status task which allowed pupils who could sometimes be disruptive to help their classmates.

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### ***Step 3 – pupils learn the names of common invertebrates and how to look after them***

The teacher brought in a selection of common invertebrates ('minibeasts') into the classroom, including worms, woodlice, centipedes, spiders, greenfly, slugs and snails. Pupils looked at each specimen in turn and discussed them. The teacher drew pupils' attention to the features of each animal, e.g. the patterns made by the foot of the slug and the snail as they crawled up the inside of the jar. Pupils also felt the bristles on the earthworms and looked at greenfly under a x20 microscope. The teacher asked pupils how they could find out what the slugs and snails ate. The pupils suggested that the teacher took pictures of the minibeasts with the digital camera. These were taken and stored on the classroom computer.

The pupils and teacher decided on a schedule for writing about each minibeast. This included: name; picture; description; what they ate; what they would need to stay alive in the classroom for a week. A range of books and several electronic information sources (e.g. CD-ROMs) were used. The teacher showed pupils how to use a book or a CD-ROM to search for the information required and then make brief notes about this. Each child wrote his or her longhand account of each minibeast on a sheet of A5 paper and added a small printout of one digital camera image, with other pictures being drawn by hand.

### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher originally thought there was no need to use ICT, apart from electronic sources of information, at any point in this work since she was mainly concerned with giving pupils first-hand experience of invertebrates and ensuring they had a positive attitude to studying and caring for them. She also wanted to show them how to handle invertebrates correctly, e.g. using a pooter to collect greenfly. However, she decided to allow the use of the digital camera to take photographs of each animal because she realised that pupils would enjoy having photographs for use later in their work. She restricted each child to a single image to supplement their hand-drawn pictures. She felt that printing out each image 32 times (one for each child) would take too much time, be expensive and have little or no educational value. In retrospect, she felt that even this limited use of the digital images had little educational benefit especially since the quality of the close-ups was not good.

She decided not to let pupils word process their writing this time, since she only had two computers available for this work and realised that it would take too long for each child to write his or her account using a computer. In any case, the two classroom computers were being used for searching for information and printing the images. The teacher wanted pupils to use the information from books and CD-ROMs selectively so she showed pupils how to make brief notes rather than indiscriminately using a whole entry.

### **Commentary on specific teaching points**

The whole class contributed to the discussion about the snails' favourite food, which ended up with snails being given the choice of pink card, lettuce, dandelion and grass. The pupils (and teacher) were surprised to see that the snails ate only the card and lettuce and that the snails' droppings were pink. The teacher asked the pupils to extend their test by thinking of other plants that they had noticed in the habitats where the snails were found. They also discussed what they would need to provide for each animal if they wanted to keep it captive for a week.

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**Step 4 – pupils sort and group the invertebrates**

The teacher wanted to introduce pupils to simple classification. She started by playing 20 questions with the whole class about a variety of topics, ending with invertebrates. (*"I'm thinking of an invertebrate." "Does it have legs?" "Yes." "Does it ...?"*).

The teacher then played an 'odd one out' game with the class, again with a variety of topics ending with invertebrates.

She then showed the class how to put the names of a set of five pets on the blackboard and then drew out a branching key using questions suggested by the pupils.

Pupils then did three grouping and sorting activities (none of which used ICT) based on the animal drawings already put on A5 sheets of paper (see Step 3):

- a. put the animals into two sets and say why they are in these sets. Do this again using a different way to group the animals;
- b. using the whole set of animals, create a branching key on a large sheet of paper;
- c. draw three different animals, one of which is the odd one out.

The class then moved to the ICT area and did two other related activities using computers. Using the large screen to demonstrate, the teacher showed the class a ready-made branching database on the computer about pets, to help them understand how the branching key worked.

In the ICT area, each group of pupils was given tasks d. & e.:

- d. create a branching database program on the computer to sort the class set of invertebrates. Save the file for later use by other pupils;
- e. use reference books and/or electronic information sources to find the meaning of words including: insect; arachnid; crustacean; invertebrate; myriapod, and annelid. Pupils doing this task were asked to write the word, their definition and a drawing in their minibeast file.

**Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher felt that although pupils had used a branching database in the past they would benefit from plotting one out on paper before going to the computer. She also felt that the branching databases needed to be created for a purpose so she ensured that each group saved their database for later use by other groups.

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### **Commentary on specific teaching points**

The teacher set up the sequence of activities knowing that many of the lower-attaining pupils would not reach task e. The teacher was aware that several of the pupils were able and keen to use scientific vocabulary, so she moved them on more quickly to use the standard scientific classification of invertebrates. The teacher started activity a. with the whole class working in small groups. She made sure that, in each group, each pupil got the chance to propose a method of grouping the animals into two sets and to explain to the rest of the group why he or she had grouped the animals in this way. Once pupils started work, again in groups, on the paper-based branching key, the teacher made sure that lower-attaining pupils had access to postcard-sized drawings of invertebrates as a concrete item to sort. Once the group was working at the computer-based branching key, the teacher gave higher-attaining pupils a wider range of animals to place on their branching tree, some of which could not be found in the school grounds. This extended their opportunity to generalise about classification and gave greater purpose to their later work on text-based and ICT-based reference material. The teacher circulated among the groups while they worked at the computers, asking questions to check and extend their understanding.

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***Step 5 – pupils predict which invertebrates they will find in each habitat***

In the classroom, the teacher used the wall map of the school to remind pupils about the different habitats they had identified. She asked them where they expected to find particular animals and asked them to make predictions based on their experience. She then assigned different groups of pupils (in fours) to look for animals in two different habitats. Each group had to record the number of each kind of invertebrate they found in each location.

**Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

At this stage there was no need for any ICT since the amount of information to be collected by each group was fairly small.

**Commentary on specific teaching points**

The teacher discussed care for the animals while pupils were surveying the habitats and ways in which pupils could minimise their impact on the environment. She also asked pupils about ways in which the searches could be made comparable (fair). Pupils were given containers to hold one sample of any invertebrate which they could not name. Where there were many individuals of one species, pupils were told to estimate the number. One member of each group had a clipboard and paper to record the habitat and animals found there.

The teacher used carefully chosen questions to focus pupils' attention. These included: *Where do you think we will find woodlice? What makes you suggest that place? Where do you think we might find ants?* She wrote on the board several of the predictions made by the pupils. These included *I think we will find ants in the cracks between the slabs. I think we will find worms in the border soil. I think that slugs are more common than snails.*

The teacher realised that it was impossible to carry out a truly fair test since there were far too many variables. However, pupils suggested that each group look for roughly the same length of time and have roughly the same number of searchers.

