

## Embedding ICT @ Secondary



# Use of interactive whiteboards in science

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# Section 1: Getting started



## 1.1 Introduction

Your interactive whiteboard has arrived in your classroom. You have had some technical training from the whiteboard's suppliers and you are ready to go. This booklet aims to help you take the first steps in using the whiteboard to support your teaching of science. You should find enough support here to get started, after which, we hope, you will soon find using the whiteboard both easy and exciting.

*'I was really excited when I first realised I was getting an interactive whiteboard in my classroom. However, it was rather a challenge quite knowing where to start. The company that sold the whiteboard gave us some really motivating training and I became very excited about the possibilities, but I still wanted some further support to use it effectively in lessons to improve my teaching.'*

*'For the first few weeks I just used it in the same way as my old whiteboard – for writing on in handwriting. But I knew that I could save what I had written and I slowly started to revisit work we had already done. I could see that I could do so much more with the interactive whiteboard. A group of us who had the boards met and the people who had had them longest talked about them and demonstrated what they could do. This made me much more confident about trying different things.'*

*'I started to add pictures and text and found some great resources online. I also started to use some CD-ROMs that we had in the department and in the library. I am feeling my way gradually and I can see the long-term benefits in using this technology.'*

## 1.2 What is an interactive whiteboard?

An interactive whiteboard is simply a surface onto which a computer screen can be displayed, via a projector. It is touch-sensitive and lets you use a pen on it (or in some cases, a finger) to act like a mouse, controlling the computer from the board itself. Changes made to information projected onto the whiteboard are transferred to the computer and can be saved and retrieved in future lessons. Everything that can be displayed on a computer can be projected onto the whiteboard and, if the computer is linked to

speakers and a DVD or video player, multimedia resources can be incorporated too. If the board is connected to the Internet, teachers can have immediate access to appropriate websites to enhance work in the lesson.

There are two main types of interactive whiteboard. Hard boards have a hard magnetic surface behind the screen and need special pens to write on them. Soft boards have a tough membrane on the surface which can be written on with a finger or a special pen. Most interactive whiteboards are supplied with specific software tools to exploit the potential of the board.



## The basics

The best way to understand how a whiteboard works is simply to find one and to have a try. You will find that it is easy to control the computer from the board itself. The most important point to understand is that anything that works on the computer will work on the interactive whiteboard too.

Certain items of equipment are needed to use the different features of interactive whiteboards.

- **Essential pieces of equipment are:** the interactive whiteboard and supplied software, computer and data projector.
- **You should also consider:** additional software, speakers, multimedia, remote input devices such as a keyboard, gyromouse or voting devices.

Other issues that need to be taken into account are:

- Installation
- Maintenance/warranty
- Security
- Networking to the school network and the Internet

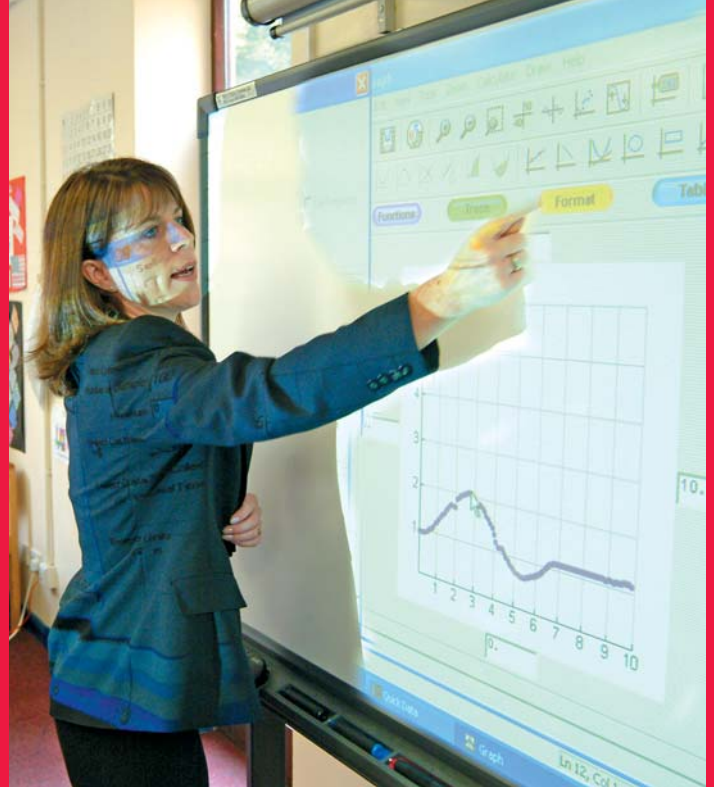
It is important to remember that there are likely to be additional costs that need to be allowed for when using an interactive whiteboard. For example, replacement projector bulbs are also needed. These are expensive but do last a long time.

For further advice on these issues and procurement visit  
[www.whiteboards.becta.org.uk](http://www.whiteboards.becta.org.uk)

*'When we first looked into getting an interactive whiteboard for our department, we realised that we needed to take into account not just the costs of the board itself, but also the cost of the computer, the projector, speakers and training for staff. We were also really keen to be linked to the Internet but the classroom we wanted to use wasn't wired up for that, so it took a few months to sort out.'*

*'It all seemed to be going well until the bulb in the projector blew. We didn't have any in stock and one had to be ordered. It took a couple of weeks to arrive and it was quite expensive. Those of us who had become used to using the whiteboard felt lost without it.'*

## Section 2: Why use an interactive whiteboard?



Interactive whiteboards have the potential to improve teaching and learning in a variety of ways. In this section, we will focus on three key areas:

### **1. Presentation, demonstration and modelling**

How the use of appropriate software and resources in combination with the interactive whiteboard can improve understanding of new concepts.

### **2. Actively engaging pupils**

How pupils' motivation and involvement in a lesson can be increased through the use of the interactive whiteboard.

### **3. Improving the pace and flow of lessons**

How the use of an interactive whiteboard can improve planning, pace and flow in lessons.

## 2.1 Presentation, demonstration and modelling

An interactive whiteboard is a valuable tool for whole-class teaching. It is an outstanding visual resource that can help teachers to present lessons in lively and engaging ways. It allows information to be presented using a wide range of resources, which can then be annotated by teachers and pupils to clarify and refine understanding. It can facilitate explanations of models by both teachers and pupils and contribute to an understanding of what happens to a model if a variable or rule is altered.

Teachers can use the board to demonstrate and present ideas in exciting and dynamic ways. The boards also allow pupils to interact with the new learning that is being demonstrated, as well as providing a valuable tool for teachers to model abstract ideas and concepts. Teachers can change what they put on the board easily, or move an object to a different place, making new connections. They will be thinking aloud as they carry out the process, making what they are doing transparent to pupils. They will gradually involve pupils, who can then add their own ideas to the board.

