Science & Technology Equipment News

Number 28
Summer 2003

For Primary Schools and Teachers of S1/S2 courses

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© SSERC 2003 ISSN 1369-9962

It is only in the microscope that our life looks so big.
Arthur Schopenhauer 1788 - 1860

We distribute over 5000 copies of each of four issues of this newsletter annually. They go into to every primary and secondary school in Scotland. Yet, on our courses and at various meetings, many primary teachers tell us they never see them. Into which black hole do those newsletters fall? Do they disappear between us and the local authority or evaporate somewhere between authority and individual teachers? Who can tell? Since we do receive requests from many primary school teachers, however, some copies must escape the drop. The content of this newsletter was prompted by such a request from a teacher, who asked us to look at some specific models of digital microscope suitable for use with 5-14 classes. The models evaluated were the Motic Digiscope DS-300 and the Intel QX-3. As a result of our evaluations, we think that each has a place in 5-14 Environmental Studies for both Science and ICT.

Microscopes

Newsletter number 2 explained, in simple terms, much of the relevant theory behind choosing and using magnifiers and microscopes. Should you be reading this current issue but never saw, much less read, Newsletter 2, all is not lost. Web page versions of the 5-14 Science and Technology News are mounted on the ISE 5-14 website.

Conventional light microscopes and magnifiers rely on lenses to alter the angle at which light enters the observer's eye. It is this effect which 'fools' the brain into interpreting images so that objects apparently seem nearer than they really are and thus much larger, literally, than life.(Just remember Father Ted's words of wisdom to Dougal - "Big = Near" Small = Far away").

When a conventional camera is used with such a microscope, the image is projected onto the film rather than the retina in the eye of an human observer. In video microscopy, the image falls on an array of light sensitive electronic detectors which convert the pattern of light into a signal which can be displayed on a TV screen or monitor. The latest kinds of such devices use an array of detectors so small that the resultant camera fits onto a single wafer of silicon - a large, single 'chip'. That, in turn, has led to the development of the so-called 'digital' microscope where the camera is part of the whole device. Now, instead of the light pattern falling on the retina of an observer, the image becomes a digital video signal which be sent to a monitor or, using suitable software, transferred to a computer, displayed on the integral screen or, with an LCD projector, projected onto a large screen or whiteboard.

The digital microscope can allow a teacher to use a single instrument to show the whole class the best ways to examine different aspects of a specimen, how to focus and what they really, really should be seeing. With a standard microscope this would mean individual attention. In classes of 20 or 30, even when the children work in pairs or groups, this is time consuming to the point of impracticality.

Figure 1 *Intel QX3 'digital' microscope.*

Figure 2 *QX3 guide and CD ROM.*

Intel QX-3

The Intel QX-3 is an inexpensive digital and video microscope marketed by a number of education equipment suppliers.The Intel QX3 Digital Microscope Initiative began at the University of Virginia in an attempt to identify ways of enhancing classroom instruction and inquiry-based learning in science. Although introduced originally in 1998 as a toy, its ease of use and the capture of still and video images for display on the computer, were seen as potentially useful in the classroom. It is of a novel design, packaged in a blue plastic outer body with a moulded specimen stage and integral sub stage and top stage lighting. There is no eyepiece. All viewing is via a computer and screen.The QX-3 is thus a significant departure from conventional school microscope designs.

As part of 'Science Year', secondary schools in Scotland were offered an Intel QX-3 to enhance work in S1-S2. Many of these, we believe, were passed on to local primary schools. We judge then, that a lot of schools will at least have seen or be aware of this microscope. We also know that it has been used successfully in a number of schools. One reason given for the QX-3 not being used at first was that many primary schools hold Apple Macintosh computers and only PC software was available. This is no longer the case. A CD with Mac software is now available. This Mac software, at £45, may be somewhat expensive for primary level. This sum, however, provides a school site licence.