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**Step 6 – pupils combine their information and produce charts to check their predictions**

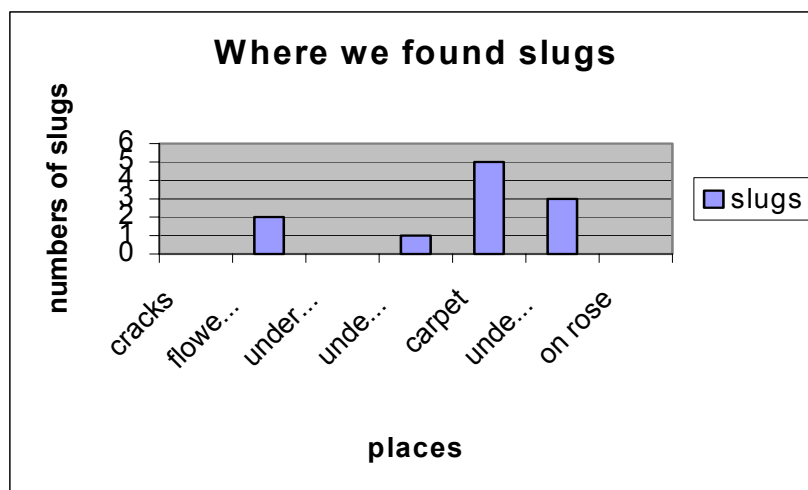
The teacher wanted pupils to pool their numerical data on the different habitats so they could check their predictions. She designed a spreadsheet [Fig.1] that showed the names of the habitats across the top cells and the names of the animals down the side. The groups in turn entered the numbers for their habitats.

<b>minibeasts in our habitats</b>							
	cracks	flowerbed	under tree	under hedge	under carpet	under brick	on rose
slugs	0	2	0	1	5	3	0
snails	1	1	0	2	1	2	0
greenfly	0	0	0	0	0	0	8
worms	0	5	1	1	4	2	0
centipede	0	1	0	0	3	2	0
woodlice	0	0	0	4	6	3	0
earwig	0	0	0	1	2	0	0

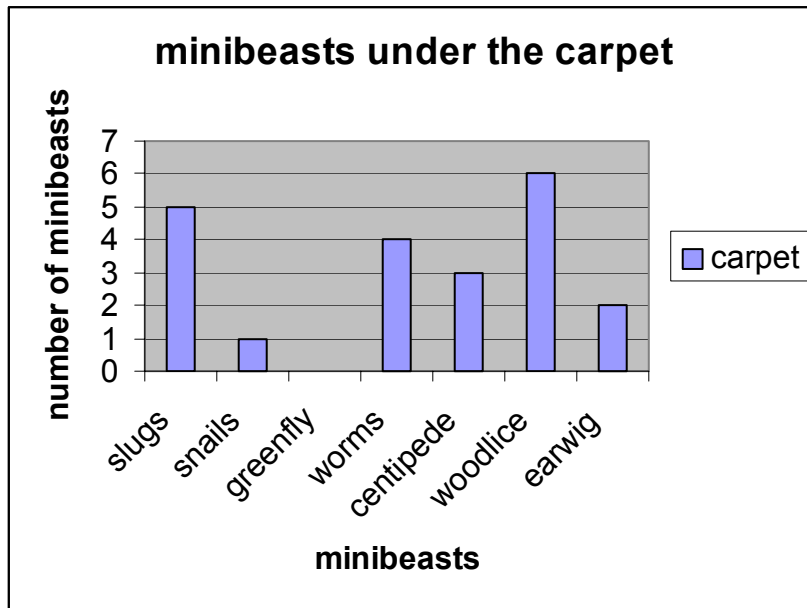
**Fig.1****Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher felt that the spreadsheet was a useful resource, but that it was too difficult for most pupils to interpret. However, once she had shown pupils how to highlight a selection and then create a bar chart, and pupils were free to choose the data they wanted, they were able to manipulate it quickly and simply. The teacher felt the speed at which each group could produce graphs and charts to support or refute a prediction made the use of the computer worthwhile. Pupils had had substantial experience of drawing bar charts and graphs from work earlier in the school and were proficient at it. Since the objective for the lesson was interpretation of data rather than drawing charts and graphs, the teacher felt the speed at which the ICT could produce neat, accurate graphs was an advantage.

She also showed the children how to create a chart showing which animals occurred in each habitat [Fig.2].

**Fig.2**

She also showed them how they could show which invertebrates were found in a particular habitat [Fig.3].



**Fig.3**

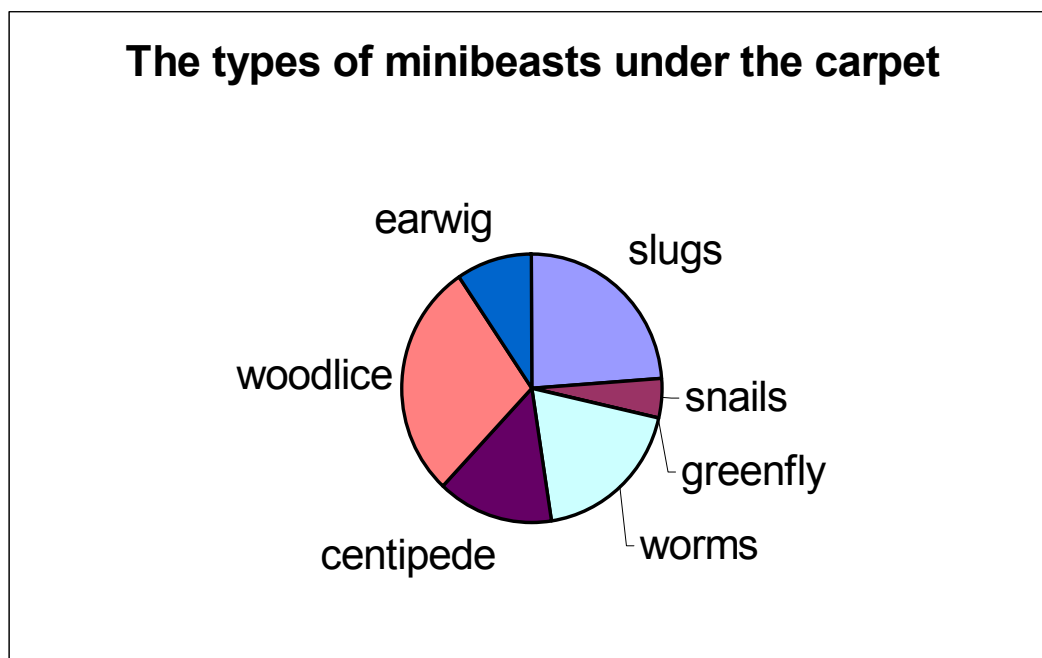
The teacher considered at this point whether she should show pupils how to produce a database of the habitats and the invertebrates found in each. However, she felt the process and the end result would be too similar to the spreadsheet and she noted that the database used in the school did not allow the production of charts.

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### Commentary on specific teaching points

Once all the data was entered the teacher demonstrated how to draw bar charts from the data. She showed pupils how to highlight the cells for slugs and draw a bar chart showing the number of slugs in each habitat. The teacher showed pupils how the same data could easily produce pie charts. She showed that pie charts were useful when looking at the numbers of animals in each habitat, but not so useful for seeing in which habitats a particular animal lived [Fig. 4].