## 2.2 Active engagement

Evidence suggests that the interactive whiteboard 'increases enjoyment of lessons for both students and teachers through more varied and dynamic use of resources, with associated gains in motivation' (Levy 2002).

The careful use of a whiteboard can support teachers in effective questioning. Well-judged questioning, which is aimed at pupils refining their ideas and posing new questions, helps them to deepen their understanding of the concept or idea.

It can provide a focus and impetus to class discussions managed by the teacher and give stimulus to small group work. The whiteboard provides an engaging focal point in the classroom. It also supports a good pace in teaching, as all the resources are prepared in advance of the lesson and are instantly available.

areas highlighted and colour added. In addition, sections of text, pictures or diagrams can be concealed then revealed at key points during the lesson. This is done with teachers or pupils at the front of the room and becomes the focal point of the class' attention.



## 2.3 Improving the pace and flow of lessons

The use of interactive whiteboards allows for the creative and seamless use of materials, as lessons or topics can be structured around a single file. Files or pages can be prepared in advance and used to link to other resources deployed in the lesson. Teachers say that preparing lessons around a single file helps with planning and assists the flow of the lesson. It also allows for reflection after the lesson.

'It is very useful as a means of planning on the basis of past teaching and, following review with colleagues, we can share, adapt and develop according to needs' (teacher quoted in Glover and Miller 2001).

Objects and text can be moved around easily using the whiteboard, diagrams labelled, text, pictures and diagrams annotated, key

Pre-preparing text, charts, diagrams, pictures, music, maps, subject-specific CD-ROMs as well as including hyperlinks to multimedia files and the Internet can give lessons a crisp pace, as no time is wasted writing on the board or moving between keyboard and screen. These pre-prepared resources can be annotated on screen if required, using the handwriting tool, and saved for future use. Files from previous lessons can then be recalled to help with reinforcing previous learning.

These strategies can also engender a greater sense of involvement and engagement in the lesson in the pupils. The work they do on the board can be saved and referred to later. Flip charts or pages can be stored at the side of the board as thumbnails and the teacher can move backwards to an earlier section, if need be, to reinforce learning for the whole class or a small group. Pupils who are unclear about what has been taught can refer back to teaching points from earlier parts of the lesson.

## 2.4 What the research says

These benefits of whiteboard use have been highlighted in Becta's publication, *Getting the Most from Your Interactive Whiteboard: A Guide for Secondary Schools*

### General benefits

- versatility, with applications for all ages across the curriculum (*Smith A 1999*)
- increases teaching time by allowing teachers to present web-based and other resources more efficiently (*Walker 2003*)
- more opportunities for interaction and discussion in the classroom, especially compared to other ICT (*Gerard et al 1999*)
- increases enjoyment of lessons for both students and teachers through more varied and dynamic use of resources, with associated gains in motivation (*Levy 2002*).

### Benefits for teachers

- enables teachers to integrate ICT into their lessons while teaching from the front of the class (*Smith H 2001*)
- encourages spontaneity and flexibility, allowing teachers to draw on and annotate a wide range of web-based resources (*Kennewell 2001*)
- enables teachers to save and print what is on the board, including any notes made during the lesson, reducing duplication of

effort and facilitating revision (*Walker 2002*)

- allows teachers to share and re-use materials, reducing workloads (*Glover & Miller 2001*)
- widely reported to be easy to use, particularly compared with using a computer in whole-class teaching (*Smith H 2001*)
- inspires teachers to change their pedagogy and use more ICT, encouraging professional development (*Smith A 1999*).

### Benefits for students

- increases enjoyment and motivation
- greater opportunities for participation and collaboration, developing students' personal and social skills (*Levy 2002*)
- reduces the need for note-taking through the capacity to save and print what appears on the board
- students are able to cope with more complex concepts as a result of clearer, more efficient and more dynamic presentation (*Smith H 2001*)
- different learning styles can be accommodated as teachers can call on a variety of resources to suit particular needs (*Bell 2002*)

- enables students to be more creative in presentations to their classmates, increasing self-confidence (*Levy 2002*)
- students do not have to use a keyboard to engage with the technology, increasing access for younger children and students with disabilities (*Goodison 2002*).

### Factors for effective use

- sufficient access to whiteboards so teachers are able to gain confidence and embed their use in their teaching (*Levy 2002*)
- use of whiteboards by students as well as teachers (*Kennewell 2001*)
- provision of training appropriate to the individual needs of teacher (*Levy 2002*)
- investment of time by teachers to become confident users and build up a range of resources to use in their teaching (*Glover & Miller 2001*)
- sharing of ideas and resources among teachers (*Levy 2002*)
- positioning the whiteboards in the classroom to avoid sunlight and obstructions between the projector and the board (*Smith H 2001*)
- a high level of reliability and technical support to minimise problems when they occur (*Levy 2002*).

## Section 3: Where do I go from here?



### 3.1 Planning to teach with an interactive whiteboard

Interactive whiteboards offer far greater potential for teaching than simply being used as electronic chalkboards. They can also enhance lessons more than a data projector and a computer used on their own. Using an interactive whiteboard to its full potential requires planning, and this will take time. However, lessons created for the whiteboard can be used again, with or without adaptations, which actually saves time in the long run. Whiteboards also allow for lessons to be improved and refined based on practice, and they are likely to benefit by being carefully structured to take full advantage of the whiteboard technology.

Interactive whiteboards offer a wide range of advantages in the teaching of all subjects. Many teachers say whiteboards have led them to plan collaboratively with other members of their departments, which has had the effect not only of saving time but also of improving the overall quality of what is produced.

Teachers interviewed also say that they feel their planning has improved because of the way the interactive whiteboard software allows them to structure their lessons before they teach them. The fact that lessons can be saved, complete with notes, and then easily altered, allows for improvement and refinement before the topic is taught again. Teachers can also create libraries of resources which build up as they use the whiteboard.

The range of content available for use with the whiteboard means that students sometimes grasp new ideas and concepts more quickly. This is partly due to the visual nature of the presentation, and partly because whiteboards offer ways of actively engaging pupils in activities. Teachers who have been using the boards for some time feel that the quality of some of their lessons has improved too.

It is not possible to say categorically that pupils' results will improve through the use of interactive whiteboards, but many teachers using them note that pupils are more engaged, more interested and more motivated. They discuss topics more and they seem to remember things better.