Since there is no eyepiece, there can be no optical magnification as such. Approximate magnifications of 10X, 60X, even 200X are displayed directly on a computer screen. Focussing, also, is carried out on screen. This can be difficult with all but the lowest magnification, of which more later. The on-screen display should help in initiating group discussion as everyone is looking at the same specimen. Images can be captured as stills, movies or time lapse videos. The QX-3 plugs directly into the computer via a USB (universal serial bus) cable permanently attached to the microscope. Power is drawn from the computer both to operate the camera and provide top and bottom illumination of the microscope stage.

PC software (on CD ROM), instruction booklet and slides are supplied as standard (Figure 2, page 1).

MOTIC Digiscope

Unlike the QX-3, the Digiscope can be used as a stand-alone microscope featuring a 20X to 100X manual zoom lens. The image quality is good and on lower magnifications there is a fair depth of focus. The camera plugs directly into a PC or Mac via a USB cable and can be used with desktops, laptops and projection devices. The camera replaces the microscope eyepiece and the cable is permanently attached to the camera.

A stage with moulded-in stage clips is used for viewing regular microscope slides, and there is also a reversible whole object stage. There is a quaintly named 'swimming pool' feature which is ideal for studying pond water. The whole objects stage is great for studying bugs, leaves, small rocks or other solid specimens (although lighting is not all it might be - see below).

The *Motic Play* software on CD-ROM is powerful, and includes image capture and manipulation software. With it pupils can capture still images or video of specimens. If care is taken in setting up calibration, specimens can be accurately measured in microns, millimetres or inches. As with the QX-3, images can be captured as stills, movies or videos.

Superbright LED bulbs powered by three *AAA* dry cells provide incident and transmitted illumination (top and bottom). The intensity control function allows an observer to choose the illumination level that works best for them.

How do they compare?

Comparative tests were carried out with the same specimens being examined in turn on the Intel QX-3 and the Motic DigiScope. The latter model exhibited superior image quality at the same magnification and superior resolution at both maximum and minimum magnification. A sequence of images, (Figures 6 to 9 opposite page), should demonstrate these points. All of these 'photomicrographs' were taken at a nominal sixty times magnification.The stem specimens give an indication of the performance with thin sections and the bee mouthparts provide more 'solid' objects.

Figure 3 *Motic microscope without its digital camera.*

Figure 4 *Motic user guide and software CD.*

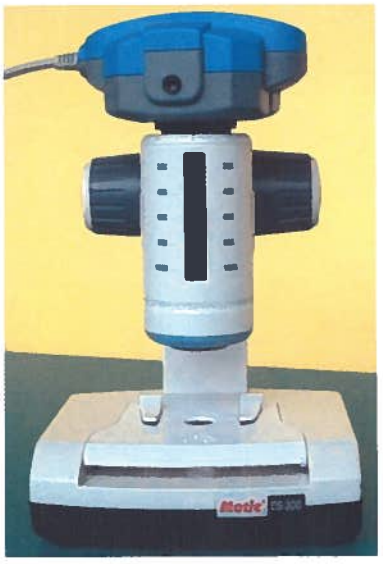

Figure 5 *Motic in 'Digiscope' mode.*

Figure 6 *Bamboo stem, cross section, Intel QX3.*

Figure 7 *Bamboo stem, cross section Motic Digiscope.*

Figure 8 *Bee's head and mouthparts Intel QX3.*

Figure 9 *Bee's head and mouthparts Motic Digiscope.*

The microscopes appear to be similar but there are marked differences. The Motic DigiScope 300 is designed to be used as both a digital and stand-alone microscope. This makes it ideal for science and biology investigations. It has the added advantages of measuring facilities and the digital camera. These help to cover the ICT strands in addition to science. Pupils from P4 to S2 will find this a simple microscope to use and should have no trouble with the software. Although we have reservations about its top lighting, the Motic Digiscope 300 appears to cover the requirements for use at primary school level and for S1-S2. For those classes it has our recommendation.