**Fig.4**

Pupils were able to use the charts to support their conclusions. They could use the graphs to show, for instance, that the best place to look for slugs was under the old piece of carpet. Pupils opened a word processing document in which they wrote a brief description of their charts and said whether the data supported or refuted any of their predictions. The higher-attaining pupils were able to “paste” their pie and bar charts into their word-processed writing electronically.

***Step 7 – pupils explain why some environments have many types of invertebrates***

The teacher asked pupils why some environments, e.g. under the carpet, under the stone and in the long grass had so many types of animals, while the school field and the soil at the base of a wall had few. Pupils offered their ideas about why some habitats had such a diversity of animal life. These included the idea that some habitats did not dry out or heat up during the day as much as others. The teacher asked pupils how they could test out their ideas. Some pupils suggested using their fingers to test humidity, thermometers to measure temperature and their eyes to estimate the amount of shade. The teacher asked them how they could make their measurements fair, and raised questions about the changes in light, humidity and temperature over a 24-hour period. She introduced pupils to a simple data logger and explained how it could be used to help them to answer their questions. Pupils used the data logger to compare measurements from three contrasting habitats.

**Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher knew that temperature and light levels could be measured using simple devices such as a thermometer or a light meter, but she wanted pupils to appreciate the way in which each habitat changed over a longer period. This was most easily done using a data logger. The teacher used a data logger, which did not need to be connected to a computer, to take readings of light, temperature and moisture over a 24-hour period. (See the Web site <http://www.vtc.ngfl.gov.uk/resource/cits/science/prfocus/psinvest/day1.html> for an example of this investigation).

**Commentary on specific teaching points**

Before starting the data logging of the outside habitats, the teacher and pupils set up the data logger to record changes in their own classroom habitat over a 24-hour period. The teacher explained that the data logger, unlike a thermometer, would produce a continuous reading over 24 hours so that the class could see what the temperature was – even when no one was at school.

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***Step 8 – pupils communicate their findings to others***

The teacher had previously communicated with a teacher in another school where pupils were also studying their school grounds (see Step 1). Pupils in the two schools communicated their findings to each other using e-mail attachments that included the word-processed information, spreadsheets, databases and images.

**Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher felt that the ability to send and receive, almost instantly, information including writing, charts and images increased pupils' enthusiasm. Pupils e-mailed the other school to request clarification of points which were not clear. Once they received the material from the other school the teacher discussed it with the whole class, drawing comparisons with their own area. Pupils were encouraged to suggest reasons for the differences they noted. The contrasts and similarities between the two schools gave the invertebrates project a productive conclusion.

**Commentary on specific teaching points**

The teacher felt that the fact that other pupils were reading and commenting on her pupils' work made them more concerned to produce accurate and informative work. She explained the nature of the activity to the class and helped groups of pupils to compile detailed, yet succinct, reports on their area. She placed limits on the amount and type of material that each group could send. To help them think of the external audience she suggested that some pupils might write their reports in the style of a magazine report or a guide to the school grounds. In any case, the teacher encouraged pupils to look at each other's work and to help each other improve and refine the material. She felt that the process of reducing and refining writing for an external audience helped pupils to clarify their thinking about the topic.

At this point the teacher reviewed her teaching objectives for the unit to check that they had all been met.

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## CASE STUDY 2: YEAR 2 PUPILS GROUP AND CHANGE MATERIALS

This is an example where pupils in a Y2 class of varied ability and experience studied grouping and changing materials. The teacher used **QCA Scheme of Work unit 2D – Grouping and changing materials** ([www.standards.dfee.gov.uk/schemes/science/sci2d](http://www.standards.dfee.gov.uk/schemes/science/sci2d)) to structure her work.

### Teaching objectives for the unit of work

For pupils to:

- i learn that there is a range of materials with different characteristics;
- ii explore different materials using the appropriate senses, making simple observations and comparisons, and begin to sort, classify and identify materials by their properties;
- iii. learn that materials often change when they are heated, and in particular, to study the way ice melts;
- iv. describe ways of making materials or objects change and the effects of these changes, using appropriate vocabulary;
- v. construct tables to record their observations and to begin to construct and interpret simple bar charts.

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### **Pupils' National Curriculum references**

This case study focuses on the following areas of the pupils' National Curriculum for primary science:

#### **Experimental and Investigative Science**

Pupils should be taught:

- 1.a** to turn ideas suggested to them, and their own ideas, into a form that can be investigated;
- 1.b** that thinking about what is expected to happen can be useful when planning what to do;
- 1.c** to recognise when a test or comparison is unfair;
- 2.a** to explore using appropriate senses;
- 2.b** to make observations and measurements;
- 2.c** to make a record of observations and measurements;
- 3.a** to communicate what happened during their work;
- 3.b** to use drawings, tables and bar charts to present results;
- 3.c** to make simple comparisons;
- 3.d** to use results to draw conclusions;
- 3.e** to indicate whether the evidence collected supports any prediction made;
- 3.f** to try to explain what they found out, drawing on their knowledge and understanding.

#### **Materials and their Properties**

Pupils should be taught:

- 1.b** to sort materials into groups on the basis of simple properties, including texture, appearance, transparency and whether they are magnetic or non-magnetic;
- 1.d** that many materials, *e.g. glass, wood, wool*, have a variety of uses;
- 2.b** to describe the way some everyday materials, *e.g. water, chocolate, bread, clay*, change when they are heated or cooled.

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### **Background information and notes**

- i. This unit was carried out by a Year 2 class with pupils of average attainment. Pupils had had experience of using computers in Year 1.
- ii. The work took place during the first part of the spring term. The teacher anticipated that snowy, icy and frosty weather conditions were likely to occur and enable her to make relevant links to the unit of work.
- iii. There was one stand-alone computer linked to a printer in the classroom. The teacher was reasonably competent in her use of the computer, only needing to ask for help from the school's IT co-ordinator to help her to create templates in the graphing program.

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## Sequence of work in order to meet stated teaching objectives

N.B. This unit of work is set out in logical steps. These do not necessarily correspond to lessons.

### ***Step 1 – pupils describe different materials***

The teacher brought in a collection of drinking beakers made from contrasting materials, including thin plastic, thick plastic, toughened glass, metal, polystyrene and wood. By selecting similar objects she was able to emphasise the difference between the object itself and the material from which it was made. Working in pairs, pupils were asked to suggest what their particular beaker might be used for and to give the reasons for their ideas. The teacher then led a discussion about other objects made from these materials. Pupils then selected one of the materials and wrote about their material's appearance and some of its other uses. The higher-attaining pupils used the simple writing frames that the teacher had prepared to help them structure their writing. The lower-attaining pupils were easily able to describe their material and record a use for it using the pre-prepared concept keyboard overlay (see below).

### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher used the computer to create and print a range of writing frames, containing appropriate vocabulary, to support pupils in their writing. By creating these on the computer, the teacher was able to save them and adapt them easily to match the level of support they provided to pupils' attainment. To help pupils who found writing difficult, the teacher set up an overlay keyboard linked to a word processing program on the classroom computer. In pairs, pupils chose a material and wrote about it, entering appropriate terms to describe it. The teacher chose lower-attaining pupils to use the overlay as she felt it helped them to express their ideas quickly and easily.