*'I guess it's almost impossible to say whether your teaching improves with a whiteboard and how far a pupil's success is attributable to the use of the board, but I know that I have seen improvements in my students' work.*

*'Their enthusiasm has definitely increased and I think that is because I am able to find more interesting and relevant resources. Let's face it, they watch TV and play with their computers at home, so I can understand their lack of interest in some of the text books we have.*

*'I was really worried at one point because I realised that last term we'd written a lot less down than we would normally do. There seemed to be more talk in class, but talk about what we were doing and what was on the board eg "What if we did this...?" or "How would it change if we did that?" I was still concerned about the lack of written work, but when the end-of-module test results came back they were actually better than they had been the year before. Pupils seemed to find it easier to remember what we did in class. Well, that has to be a bonus!'*

It is important to realise that using an interactive whiteboard on its own will not provide any magic solutions to problems. Nor should teachers feel obliged to use the whiteboard in every part of a lesson, or indeed in every lesson. Sometimes the whiteboard might only be used for a starter or a plenary. As with any resource, its use will have most impact when it is used appropriately to enhance teaching and learning.

Teachers need to understand the generic software that comes with the whiteboard and its potential for helping them to create curriculum resources. They also need to identify subject-specific resources that can enhance the work they are doing on the whiteboard; eLCs (eLearning Credits) are likely to be available to help them purchase these resources where necessary.

In summary, using an interactive whiteboard has the following advantages:

- The lesson can be pre-prepared, which can contribute to a brisker pace and, teachers report, more time for meaningful discussion.
- Links can be created from one file to another - for example, to a sound or video file or an Internet page. This saves time looking for another resource and keeps the lesson flowing smoothly. It allows for the integration of a variety of media, facilitating audio and visual tasks. This is particularly important in languages, where teachers are very aware of the value of pupils being able to see and hear language simultaneously.
- Structuring the presentation of new material around a series of pages demands a logical step-by-step approach that can enhance and enrich lesson planning.
- Files can be saved to the school network at the end of a lesson for pupils to access later. The files can be saved in their original format or as they appear at the end of the lesson, complete with annotations and final tasks. These can be a useful reference point for both teacher and pupils, to be drawn upon later for revision purposes.

## 3.2 Using software tools

In the introduction, we mention that an interactive whiteboard is, in part, a display board for your computer. This means that all the resources which are on your computer can be displayed on the interactive whiteboard.

This gives you the scope to use resources such as:

- Presentation software
- Word-processing software
- CD-ROMs
- The Internet
- Image files (eg photographs, drawings, diagrams, screenshots)

- Movie files (eg sections of video from television programs, VHS video cassettes or files from a digital movie camera)
- Links to sound files (such as sections from cassettes or radio or recorded by a pupil or member of the teaching staff). Any sound included in a CD-ROM or Internet page will also play, providing that speakers are attached.
- Whiteboard software, which has the additional advantage over presentation software that items can be moved on the screen.
- Subject-specific software.

available on a computer, eg colour, movement and sound, all of which are more difficult (but not impossible) to achieve in a traditional lesson.

It is probably the ease with which such features can be deployed that makes pupils say that the resources used on an interactive whiteboard are generally more 'exciting' than those used in 'traditional' lessons. However, teachers do often have to search around to find appropriate resources. Look at the **Further links and references** section of this publication for some ideas to help with finding suitable materials.

It is probable that lessons will involve a variety of these resources and that the teacher will pick and choose from what is available. Many of the resources listed above will take advantage of the features

In addition, most interactive whiteboards come with a useful range of generic functions which are likely to include some of the following:

Whiteboard function	Contribution to teaching and learning
Colour	The range of colours available on an interactive whiteboard allows teachers to use colour to indicate important areas for focus, to link similar ideas or to differentiate between ideas, or to demonstrate a process using colour. Examples of this might be a choropleth map in geography or a diagram of the digestive system in biology.
Annotations on the screen	These are useful for modelling thinking and for adding information, questions and ideas to text, diagrams or pictures on screen. Annotations can be saved, referred to again or printed off for pupils to use.
Inclusion of sound and video clips	This can significantly enhance learning in a lesson. The technology also allows screens from video clips to be captured and displayed as still images for discussion and annotation.
Drag and drop	This helps pupils to group concepts, identify advantages and disadvantages, identify similarities and differences, and label maps, pictures, diagrams, equipment for an experiment and much more.
Highlighting specific elements of the whiteboard display	Text, diagrams and pictures can be highlighted on the whiteboard, allowing teachers and pupils to focus on particular aspects of the display. It is often possible to cover part of the display and reveal it only when needed. This can be helpful when pupils are being expected to focus on just a part of a text or a picture. Some interactive whiteboard software includes shapes that can also be used to help pupils focus on a particular area. Sometimes, there is a spotlight facility which teachers and pupils can use to select and focus on a particular aspect of the lesson.



continued	continued
Cut and paste	Sections can be cut and erased on screen, copied and pasted, undone and redone. These features help give pupils the confidence to take risks, as they know they can always go back or make changes.
Flip chart pages	These pages can be turned backwards and forwards, allowing teachers to go over particular aspects of a lesson or to recap areas that some or all of the pupils may not have understood. Pages can be viewed in any order and images and text can be dragged from one page to another. It may also be possible to make a link between pages, so that a teacher can move between a general statement and a more detailed analysis.
Split screen	Teachers can split the screen and display two different sets of things at once. This can be useful when exploring what happens if particular changes are made.
Rotate objects	This allows objects to be moved so that pupils can see symmetry, rotation and reflection.
Linking a digital microscope to the screen	This can provide a greatly enhanced experience when it comes to examining and discussing microscopic images.

These features can add significant value to teaching with an interactive whiteboard. For example:

- Using the drag and drop feature
- Using annotation and highlighting

### Using the drag and drop feature

When using an interactive whiteboard, any item on the board can be moved to another position, using a technique called 'drag and drop'. This enables text or pictures to be moved anywhere on the board by pressing down on the item to be moved, holding it down and moving it, then releasing the pressure where you want it to stop – rather like moving a coin across the surface of a table. Using traditional methods, the same effect could be created by writing words on card or cutting out pictures and then sticking

them to a board. However, doing this on a computer is much less time-consuming, easier to manage and reduces the need to store paper-based resources.

Being able to move items on screen helps with activities such as:

- Matching
- Labelling
- Grouping
- Sorting
- Gap filling
- Ordering

Pupils can experiment by trying the task and, if their answers are incorrect, simply moving items and trying again. Pupils say they find this more motivating than doing a task on paper

where errors are permanent. There can also be a discussion based around what is on the interactive whiteboard. Using careful questioning, teachers can encourage pupils to explain their actions, thereby demonstrating their understanding and sharing their knowledge with the rest of the class.

Tasks using drag and drop are ideal for starters as they can be used to gain focus in the classroom. They can also act as revision from a previous lesson or a lead-in to the current lesson.

Drag and drop activities can also be useful during the main part of the lesson or plenary sessions, consolidating knowledge and applying the new knowledge and skills to other topic areas or providing a focus for extension.