The Intel QX-3 is more an on screen magnifier than it is a microscope in the usual sense. It does, however, offer a lot for the money (especially if you got one free!). It is more likely to be of use in science lessons for pupils P4 to S2 where the main focus is the application of ICT in science. Primary teachers have told us that pupils do enjoy the game-style software, which comes complete with sound. Of course they also like the futuristic shape of the thing itself. (It's a shame that fun and enjoyment don't feature more heavily in the National Arrangements documents). The reservations we have on lighting and focussing make us sceptical of the benefits of the QX-3 for anything but simple science investigations. Should the teacher have experience in microscopy then there are techniques that could be used to enhance the performance of the instrument. In the normal run of things, we probably wouldn't have recommended the QX-3 as a microscope for use in primary science. Despite that, feedback from primary teachers - on its ease of use added to currently competitive pricing - suggests that it's won a place in many primary schools.

Do they do what it says on the boxes?

Both microscopes more or less match up to their maker's blurb. The *Motic Digiscope 300* is the more useful for science investigations, because it can be used as a stand alone optical microscope as well as with the digital camera and the latter, also, may be used on its own. Resolution is reasonably good with the Motic model. This is the case whether the device is used on its own for direct observations or with the camera and a computer screen. There is an apparent loss of resolution when the digitised image is magnified further using an LCD projector. The microscope body and stage are fairly robust and the integrated stage clips are useful. The *Motic Play* software, supplied with the microscope on CD-ROM, is intuitive and pupil friendly. It has good facilities for measurements.

The *Intel QX-3* is a less robust instrument, the stage is liable to move if not handled carefully by pupils and there are no stage clips. Pupils working in groups are prone to jostling the controls and moving the stage. Because focussing can only be done by watching the image on the computer screen, this can cause problems at the higher magnifications. The time lag is quite marked between moving the coarse focus knob and changes on screen. We met problems when staining potato sections on a slide to show starch granules when the image just would not stay in focus. This we put down to the small depth of focus at 200X magnification. However from third party reports, we understand that pupils enjoy using the software, which is intuitive and simple to use particularly the video capture utility.

Both models have illumination from below the stage, for specimens to be examined in transmitted light, and from above to light solid specimens (incident illumination). The *Digiscope* has inadequate top lighting. The *Intel QX-3* is slightly better. Neither gives sufficient illumination to view a solid object properly on screen. Additional lighting from an external lamp is needed to give reasonable results.

The Motic only makes sense if it is bought with the digital camera. The microscope on its own is not a good buy. A Motic student microscope of conventional design can be purchased for about £60 and would give superior results for straightforward microscopy. An excellent instruction book, come teacher's guide, is provided with the Motic package. This includes suggestions for a range of investigations and, to further assist the teacher, there are samples of images captured with the camera.

* * *

Buyer's guide

The **Motic DigiScope** is supplied by **Philip Harris**. It comes with a Quick Start Manual, a softpak carrying case, set of prepared slides, stains, basic dissection kit with storage case and CD software. An excellent instruction book and teachers' guide is included. This pack costs £110.00 and the microscope on its own is £49.00. Minimum requirements to run the imaging software are: PC running Windows 98 or better, Mac OS9, 64 MB RAM (128 recommended) 300mHz, USB port, CD-ROM drive.

The **Intel QX-3** is sold by **Economatics** and **EDU-LAB**. The Computer Microscope Pack from Economatics at £59.95 contains a QX3 Microscope with stand, sample slides, tweezers and containers, software on CD-ROM, with an instruction and activity guide. N.B.The QX3 software is a single user licence and is not for use on a network. Minimum requirements to run the software are: A Windows USB enabled computer. Windows 98, Intel, Pentium or Celeron processor 200 MHz or faster (or equivalent), 32 MB of RAM, Min 75 MB hard disk space, Quad speed (4x) CD-ROM, 800 x 600 display, 16-bit colour, 16-bit Windows-compatible sound device, video and sound compatible with DirectX.

A Digital Blue QX3 Computer Microscope Pack from EDU-LAB comprises a QX3 Microscope with stand, sample slides, tweezers and containers, software on CD and instructions costs £75.00. A version with curriculum guide costs £85.00 with PC computer requirements as above. A Macintosh Version of the QX-3 software CD costs £45 for a whole school licence.

Supplier addresses are provided overleaf (foot of page).

Acknowledgement: We are grateful to Neil Taylor, Janette Kean and teachers in the Partnerships in Primary Science (PIPS2) Project for their assistance with this evaluation exercise.