### **Commentary on specific teaching points**

In their explanations and in their writing the teacher encouraged pupils to make a link between the type of material used and the way the tumbler would be used, e.g. pottery used to hold warm liquids; plastic for use outdoors. She drew pupils' attention to features of the materials, e.g. flexibility, whether they absorbed liquid, durability, and heat insulating properties. She was keen that pupils should become familiar with and use the correct scientific vocabulary, e.g. *absorbent, stiff, transparent, conducts heat*, and so she used and reinforced this vocabulary during the lesson.

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### ***Step 2 – pupils sort and begin to classify materials***

Having established an understanding that when an object is made the material it is made from is selected because of its properties, the teacher wanted pupils to be able to sort materials according to their properties. She approached this in a variety of ways.

- a. In groups of three they were given eight different materials to work with: acetate, bubble wrap, foil, paper, plastic bag material, stiff board, stiff plastic and tissue. Pupils then took turns to find a way to classify the materials into two sets, e.g. hard to tear and easy to tear. They recorded this by sticking small samples of the materials onto their paper.
- b. The teacher then played a 20-questions game with the class, in which pupils had to guess the material (*"I am thinking of a material ..."*). Pupils questioned the teacher, e.g. *"Is it transparent?"* and the teacher answered either *"Yes"* or *"No"*.
- c. Pupils sorted materials using a branching key on paper – for an example, see *Fig.5*.

Working with small groups of pupils around a standard monitor, the teacher showed them how to use a simple branching key which she had set up on the computer. The pupils were then able to play a "Guess the material" game using the computer. They thought of a material and answered the questions on the screen. The computer usually arrived at the right answer provided that the previously entered questions were unambiguous. The teacher then showed them how to add more materials (velvet, glass and steel) and save their own versions of the key to disk.

### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher decided to use a computer branching key because it helped pupils refine their ability to write and answer questions accurately and built on the skills they had acquired when completing the paper version.

### **Commentary on specific teaching points**

The teacher used the activity to refine pupils' ability to observe, describe, think logically and group similar materials. She wanted to expand their experience of materials and to extend the scientific vocabulary they used to describe them.

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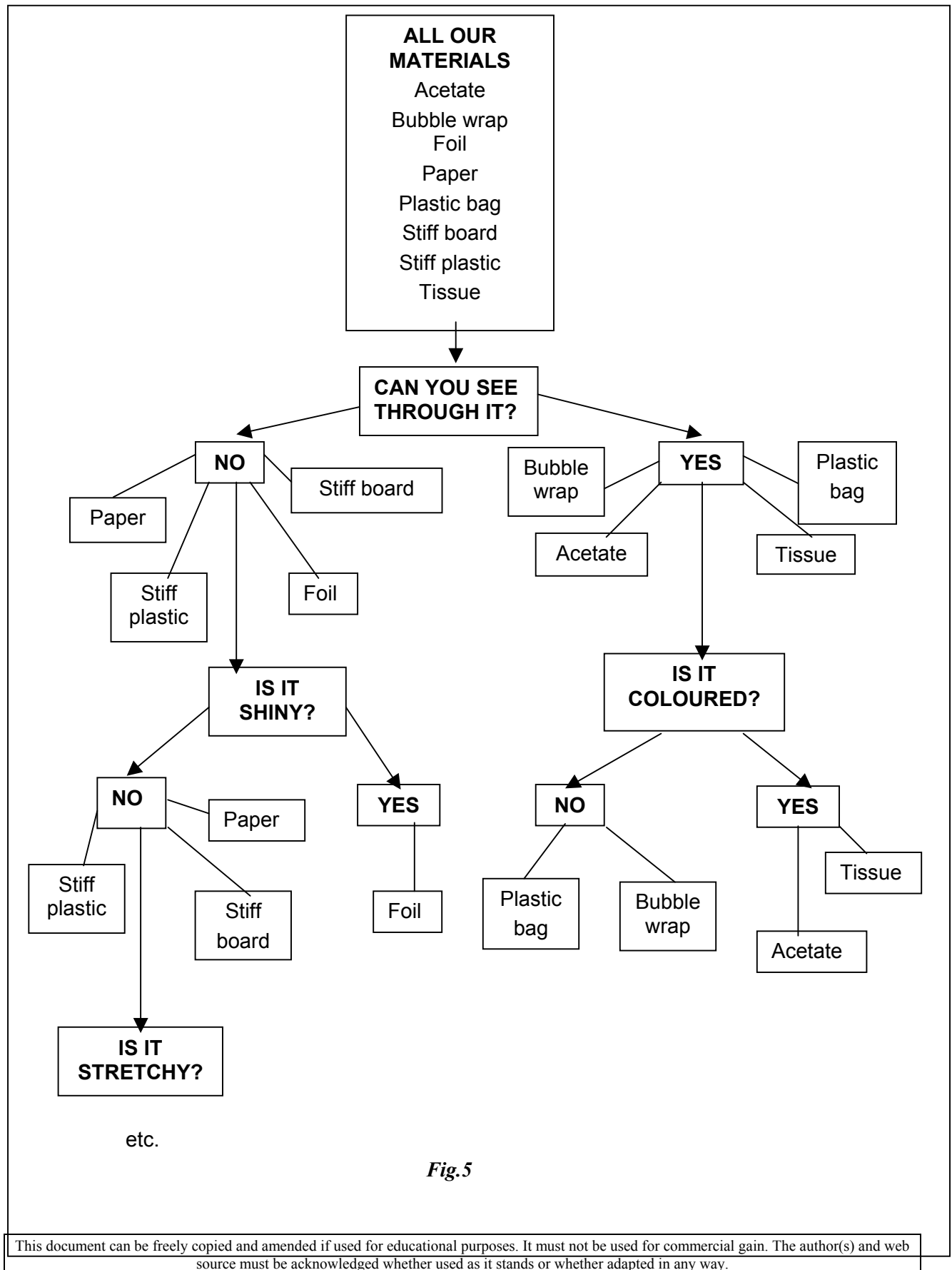


Fig.5

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### ***Step 3 – pupils learn that some materials change when they are heated***

Pupils soon realised that some materials were more appropriate for the making of drinking beakers than others. The teacher explained that the pottery drinking beakers were made from clay, just like the clay pupils had used before in the classroom. She showed pupils two drinking beakers, one before it had been fired and one after. Pupils were intrigued by the difference between the wet clay and the fired clay and asked lots of questions, e.g. *Where does the water go? If we add water to the fired clay, will it go back to wet clay again?* The teacher helped pupils decide on the type of information they would need to gather if they were to compare wet and fired clay, e.g. *What happens if you wet it? What happens if you put it in the sunshine? What does it feel like? What does it look like?* Each child then weighed two lumps of clay using a simple balance to make sure they were of equivalent mass. One lump of clay was made into a beaker to be fired. The other was kept in a plastic bag for later comparison. Before the beakers were fired, pupils weighed, measured and drew their drinking beakers. They repeated this once the drinking beakers came out of the kiln. Using a flip chart, the teacher then showed pupils how they could compare their pots easily by presenting information in a table. With pupils gathered around the computer screen, she then showed them how to use a simple computer program to create a bar chart from information entered into a spreadsheet of weight and size of the clay before and after firing. Pupils referred to their bar charts during a class discussion about the changes.

### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher wanted pupils to see graphically that the process of drying resulted in both a weight change and a change in size. The spreadsheet and graph allowed her to do this quickly and easily. She could have asked pupils to draw the graphs by hand but this would have been time-consuming, and the effort required for pupils to produce accurate graphs might have diverted their attention away from the scientific relationship she wanted to demonstrate. Drawing graphs was not an objective for this lesson; the use of ICT was a more efficient and effective way of meeting the scientific objectives.

The teacher might have used a flip chart or an OHP to show pupils the graph. In this case, use of a computer screen offered no significant advantage over other methods, so she chose the most convenient. She would have preferred to use a large screen for whole-class teaching but she didn't have one, so by working with part of the class only at a time, she ensured that all pupils could see the material on the standard monitor clearly.

### **Commentary on specific teaching points**

The teacher emphasised the need for the test to be fair if the comparisons made were to be valid.

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***Step 4 – pupils use thermometers to measure temperature***

In this step, the teacher built upon pupils' interest in the ways in which materials are used for specific purposes. Referring to their earlier work, she revised with pupils the reasons they thought some drinking beakers were better at keeping liquids warm than others. She asked them how they could find out how cold or how warm something is. Most pupils knew that they would use a thermometer. The teacher then showed pupils how to use a digital thermometer. They used this to measure the temperature of warm water, cold water from the tap, water that had been outside in the sun, water that had been outside in the shade, and water that had been inside the classroom. The teacher wrote this data on the board, and then she reminded the class that the data could be put into a spreadsheet and made into a bar chart. With the class watching, the teacher supervised pupils as they entered their individual data into the spreadsheet. She then produced a graph showing the class results. Each child was given a printout of the bar chart and wrote a brief description to accompany it.

**Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher used digital thermometers, rather than standard glass/alcohol thermometers, because they were more convenient and safer to use. They gave accurate readings without the necessity for pupils to read a scale, and this meant that all the pupils could complete the task effectively.

**Commentary on specific teaching points**

The teacher's use of the spreadsheet to enter data with the whole class meant that pupils could see the bars "grow" as the data was entered, and gave the teacher the opportunity to assess pupils' understanding of how their findings related to the final graph and to undertake further teaching as necessary. The chart proved to be a very visual way for pupils to compare temperatures in different places. Pupils who found comparison of numbers difficult found it easy to compare the height of the bars.

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***Step 5 – pupils work further on temperature change***

On a cold morning, the teacher took pupils on a short walk around the school grounds to show them the ice that had formed on the school pond. They discussed how the drop in temperature had caused the water to turn into ice. Back in the classroom, pupils were given a bowl containing small cubes of ice. They observed the changes that took place as the ice melted. The teacher then set up two bowls of ice in the classroom. She placed a digital thermometer in each one and asked pupils to suggest two contrasting places they could keep the bowls to compare the rates at which the temperature of the contents of the two bowls rose. Pupils suggested that one should be put on a sunny windowsill and the other in a dark cupboard. Some pupils thought that the darkness of the cupboard would keep the ice solid. The teacher asked pupils to predict what would happen to the temperature during the day. Two pupils were to keep a record of the temperature of each bowl every half hour during the day. Following afternoon break, pupils read out their results and the teacher put the data onto a spreadsheet. The next morning she gathered the pupils around the computer and showed them the bar chart for the ice that had been left in the sunshine. This was discussed and printed. The pupils were asked to add a sentence explaining what had happened. The teacher, helped by pupils, then printed a chart that showed what had happened to the temperature of the bowl left in the cupboard. Pupils were asked to compare the way in which the two bowls had warmed, by placing both bar charts side by side. Later, the higher-achieving pupils were able to combine both sets of data to show the bars side by side.

**Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher decided to use the graphing program to display pupils' results because the gathering of the results had taken a long time and she felt that further time spent drawing the bar chart would detract from the pupils' identification of patterns in their results.

**Commentary on specific teaching points**

The teacher wanted pupils to realise that the change from ice to water was dependent solely on temperature, and emphasised this as she discussed the outcomes. She also took the opportunity to develop pupils' skills of prediction and measuring. She wanted to help pupils to understand the relationship between the measuring they had done and its graphical representation and to help them to interpret the bar charts.

At this point the teacher reviewed her teaching objectives for the unit to check that they had all been met.

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### CASE STUDY 3: YEAR 6 PUPILS STUDY FORCES

This is an example where children in a mixed ability Year 6 class studied balanced and unbalanced forces. The teacher used **1998 QCA Scheme of Work unit 6E – Balanced and unbalanced forces** ([www.standards.dfes.gov.uk/schemes/science/sci6e](http://www.standards.dfes.gov.uk/schemes/science/sci6e)) to structure her work. Several teaching objectives taken from the QCA unit of work are listed below.

#### Teaching Objectives for a unit of work (Year 6)

For pupils to learn:

- i. to make repeat measurements;
- ii. to consider patterns in results;
- iii. to represent data in line graphs;
- iv. to use results to draw conclusions;
- v. that forces can be measured in newtons;
- vi. that how much an elastic band stretches depends on the force acting on it;
- vii. that when an object is submerged in water, the water provides an upward push on it;
- viii. that when an object floats, its weight acting downwards is balanced by the upthrust from the water;
- ix. that air resistance slows falling objects.

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### **Pupils' National Curriculum references**

This case study focuses on the following areas of the pupils' National Curriculum for primary science at KS2:

#### **Experimental and Investigative Science**

Pupils should be taught:

- 1.d** that changing one factor and observing or measuring the effect, whilst keeping other factors the same, allows a fair test or comparison to be made;
- 2.c** to check observations and measurements by repeating them;
- 3.a** to use tables, bar charts and line graphs to present results;
- 3.b** to make comparisons and to identify trends or patterns in results;
- 3.c** to use results to draw conclusions;
- 3.d** to indicate whether the evidence collected supports any prediction made;
- 3.e** to try to explain conclusions in terms of scientific knowledge and understanding.

#### **Physical Processes**

Pupils should be taught:

- 2.b** that objects have weight because of the gravitational attraction between them and the earth;
- 2.c** about friction, including air resistance, as a force which slows moving objects;
- 2.d** that when springs and elastic bands are stretched they exert a force on whatever is stretching them;
- 2.g** that forces acting on an object can balance, *e.g. in a tug of war, on a floating object*, and that when this happens an object at rest stays still;
- 2.h** that unbalanced forces can make things speed up, *e.g. an apple being dropped*, slow down, *e.g. a shoe sliding across the floor*, or change directions, *e.g. a ball being hit by a bat*.