### **Using annotation and highlighting**

With an interactive whiteboard, all the materials that can be accessed through a computer can be used in lessons, including charts, diagrams, animations, sound and video. The variety of materials enables a greater selection of teaching strategies and activities to be used and for a wider range of learning skills to be addressed.

When working at the interactive whiteboard, it is possible to take a pen and make notes, add comments, circle, underline or highlight anything that is on the board. How this is done depends on the type of board being used, but the key teaching advantage is that the interactive whiteboard can prompt greater discussion in the classroom, when supported by probing questions by the teacher. Of course, it is possible to underline and add notes on a traditional board. The advantages of using an interactive whiteboard are that:

- The notes are added to pages that have been prepared before the lesson.
- The notes can be kept once the lesson is finished, rather than erased.
- Different colours can be used as well as items such as a highlighter, which could only be achieved using an OHP slide with traditional methods.

The flexibility of the whiteboard for this type of activity provides greater engagement for pupils, especially kinaesthetic learners.

Notes and comments can be added over the top of anything that is displayed on the screen and then the notes can be saved within the file. This means that pupils can access the file later or pages can be printed for the pupils' notes. This technique can be adapted to a variety of tasks – any task that involves sorting, matching, grouping or ordering items can be done effectively on the interactive whiteboard.

## Section 4: Pedagogy and the interactive whiteboard

The teaching and learning strategies you need to use when teaching with interactive whiteboards will not be unfamiliar. The features that make for successful lessons are the same, regardless of the technology or equipment you use. Successful lessons are well-designed and well-structured. They have clear learning objectives and outcomes and are broken into teaching episodes. This structure helps pupils to understand the content of the lesson and to relate it to what they already know.

The Key Stage 3 Strategy publication **Pedagogy and Practice: Teaching and Learning in Secondary Schools** sets out the characteristics of the teaching episodes in a typical lesson. These include:

- A starter activity.
- An introduction outlining the purpose and objectives of the lesson.
- The introduction of new learning or the introduction of a task. Typically, this will be the main area of whole-class teaching and may be repeated at different points of the lesson.
- The development of the learning by pupils.
- Plenaries at the end or during the lesson, providing opportunities to review what has been learned and reflect on the learning process.

The lesson structure is the same, whether or not an interactive whiteboard is used. Some aspects of lessons, however, can be enhanced by the boards. For example, the interactive whiteboard is particularly useful when using a style known as inductive teaching, in which pupils are expected to reach hypotheses based on sorting, classifying and re-sorting information.

The teacher can model different ways in which information might be classified using the features of the board, such as moving objects, and using colour and highlighting, while bringing pupils into the process. Pupils can

then work in small groups away from the board, taking the classification process further. They can be drawn back to the board at intervals so that different groups can present their thinking to the class for discussion, before continuing with the task.

The following section shows the phases in a typical lesson and looks at the contribution that an interactive whiteboard can make to each phase. However, this contribution ultimately depends on the materials used and how teachers exploit them, as well as how they interact with the pupils. The role of the teacher is still central in an effective lesson. The appropriate use of an interactive whiteboard can significantly support effective teaching.

The case studies give some examples of how interactive whiteboards could be used in science to enhance learning and teaching during the different episodes of a lesson. Remember that these are only examples and that interactive whiteboards offer many more possibilities than suggested here.

## 4.1 Using an interactive whiteboard for a starter activity

Teachers can use the dynamic nature of interactive whiteboards in a lively and engaging way in starter activities. Pupils can be set challenges using the board and can write their ideas on it. Teachers can also call up aspects of previous lessons to check pupils' recall.

## Case study 1

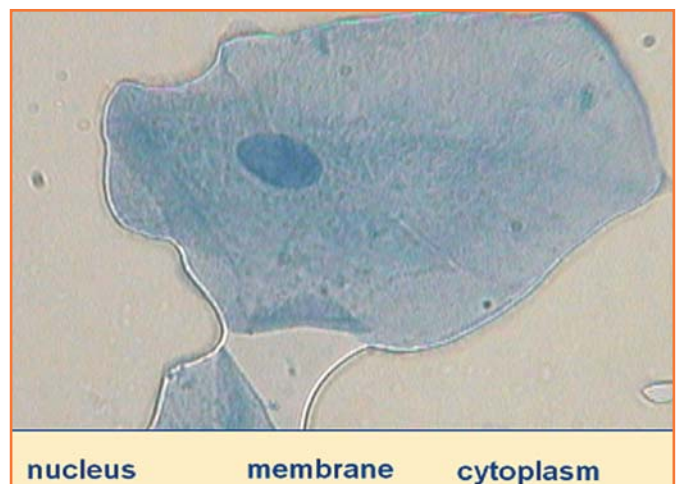
In this lesson, the teacher attaches a digital microscope to the computer, making use of the fact that anything that can be displayed on the computer screen can also be displayed on an interactive whiteboard. Pupils in year 7 have begun working on cells and this work will be further developed in this lesson.

Pupils will learn how to use a microscope safely and effectively, while carrying out an investigation exploring the differences in structure between plant and animal cells. The teacher has prepared a starter activity to introduce pupils to using the microscope and to check their recall of cell structures from the previous lesson.

The teacher's computer is connected to the interactive whiteboard and to a microscope.

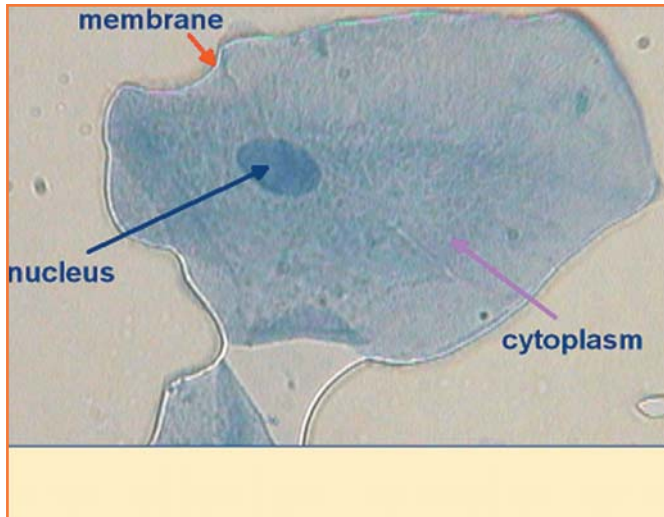
Any slide that is prepared will be seen on the computer screen and therefore shown on the interactive whiteboard. This means that the cells can be shown to the whole class at the same time. Any adjustments made to the microscope are seen simultaneously on the interactive whiteboard.

The teacher can also add annotations to the image shown by writing over the microscope image. Common issues surrounding the view down the microscope, such as the identification of air bubbles as opposed to cells, can be addressed collectively. Screenshots can also be taken, saved and used at another time, to remind pupils of what was seen through the microscope. These can be adapted for task-based work at the interactive board.



With grateful thanks to UM IBSCORE website for use of cheek cell image

Here the teacher uses an image captured from the microscope and displayed on the interactive whiteboard. The labels below can be dragged across the board and placed in the correct place. There is also a tool for drawing arrows. Pupils are invited to the board to place the arrows and labels. This helps to keep the pupils involved and they discuss as a class where the labels should go.



Having made sure that pupils understand what they can see on the whiteboard, the teacher displays a wide range of specialised cells to draw out the differences and similarities between plant and animal cells or different types of specialised cells.

It is also possible for the teacher to display images of the same cell at greater magnification (downloaded from the website: [http://biology.dbs.umt.edu/biol101/labs/lab\\_6\\_images/sect05and02/section\\_2and5\\_cellimages.htm](http://biology.dbs.umt.edu/biol101/labs/lab_6_images/sect05and02/section_2and5_cellimages.htm)) and use these to check whether pupils understand about magnification and field of view.

## 4.2 Using an interactive whiteboard for the:

- Introduction of new learning;
- Development of the learning by pupils.

Interactive whiteboards are useful for introducing new learning and developing learning in that they allow teachers to collect all the resources they need on their computer. This means that teachers can structure lessons carefully in advance, ensuring a smooth flow and maintaining a good pace.

Interactive whiteboards can make an important contribution to the presentation of new information, modelling new concepts and processes, creating simulations, stimulating discussion and explaining new ideas.

Once pupils have begun to learn new ideas, it is useful if they can practise their knowledge or apply the new concepts to a different context. This may be a time to discuss what they have learned or allow them to consolidate learning before moving on, and can be done away from the board.

## Case study 2

This lesson is based around aspects of Unit 7E *Acids and alkalis* of the QCA schemes of work. Pupils in Year 7 will learn to use indicators to classify solutions as acidic, alkaline or neutral. They will then apply this knowledge to the pH scale.

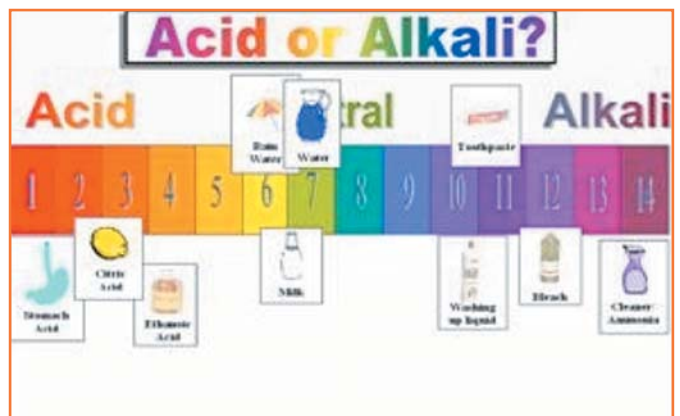
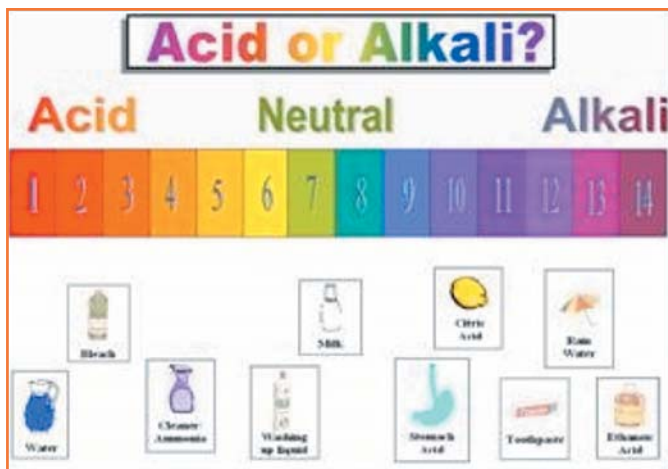
At the start of the lesson, the teacher opens a file on the computer containing a diagram with the pH scale and a collection of items. The screen is displayed in full colour. This is useful as the colour reflects the colours that will appear when the pupils use the indicators later in the lesson.

The teacher begins by modelling the process of placing the items on the scale, thinking aloud to make the process clear. She changes her mind about where some items should go, explaining why she has done so. She brings pupils into the process, inviting them to come to the front and guess where certain items would be on the scale.

Pupils can move an item on the board by pressing it with a pen or with their finger (depending on the type of board) and simply dragging it across the surface. The only way to achieve this with traditional methods would be with pieces of card and sticky tape. Another advantage of the interactive whiteboard is that the page can be saved when the pupils have completed their guessing. This can be opened again later in the lesson to compare their guesses with their results from the practical investigation.

investigation and see whether they were correct in their earlier hypotheses. This gives the opportunity for discussion arising from changes in their opinions, and also illustrates how initial thinking can be confirmed or modified by experimentation.

The final page can be saved and printed for pupils to access later. This makes it useful for revision.



A practical investigation is then carried out where universal indicator paper is used to find the pH of different solutions. Instructions for the practical task, which have been typed into the computer before the lesson, are displayed on the interactive whiteboard. This saves time in writing on the board and the instructions are clearer because they are typed, not handwritten. This helps to maintain the pace and flow of the lesson.

After the practical task is completed, the teacher is able to return to the original pH scale screen. Pupils can give their answers following their

### Case study 3

A teacher working with a Year 9 group is looking at the force of gravity and decides to investigate it in the context of stages in a mission to the moon. Having established that the pupils remember that every object is surrounded by a gravitational field that pulls any other object towards it, the teacher moves on to set the pupils a challenge.

He opens a file that has been prepared before the lesson and displays it on the interactive whiteboard. The first page of the file shows different stages in a mission to the moon. Pupils need to think about the astronaut and the gravitational forces acting upon him or her during the mission. Each group of pupils will be asked to answer one of the questions, but they do not know which one. Having the file prepared before the lesson saves time in displaying the work for the pupils and allows them to quickly take part in the task.

Consider how gravity would affect an:

- 1) Astronaut on earth (training for space)
- 2) Astronaut in shuttle during take off.
- 3) Astronaut in space
- 4) Astronaut on moon
- 5) Astronaut returning to earth

Astronaut in space

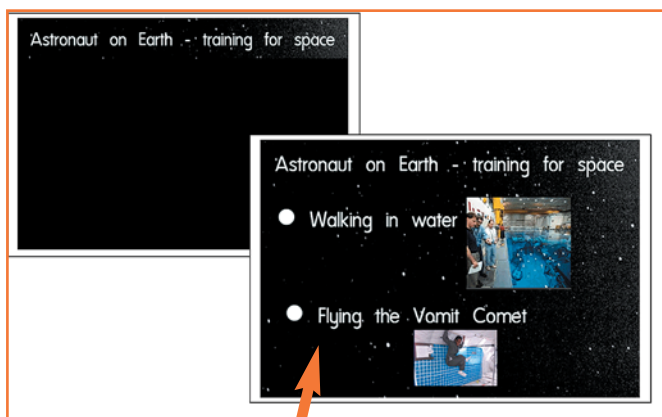
Is the astronaut still experiencing the force of earth's gravity?