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### Background information and notes

- i. This unit was carried out by a mixed-ability Year 6 class in an urban school. The class had a high proportion of able pupils.
- ii. The teacher had the use of two computers for each session, with occasional access to three other machines.
- iii. The pupils had used a simple database to collect information and to plot bar charts as part of their work in geography in Year 3, but they had not used spreadsheets before.
- iv. The teacher had not used spreadsheets before using them in this unit of work. She had taught about forces before, and had found that the large amount of data that pupils collected often made it difficult for them to see the patterns necessary for them to understand the scientific principles. Also, drawing graphs from the data pupils collected was time-consuming and often became the focus of the lesson, rather than interpreting the information shown on the graph. When the teacher discussed this with the school's science co-ordinator, he suggested that using a spreadsheet to collect and analyse the data would solve many of these problems. The teacher asked the ICT co-ordinator to spend some time with her introducing her to spreadsheets. She then practised on her computer at home, using the NGfL Virtual Teacher Centre to find information on spreadsheets and how they could be used in science.
- v. She used the **QCA Scheme of Work unit 6E – Balanced and unbalanced forces** as the basis for her work but was aware that pupils might not be aware that the activities were linked by the theme of forces. She wanted to make the theme of the work explicit to pupils from the outset.

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**Sequence of work in order to meet stated teaching objectives**

N.B. The unit of work is set out in logical steps. These do not necessarily correspond to lessons.

***Step 1 – teacher preparation***

The teacher prepared in advance two tables [Figs. 6 and 7] within the spreadsheet program which pupils would use later to collect data. One had spaces for pupils to record the name and weight of each object; the other allowed both the weight and the mass of the object to be recorded. She adjusted the font size of the column headings, and made the headings bold so that pupils could read them more easily.

<b>Object</b>	<b>Weight (N)</b>

*Fig. 6*

<b>Object</b>	<b>Weight (N)</b>	<b>Mass (g)</b>

*Fig. 7***Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

Pupils could have drawn out the tables for themselves, but the teacher wanted them to spend as much time as possible focusing on interpretation of their results to aid their understanding about forces. Because she had set up the spreadsheet on the computer in advance, pupils were able to enter their measurements directly, rather than writing them on paper first and then transferring them to the computer.

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### ***Step 2 – pupils measure the pull of gravity***

The teacher asked pupils to measure the pull of gravity on different objects in the room. She provided them with a range of force meters calibrated in newtons. Pupils chose the best force meter to measure the weight of each object and entered their measurements directly into the two-column table on the computer [Fig. 6]. The teacher then used the graphing facility of the spreadsheet to produce a bar chart of pupils' results, organised from heaviest to lightest. She printed out and then enlarged the graph using a photocopier. She then discussed what the graph showed with the whole class.

### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The graphing facility on the spreadsheet package enabled the teacher to produce a graph of pupils' results quickly and easily, rather than spending time on drawing it. Drawing graphs was not an objective for this lesson. If it had been, the teacher would have asked pupils to construct the bar chart manually. However, she judged that pupils had had plenty of experience of drawing bar charts in previous years and understood the principles well. She felt that the time could be better spent on interpreting the graph.

The teacher printed out the graph and then enlarged it so that all the pupils could see it clearly. If she had had a large computer monitor, she would have conducted the whole class session directly on the screen. This would have offered the advantage of allowing her to manipulate the data or change the graph in response to pupils' suggestions or questions, or to make particular teaching points.

The teacher did not have access to digital force meters, though if she had she would have used them. She felt that the digital display would have made taking accurate readings easier and would therefore have made the task accessible to more pupils.

### **Commentary on specific teaching points**

While pupils were taking measurements, the teacher reminded them that the weight of an object was a force, measured in newtons, and that this was a measure of the force exerted by each object. She illustrated this by asking pupils to look at the way the spring on the force meter stretched.

She discussed the appropriateness of pupils' choice of force meters and encouraged them to take accurate readings. When looking at the graph with the class, she re-emphasised that the heaviest objects were those exerting the greatest force.

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### ***Step 3 – pupils investigate the relationship between the weight and the mass of an object***

This activity was carried out by the average and higher-attaining pupils in the class.

The teacher gave pupils standard masses (e.g. 100g, 200g, 500g, 550g) and pre-weighed objects, e.g. bags of sugar and other groceries with masses printed on the packaging. Again pupils were asked to find the weight of the object in newtons and to enter their findings directly into the three-column table on the computer [Fig. 7]. She then used the graphing facility of the spreadsheet package to plot force against mass and to produce a scattergram of pupils' results. She asked pupils if they could see any patterns in the data.

#### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

If pupils were to see the pattern (a straight line), the points on the scattergram had to be plotted accurately. Because this group was smaller, the teacher was able to conduct the whole class lesson around the standard monitor and to demonstrate the line of best fit in response to pupils' suggestions. If she had wanted to work in this way with the whole class, she might have used a larger monitor, to make sure that all pupils could see. As in Step 2, the teacher judged that the graphing facility on the spreadsheet package enabled her to produce a graph of pupils' results quickly, rather than spending time on drawing it. Drawing graphs was not an objective for this lesson. If it had been, the teacher would have asked pupils to construct the bar chart manually. However, she judged that pupils' time could be better spent on interpreting the graph.

#### **Commentary on specific teaching points**

Pupils noticed that the line of best fit was a straight line through the origin. Two readings did not fit this pattern. The teacher asked pupils why these might be anomalous. Pupils re-checked their readings for these objects. She made sure that pupils understood the implications of the straight line they had obtained, i.e. that as the mass of an object increases so does its weight. She asked pupils to use the line graph to predict the weight of objects of different masses, e.g. 700g. Pupils checked their predictions using the force meter. The teacher talked to pupils about gravity as a constant force. They discussed why it was constant, what it was on Earth, and whether it was the same elsewhere.

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***Step 4 – pupils learn about the pull of gravity on the Moon***

The teacher showed the children a short video clip of astronauts on the Moon taken from a CD-ROM. The class discussed the pull of the Moon's gravity. The teacher explained that the pull of gravity on the Moon was approximately one-sixth of that on the Earth. Children then weighed themselves with a bathroom scale calibrated in newtons, recorded this and then calculated their weight on the Moon. They then calculated the weight of a dog on the Moon, given its Earth weight, and the weight of their teacher on the Moon. They incorporated what they had learned into a short account of what it would feel like to walk on the Moon.

**Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The video clip was taken from a CD-ROM. The teacher could have used a similar clip from commercial video tape or a recording of a school science broadcast but this could not be found as easily as the CD-ROM clip. Pupils were just able to see the clip on the standard size monitor, but would have had a better view if a bigger monitor had been available. The use of the video clip gave pupils an excellent illustration of the effects of reduced gravity, much better than could have been achieved by teacher exposition or reference to still pictures in textbooks. The constant of the Moon's gravity to the Earth's is 0.165:1. The teacher therefore allowed pupils to use calculators to calculate their weight on the moon, since mental or paper-based division of numbers was not a objective for this lesson. The teacher wanted pupils to obtain an accurate figure as quickly as possible so that they could concentrate on the science objectives. The teacher was tempted to let pupils use the spreadsheet again to do the calculation but she decided not to, since calculators enabled pupils to do this simple job very easily.