Pupils work in small groups, considering each question in turn, not knowing which one they will be required to answer. If available, pupils could use the Internet to try and find answers to their questions, but they may be better simply using their existing knowledge.

The teacher turns to the next page of the file and uses a special tool which allows just part of the page to be shown. This is like using a sheet of paper over an overhead projector slide.

**Pupils share their hypotheses with the class and the teacher makes comments, asking further questions where appropriate. The teacher then reveals the rest of the slide...**



**It contains possible answers to the question which are hyperlinked to relevant Internet pages where more can be read about each topic or more pictures seen to help clarify the ideas shown.**

It is also possible to create links to other types of digital files. This makes it possible to show short video or audio files.

In this presentation, the teacher has included a video clip of astronauts working in space for the page Astronauts in space, while another link goes directly to the BBC archive on the Internet, where the pupils are able to see footage taken at the time of the first moon landing. They can see the bouncing footsteps and relate this to the conclusions they have drawn about gravitational force.

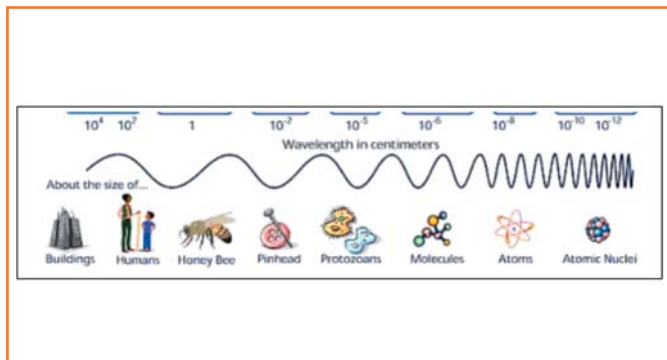
Video clips could be included in a traditional lesson on a VHS tape, but it is much easier to use short clips, which illustrate exactly the points being made and which can be replayed from any point and controlled directly at the board. Pupils say that seeing video helps them to understand a topic and that they remember it better.

The teacher concludes the lesson by saving the file to a pupil area on the school server. This is accessible in school and over the Internet, so pupils can revisit any of the websites that have been studied during the lesson to look at them in more detail.

## Case study 4

Working with a Year 11 group, the teacher wants to cover the details of the electromagnetic spectrum. Using diagrams prepared before the

lesson, the teacher is able to discuss the nature of electromagnetic waves and the way in which frequency and wavelength change.



The teacher divides the pupils into small groups and gives each one of the following topics to find out about:

- Gamma Rays
- X-rays
- Ultraviolet rays
- Visible light rays
- Infrared light rays
- Microwaves
- Radio waves

The pupils are told that they are to become an 'expert' panel on the topic they have been given and that they will be asked to present information about their topic at a 'conference', with questions after each presentation.

For each topic for GCSE, the pupils are required to know:

- The names of the types of wave.
- The order that they're arranged in.
- The uses of each type of wave.
- How each type of wave is made.
- The dangers of each type of wave.

They are given lesson or homework time to prepare materials to present to the rest of the class which must cover all the information required. The teacher can provide web addresses to point pupils to the most suitable

sources of information. More able pupils may be able to source this information for themselves.

Using presentation software pupils work at the interactive whiteboard, demonstrating their knowledge. Pupils find this advantageous because they have to find and refine the information they need themselves. They enjoy putting together a presentation and they find that delivering a talk to the rest of the class is easier when there are visual supporting materials.

While the presentations are taking place, pupils in the class will complete a grid of questions, quizzing their classmates to find all the answers to the topic. The pupils use the presentations and their knowledge to answer the questions.

## Case study 5

In this lesson for GCSE, pupils will look at defects in vision and how they can be corrected using lenses. Pupils already understand the fact that light is refracted as it moves through a lens, and the lesson begins by opening a file which has been prepared in advance, containing a photograph of a person wearing glasses. As pupils enter the classroom, this is displayed on the interactive whiteboard with the questions: 'Why is this man wearing glasses? How do the glasses help him?'

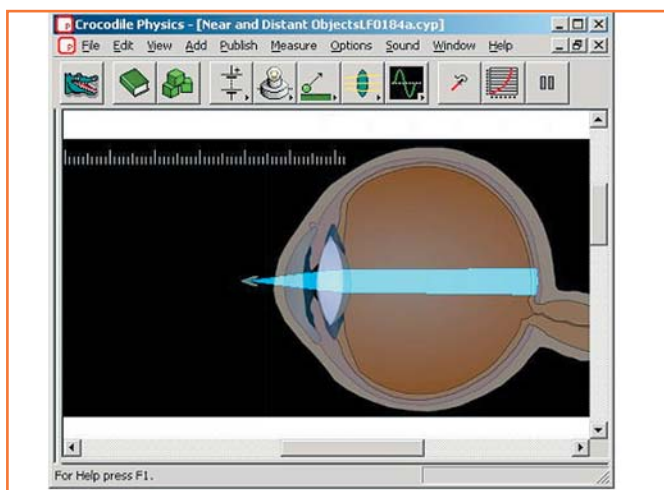
The teacher begins eliciting answers to the questions, writing phrases such as 'short-sighted', 'long-sighted' and 'lenses' on the interactive whiteboard as the pupils give them. This allows the pupils to focus on the topic to be covered and the visual stimulus immediately places the lesson in the real world, rather than it being purely an academic exercise. The file can be saved, complete with the pupils' notes and comments. This can be opened from the computer again later to insert new information.

**Why is this man wearing glasses?  
How do the glasses help him?**



Photograph reproduced with grateful thanks to Sarah Maidlow and James Hilling

The teacher then opens some specialist software which deals with the topic of optics and defects in the human eye. This software can be controlled directly from the interactive whiteboard. The teacher opens the part of the software containing an image of the human eye and a diagram where light enters the eye:



Crocodile Physics courtesy of Crocodile Clips Limited

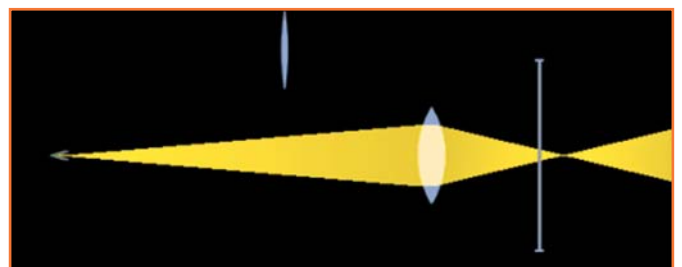
Pupils look at what happens to the light and where the image is formed on the retina. In this example, the position of the image is not static and the shape of the lens can be changed. A pupil or a teacher working at the board can make the lens fatter or thinner. This changes the focal length of the lens and the way that the light falls on the retina.

A ruler is included in the software, which can be dragged across the board, allowing pupils to take measurements and draw conclusions about what is happening in the eye. The teacher lets pupils establish what 'short sight' and 'long sight' mean, and why they would occur.

On returning to the interactive whiteboard software, a prepared page is ready to use, helping to maintain the pace of the lesson. The teacher asks groups of pupils to identify the type and magnitude of defect shown by one of a series of eye diagrams, and explain their answer to the rest of the class.

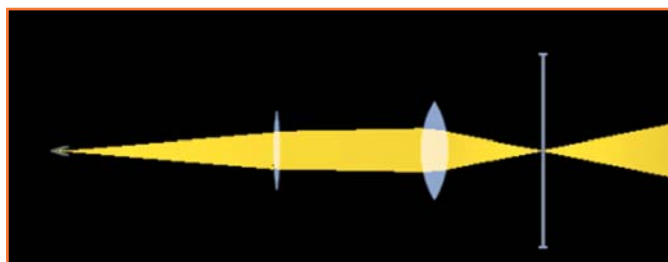
Having said what the vision defects may be, the pupils now find out about how these can be corrected.

The teacher returns to the specialist software and shows how pupils will now experiment with different types of lenses. This part of the lesson could be taught as a whole-class activity or, if appropriate, pupils could now move on to their own computers. The interactive whiteboard is useful in either case, as the teacher is able to demonstrate the part of the software that will be used and what the pupils will do.



Light from near object is not focused on the retina but **behind it**

A simulation can be created to illustrate long sight, in which a lens can be moved into the light, correcting the focal length. Pupils can experiment by adding different types and thicknesses of lenses and observing the effects. There is also a zoom feature to zoom in on the retina on the screen, to show how the light is focused.



Vision corrected using a **convex lens**. Light from a near source is now focused on the retina.

Pupils carry on working either on their own or as a whole class, investigating ways of correcting long and short sight.

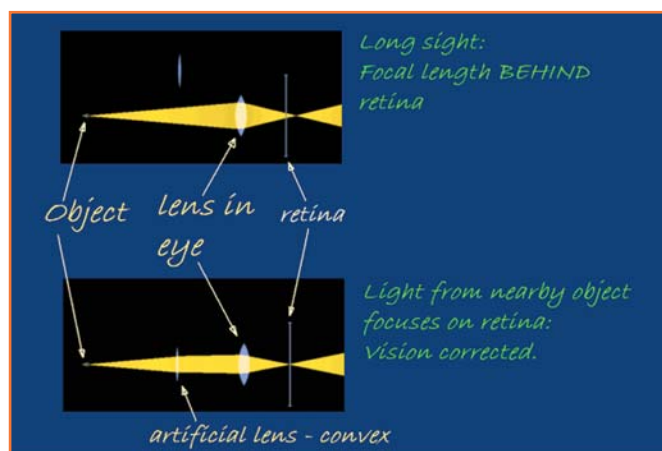
### 4.3 Using interactive whiteboards in the plenary session

Interactive whiteboards can contribute hugely to plenaries. Pupils can use the boards to present some of their ideas to the rest of the class for discussion, encouraging them to review and reflect on what they have learned. Learning can be reinforced with games and quick quizzes, and the interactive whiteboard can also be used to point pupils to extension activities, such as websites related to the topic.

#### Case study 6

In the lesson outlined in case study 5, the teacher creates a plenary using screenshots from the software and places these into the interactive whiteboard software. Pupils are given two minutes in their groups to identify what each picture shows, then representatives from the groups go to the board to annotate the pictures, explaining what they are. The teacher uses questions to get them to talk about why they are annotating each picture in a particular way.

This helps pupils reflect on what they have learned and to make their reasoning explicit.



Arrows can be added easily and accurately by using the software then dragging the arrow onto the board. A range of colours is available and the pupil or teacher can use different colours for labelling and for explanations to avoid confusion.

Pupils find the strong visual representation aids understanding and the file can be saved and printed for the pupils to use later for revision.

## Section 5: Emerging technologies



Interactive whiteboards have paved the way for a host of interactive technologies in the classroom. Some of these require an interactive whiteboard in order to work, some complement an interactive whiteboard, and others can work with just a computer and a projector.

### **Slate or graphics tablet**

This wireless piece of equipment, which is about the same size as an A4 pad of paper, allows an interactive whiteboard to be controlled from anywhere in the room. This is done by the teacher or pupil holding the slate and using a special pen on it. The cursor on the board moves in line with the movements on the slate.

The tablet has advantages for classroom management, as the teacher can be situated anywhere in the classroom and still control all the functions of the board. In addition, the slate allows pupils who do not want to come to the board, or who are not physically able to do so, to participate fully in lessons.



### Remote keyboards

Teachers or pupils can enter text onto the computer from anywhere in the classroom when using the remote keyboard. The keyboard works wirelessly with the computer, with any text typed being displayed on the interactive whiteboard. This is useful for shared writing activities or for a pupil to make notes directly onto the interactive whiteboard during class discussion.



### Remote mouse

All the actions of a computer mouse can be carried out from any position in the classroom by this wireless device, also often known as a gyromouse.

Rather than moving over the surface of a desk, the remote mouse can be moved through the air to control what is happening on the screen. The remote mouse can be used from anywhere in the room.



### Tablet PC

Using wireless connections to transmit data to a projector, the tablet PC can be used freely from anywhere in the room. Tests are currently being carried out to assess the value of using tablet PCs in this setting through the DfES Testbed project.

### Voting devices

Voting devices allow teachers to ask pupils to vote electronically on questions. These could be multiple choice questions, with several options to choose from, or pupils could be asked to express an opinion across a range of answers (eg from A = agree strongly to E = disagree strongly). Some voting devices allow numerical answers to be entered. Teachers can even ask pupils if they understand or are if they are ready to move on. As pupils vote anonymously, they are less likely to be afraid to admit that they would like more time on a section of work.

Results from the vote are displayed immediately on the interactive whiteboard, allowing for immediate feedback on questions. Some software allows for detailed analysis of the results in order to offer more support to pupils who are scoring below the expected levels.

### Digitizer

A digitizer is rather like an overhead projector that can enlarge opaque objects. It allows any small object to be enlarged and displayed on an interactive whiteboard. A teacher could, for example, open a book and place it on the digitizer. The page of the book would be displayed clearly on the board. Using the right software, images can then be annotated or saved.