**Commentary on specific teaching points**

The teacher explained that the reason why astronauts could jump so high was because gravity on the moon was pulling less hard than on Earth, and she reminded pupils that it is gravity that determines the weight of an object or person. The teacher was aware that some pupils might be sensitive about their weight and therefore handled this activity very carefully.

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### ***Step 5 – pupils apply forces to everyday materials***

Pupils were shown several stretchy materials and, focusing on the stretchiness of the material, asked to identify things that they would like to find out about them. Through discussion with the whole class they identified four questions:

- i. which of a range of materials was most stretchy?
- ii. what would happen to a length of stretch fabric as more mass was added?
- iii. would narrow strips of a material stretch more easily than wider strips?
- iv. which elastic band would stretch most?

The teacher discussed how pupils would find answers to their questions and asked groups to design a “fair test” to answer one of the questions. Each group designed their own table to record their results. The teacher took one group’s results for each of the four tests and entered the results onto a spreadsheet. She then used the graphing facility of the spreadsheet package to demonstrate to pupils how they could produce a graph from each set of results. She discussed the graphs produced with the class.

### **Teacher’s decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

Although the teacher did not want pupils to spend time plotting graphs in this activity, she did want to remind them about some important points when using graphs to display data in science: for example, the appropriateness of different graphical forms for different kinds of data, or which variable should be put along the  $x$  axis and which should be put along the  $y$  axis. The graphing facility allowed her to move between scattergrams, bar charts and line graphs at will, and to swap axes instantly. This would not have been possible without the ICT.

### **Commentary on specific teaching points**

The teacher reminded pupils that their tests should be fair. She helped pupils to construct their tables to record their results, where necessary.

When pupils were looking at graphs from their results, the teacher was anxious that they should consider the kind of graph they would draw from their results, as well as what they could deduce from looking at the graph. For example, in investigation i. the teacher asked pupils, “*Can we draw a line graph from the first set of results?*” because she wanted them to realise that their results showed discrete variables (i.e. whole integers) and could therefore only be represented as a bar chart.

She wanted pupils to identify the independent variable and to understand that this must go on the  $x$  axis so she asked pupils, “*Which axis should have the weight on it, and which should have the amount of stretch on it?*”

She wanted pupils to look at other features of the graphs, such as the steepness of the line, and to understand what this told them about their materials: “*We have results for thin red nylon and thick black nylon – which of these two lines shows which?*”

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**Step 6 – pupils investigate floating forces**

The teacher asked the children what they thought would happen to the reading on a force meter when the objects being weighed were in water. They recorded and discussed their predictions. The teacher then asked pupils to come forward and weigh different objects, first in air and then in a plastic aquarium filled with water. Once they had weighed their object, they entered their result on a table [Fig.8] that the teacher had drawn on a flip chart. The class worked out the difference between the two weights and this was entered in the table too.

object	weight in air	weight in water	difference

**Fig. 8****Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher decided not to use ICT in this session, as it offered no advantage in meeting the teaching objectives. Pupils used calculators to work out the difference between weights quickly and accurately. When the figures were easier, the teacher encouraged pupils to work out the differences using mental methods, and to check one another's answers.

**Commentary on specific teaching points**

The teacher had discussed buoyancy, floating, sinking and upthrust with the class following their swimming lessons. Whenever relevant, she related this work to the things they had noticed while swimming.

She explained the differences in the readings to the class, i.e. that when an object is submerged in water, the water provides an upward push on it; and that when an object floats, its weight acting downwards is balanced by the upthrust from the water.

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### ***Step 7 – pupils investigate air resistance***

The teacher organised four groups to explore different aspects of air resistance:

- i timing the fall of spinners (gyrocopters) with wings of different length;
- ii measuring the distance travelled by a car off a ramp with different sizes of card air brakes;
- iii timing the fall of parachutes of different areas and with different paperclip masses from the second storey of the school;
- iv measuring the distance that sheets of A4 paper, screwed up into different diameter balls, can be thrown.

She emphasised that each group doing practical activities should repeat their tests three times to check results. Each group entered their results directly onto a spreadsheet with three cells for each main variable in the experiment and a fourth cell that automatically averaged the results to one decimal place. At the end of their session, the children were shown how to present either bar charts or, where appropriate to each activity, line graphs.

#### **Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher decided to use a spreadsheet here, as she wanted the children to make three readings for each main variable in the experiment. She did not want the children to get bogged down in calculations and recording. She wanted them to use their graphs in drawing conclusions from their results, and felt the speed at which the computer could produce graphs helped them to focus on this.

#### **Commentary on specific teaching points**

The teacher related these investigations to pupils' own experiences: for example, during the cycling proficiency course some pupils had noticed that they could not cycle fast in a headwind and had to lean forward; also, pupils had studied the way winged seeds were dispersed from trees.

The teacher emphasised that she wanted the children to ensure that their tests altered only one variable at a time. She also explained why she wanted each group to take three readings, saying that she had put a formula into the fourth cell that calculated the mean automatically. She asked the higher-achieving pupils who finished early to extend the investigations, e.g. looking at spinners carrying different masses, or investigating water resistance. In these cases pupils designed the spreadsheet to record their results themselves.

The teacher selected the activities carefully, knowing that each would produce data that could be used to draw a line graph.

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***Step 8 – pupils use simulations to help apply and clarify their ideas***

The teacher used a program on the computer that simulated the speed of fall of different sizes of parachutes. She scheduled groups to use the program on the classroom computers over a week. She emphasised that they were to predict the results of their virtual experiments before carrying them out. She asked each group to write a brief collaborative report on what they had learned from using the program.

**Teacher's decisions about whether or not to use ICT in meeting the teaching and learning objectives and justifying and explaining any use of ICT**

The teacher did not want the “virtual lab” work to replace the practical activities, but she felt that carrying out experiments on the computer was a good way to enable the children to predict and hypothesise using their knowledge of air resistance. They would get instant feedback to reinforce their learning of how air resistance operates.

**Commentary on specific teaching points**

The teacher wanted each group to predict and explain what was going to happen in each instance presented by the computer. She emphasised that the children did not need to complete every task as she was more interested in the reasons they gave to support their ideas.

At this point the teacher reviewed her teaching objectives for the unit to check that they had all been met.

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## Section Four

### Further useful information: primary science

This section lists other sources of examples of the use of ICT in teaching primary science, together with some addresses, to help trainers obtain further useful information and advice.