### Video conferencing technology

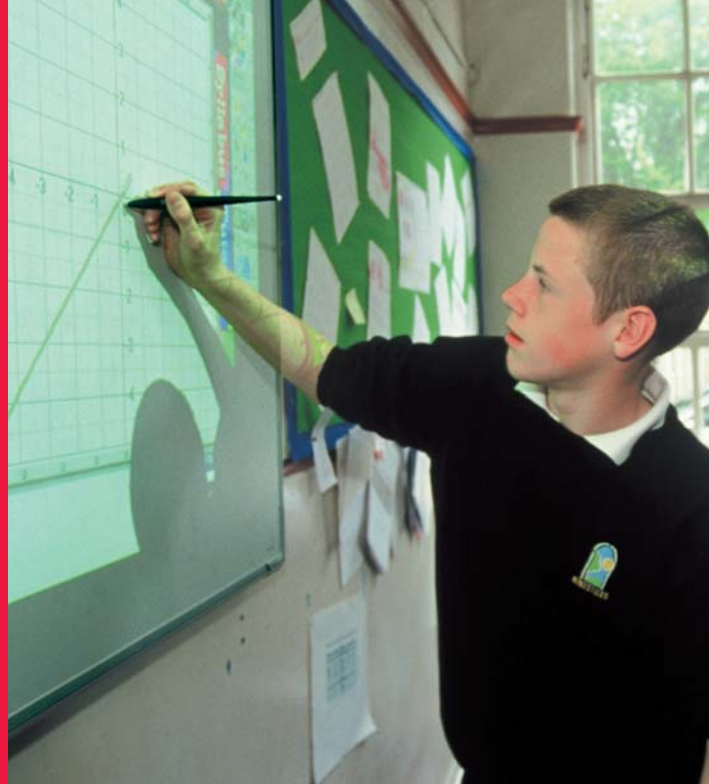
A computer with a webcam offers the possibility of video conferencing during lessons. Links can be established with people outside the

classroom and live streaming video displayed on the interactive whiteboard. Video conferencing technology enables 'experts' to contribute to lessons – for example, by linking up the classroom with a specialist who is able to answer pupils' questions from a laboratory, a museum or overseas. The video link can be recorded and replayed later in the lesson using the interactive whiteboard, to analyse or recall what was said during the interview.

### **Digital repositories**

As the use of digital technology develops, so too will banks of resources that can be searched and downloaded to provide short video or audio clips for lessons. Searching the Internet for material can be time-consuming and ultimately frustrating, so the advent of resources which can be quickly and easily accessed and customised for particular lessons is a welcome development.

## Section 6: Further links and references



There is a wide range of further sources of information, advice, resources and other materials available to help you make the most of the interactive whiteboard in supporting learning and teaching.

The Department for Education and Skills wishes to make it clear that the Department, and its agents, accept no responsibility for the actual content of any of the non-Department materials suggested as information sources within this document, whether these are in the form of printed publications or on a website.

### Department for Education and Skills

**[www.dfes.gov.uk](http://www.dfes.gov.uk)**

Homepage for the Department for Education and Skills (DfES).

**[www.dfes.gov.uk/ictinschools](http://www.dfes.gov.uk/ictinschools)**

For information on all policy areas relating to ICT in schools.

**[www.curriculumonline.gov.uk](http://www.curriculumonline.gov.uk)**

Online catalogue of digital learning resources.

**[www.learnevaluations.co.uk/findeval\\_intro.aspx](http://www.learnevaluations.co.uk/findeval_intro.aspx)**

Homepage of Evaluate, a Guardian newspaper-run, DfES-appointed evaluation service for products registered on Curriculum Online.

**[www.schoolzone.co.uk/evaluations/findeval.htm](http://www.schoolzone.co.uk/evaluations/findeval.htm)**

Features independent evaluations of thousands of web-based learning materials, as well as details of educational suppliers and products. DfES - appointed evaluation service for products registered on Curriculum Online.

**[www.teachernet.gov.uk](http://www.teachernet.gov.uk)**

Homepage of TeacherNet, the Government gateway for educational professionals.

**[www.teachernet.gov.uk/teachingandlearning/secondary/ks4/](http://www.teachernet.gov.uk/teachingandlearning/secondary/ks4/)**

TeacherNet information about Key Stage 4.

**[www.publications.teachernet.gov.uk](http://www.publications.teachernet.gov.uk)**  
Online publications for schools service.  
View, download or order paper copies of  
the latest publications.

**[www.standards.dfes.gov.uk](http://www.standards.dfes.gov.uk)**  
Homepage of the DfES Standards Site,  
containing information on the latest  
educational initiatives.

**[www.standards.dfes.gov.uk/keystage3/](http://www.standards.dfes.gov.uk/keystage3/)**  
Information on ICT across the curriculum  
in Key Stage 3.

## British Educational Communications and Technology Agency

**Becta main site**  
**[www.becta.org.uk](http://www.becta.org.uk)**  
Website of the Government's key partner  
in developing and delivering its information  
and communications technology (ICT) and  
e-learning strategy for schools and the  
learning and skills sector.

**Interactive Whiteboard Catalogue**  
**[www.whiteboards.becta.org.uk](http://www.whiteboards.becta.org.uk)**  
Online resource enabling you to look at  
interactive whiteboard solutions, services,  
suppliers and pricing before having a site survey  
carried out. Using the site, you can compile a  
shopping list of items and find all the necessary  
information to place an order with a supplier.

**ICT advice for Teachers**  
**[www.ictadvice.org.uk](http://www.ictadvice.org.uk)**  
Advice from Becta on the use of ICT in  
different areas of the curriculum.

**Teacher Resource Exchange**  
**[www.tre.ngfl.gov.uk](http://www.tre.ngfl.gov.uk)**  
Database of resources and activities  
designed to help teachers develop and share  
ideas for good practice. All resources on the  
TRE are checked by subject specialists to  
ensure they are of the highest possible quality.

**National College for School Leadership**  
**[www.ncsl.org.uk](http://www.ncsl.org.uk)**  
For information and advice on the strategic  
leadership and ICT course.

**Qualifications and Curriculum Authority (QCA)**  
**[www.ncaction.org.uk/subjects/ict/inother.htm](http://www.ncaction.org.uk/subjects/ict/inother.htm)**  
For information on ICT in subject teaching.

## Subject association website science

**The Association for Science Education (ASE)**  
**[www.ase.org.uk](http://www.ase.org.uk)**



Copies of Whiteboard series can be available from:

**DfES Publications:**

Telephone 0845 60 222 60  
Facsimile 0845 60 333 60  
Textphone 0845 60 555 60  
email [dfes@prolog-uk.com](mailto:dfes@prolog-uk.com)

Ref: DfES/0812/2004

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