#### **Publications available from the Teacher Training Agency**

Publications line: 0845 606 0323

Initial Teacher Training National Curriculum for the use of Information and Communications Technology in subject teaching TTA 1998  
[Annex B of DfEE Circular 4/98]

Initial Teacher Training National Curriculum for primary science TTA 1998  
[Annex E of DfEE Circular 4/98]

Initial Teacher Training National Curriculum for secondary science TTA 1998  
[Annex H of DfEE Circular 4/98]

Assessing Your Needs in Literacy, Mathematics and Science: Needs Assessment Materials for Key Stage 2 Teachers [CD-ROM]

ICT Identification of Your Training Needs: Primary Disc [CD-ROM]

#### **Publications available from the Department for Education and Employment**

Publications line: 0845 602 2260

DfEE Circular 4/98: Teaching: High Status, High Standards 1998

#### **Publications available from the British Educational Communications and Technology Agency (BECTa)**

Publications line: 024 7641 6669

Information Technology in English Schools: a commentary on inspection findings 1995/96  
NCET/OFSTED 1997 £3.95 ISBN: 1 853 794 066

Approaches to IT Capability: Key Stage 1 & 2 NCET 1995 ISBN: 1 853 793 221  
*This consists of a handbook that gives guidance on implementing and assessing ICT and contains science-specific examples.*

IT's primarily science: how computers can help in Key Stage 2 science NCET 1994  
*Covers communicating science, starting science, using data in science and collecting data in science.*  
Available on-line at: [www.vtc.ngfl.gov.uk/resource/cits/science/prfocus/itprim/prsciin.html](http://www.vtc.ngfl.gov.uk/resource/cits/science/prfocus/itprim/prsciin.html)

Primary science investigations with IT: using IT to support Key Stage 2 science NCET 1994  
ISBN: 1853792985  
Also available on-line at: [www.vtc.ngfl.gov.uk/resources/cits/science/prfocus/psinvest/psiindex.html](http://www.vtc.ngfl.gov.uk/resources/cits/science/prfocus/psinvest/psiindex.html)

source must be acknowledged whether used as it stands or whether adapted in any way.

### **Publications available from the Association for Science Education**

IT in primary science: a compendium of ideas for using computers and teaching science R Frost ASE 1995

### **Journals**

Subject-specific periodicals and journals and the educational and national press include articles on the use of ICT in primary science teaching from time to time. The following may be particularly useful:

Primary Science Review Association for Science Education 5 issues per year

### **Useful Web sites**

- National Grid for Learning (NGfL)  
National Grid for Learning – Learning Resource Index of Web sites  
National Grid for Learning – Museums and galleries section  
*The NGfL is the national focal point for learning on the Internet.*  
Web site: [www.vtc.ngfl.gov.uk/resource/cits/science/resource/res\\_ind.html](http://www.vtc.ngfl.gov.uk/resource/cits/science/resource/res_ind.html)
- Virtual Teacher Centre (VTC): Using ICT in Science  
Web site: [www.vtc.ngfl.gov.uk/resources/cits/science/index.html](http://www.vtc.ngfl.gov.uk/resources/cits/science/index.html)
- Virtual Teacher Centre conferencing site  
Web site: [www.forum.ngfl.gov.uk/cgi-bin/WebX?vtc](http://www.forum.ngfl.gov.uk/cgi-bin/WebX?vtc)
- BECTa Educational Software Database  
Web site: [www.vtc.ngfl.gov.uk/resource/est/](http://www.vtc.ngfl.gov.uk/resource/est/)
- BECTa CD-ROM reviews  
Web site: [www.becta.org.uk/projects/cd-roms/](http://www.becta.org.uk/projects/cd-roms/)
- BBC primary science site – on-line learning resources for 5-11 year olds  
Web site: [www.bbc.co.uk/education\\_webguide/pkg\\_main.p\\_results?in\\_cat=38](http://www.bbc.co.uk/education_webguide/pkg_main.p_results?in_cat=38)
- Science Museum on-line Education Service and a gateway to other sites  
Web site: [www.nmsi.ac.uk/education.html](http://www.nmsi.ac.uk/education.html)
- SCICentre (University of Leicester & Homerton College Cambridge)  
*Promotes the accurate understanding of scientific concepts and skills, including ICT skills, in newly qualified primary school teachers.*  
Web site: [www.leicester.ac.uk/education/centres/sci/SCICentre.html](http://www.leicester.ac.uk/education/centres/sci/SCICentre.html)

### **E-mail groups**

- Sci-ed-inet  
*Mailbase list for research on use of the Internet for science education in the UK; intended to bring together teacher trainers and others providing science education content/activities on the Internet.*  
Web site: [www.mailbase.ac.uk/lists/sci-ed-inet/](http://www.mailbase.ac.uk/lists/sci-ed-inet/)

**Organisations to contact for advice on the use of ICT in primary science teaching**

Association for Science Education (ASE)  
College Lane Hatfield Hertfordshire AL10 9AA  
Tel: 01707 267411 Fax: 01707 266532  
Email: ase@asehq.telme.com Web site: www.ase.org.uk

Association of Science Education Tutors (ASET)  
Dr Clive Buckley School of Education and Humanities North East Wales Institute of HE  
Plas Coch Campus Wrexham LL11 2AW  
Web site: www.newi.ac.uk/aset/aset.htm

British Association for the Advancement of Science  
23 Saville Row London W1X 2NB  
Tel: 020 7973 3500 Fax: 020 7973 3051  
E-mail: elaine.stanley@britassoc.org.uk Web site: www.britassoc.org.uk

**General contacts for the use of ICT in subject teaching**

British Educational Communications and Technology Agency (BECTa)  
Milburn Hill Road Science Park Coventry CV4 7JJ  
Tel: 024 7641 6994 Fax: 024 7641 1418  
E-mail: Becta@becta.org.uk Web site: www.becta.org.uk

British Film Institute  
21, Stephen Street London W1P 2LN  
Tel: 020 7957 8918 Fax: 020 7436 0439  
E-mail: tony.slaughter@bfi.org.uk Web site: www.bfi.org.uk

Information Technology in Teacher Education (ITTE)  
c/o Moira Monteith School of Education Sheffield Hallam University City Campus Pond Street  
Sheffield S1 1WB  
Tel: 0114 272 0911  
E-mail: m.c.monteith@shu.ac.uk

Micros and Primary Education (MAPE)  
Cilgeraint Farm St. Ann's Bethesda Gwynedd LL57 4AX  
Tel/Fax: 01248 602 655  
Web site: www.mape.org.uk

National Association of Advisers for Computers in Education (NAACE)  
PO Box 60 Tipton West Midlands DY4 0YS  
Tel: 0121 530 9732 Fax: 0121 530 9732  
E-mail: mikesmith@rmplc.co.uk Web site: www.naace.org

Qualifications and Curriculum Authority (QCA)  
29 Bolton Street LONDON W1Y 7PD  
Tel: 020 7509 5555  
E-mail: info@qca.org.uk Web site: www.qca.org.uk

Teacher Training Agency (TTA)  
Portland House Stag Place LONDON SW1E 5TT  
Tel: 020 7925 3700 Fax: 020 7925 3792  
E-mail: [enquiry@teach-tta.gov.uk](mailto:enquiry@teach-tta.gov.uk) Web site: [www.teach-tta.gov.uk](http://www.teach-tta.gov.uk)

<http://www.tta.gov.uk/assets/teaching/ict/exemplification/psci.doc> downloaded 15/12/03

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**Notes of additional useful contacts**

(e.g. LEA intranets, partner school Web sites, discussion group and conference sites)

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