Components & Materials

Item	Description	Price
593	Miniature motor, 1.5V to 3V, 2mm dia. shaft	30p
614	Miniature motor, 3V to 6V, 2mm dia. shaft. Both motors above can be used for project work but they run at fairly high speeds, some gearing will be required. See worm/gear, item 811.	45p
621	Miniature motor, 1.5V to 3V, now with 8 tooth pinion. The open body of this motor makes it ideal for showing how such a motor is constructed	25p
798	Pack of 24 gears, 6 each of 12, 20, 30 or 40 teeth, dia.15, 22, 32 and 40 mm. 12 tooth gear fits motor shaft and 40 tooth gear push fits in cotton reel	£2.00
799	Pack of 24 cams, 6 of each of 4 shapes	£1.00
800	Pack of 100 wheels, 39 mm dia., assorted colours, 3 mm axle hole	£5.25
811	Worm and gear, 34 to 1 speed reduction	35p
817	Axles 3 mm dia., nickel plated, round ends, push fit on SSERC plastic wheels, gears and pulleys: 70 mm long, per pack of 4	40p
818	As above but 95 mm long, pack of 4	40p
819	As above but 12 mm long, pack of 4	40p
820	Worms to fit 2 mm electric motor shaft, pack of 5	£1.00
821	Reducers 3mm to 2mm enables gears, pulleys and wheels, to be fitted to motor shaft, per 5	25p
867	Reducers, 4 mm to 2mm, as above, per 5	25p
868	Reducers, 4 mm to 3 mm, as above, per 5	25p
710	Sonic switch. Out of stock.	85p
723	Microswitch miniature, lever operated	40p
822	Plastic toggle switch, low voltage	40p
688	Crocodile clips, red, miniature, insulated	5p
759	As above, but black.	5p
788	Crocodile leads, assorted colours, insulated croc. clips at ends,36 cm long. Pack of 10	£1.35
835	2 x AA Cell ('battery') holder	15p
845	2 x C Cell ('battery') holder	20p
729	Battery connector, PP3 type, snap-on press-stud, suitable for Items 835 and 845	5p

Item	Description	Price
789	MES (miniature Edison screw) bulbs 3.5 V	10p
691	MES battenholders for above.	20p
866	Lens end lamps, 1.2 V MES. Ideal for use where a narrow, concentrated beam of light is needed. Bargain pack of 100	£3.50
508	LED (light emitting diode) 3 mm, red, per 10	50p
761	LED 3 mm, yellow, per 10	60p
762	LED 3 mm green, per 10	60p
790	3V buzzer (works with solar cell see Item 838)	55p
846	Sound module with 'melody' chip	£1.00
838	Solar cell, 100 x 60 mm, 3.75 V per cell, max.	£2.10
839	Solar motor, body 25 dia.12 mm long with shaft 2 mm dia 6 mm long	£1.70
840	Solar pack : one of each solar cell, solar motor propeller (801), and 3 V buzzer - with notes.	£3.75
836	Motor mounts, plastic, push-fit with self adhesive base pad for SSERC motors 593 & 614, 10pk	£2.35
801	Propeller, 3 blade, to fit 2 mm shaft. Blade 62 mm long	35p
792	Propeller kit with hub and blades for ten 3 or 2 bladed propellers	£3.50
794	Cotton reels (for making buggies, rubber powered tanks etc.) pack of 20*.	75p
796	Pack of 20 pulleys, 5 of each of 10, 20, 30 and 40 mm diameters.	£2.50
837	Ring magnet, 40 mm o.d., 22 mm i.d.	35p
815	Ceramic square magnet, 19 x 19 x 5 mm	15p
823	Ceramic magnets, poles at ends, 10 x 6 x 22mm	12p
861	Bimetallic strip, 10 cm length	30p
882	Quartz clock movement , dimensions 56x53x17mm, with wall hanging bracket, Suitable for dial thickness up to 10mm. Includes plastic hands suitable for dial diameter to 200mm. Requires an AA battery. See CD Clocks, Newsletter 18.	£1.75
884	Onager kit. Wood cut to length etc.	£2.00
885	Chariot kit. Templates and parts.	£2.00

Item 794* ***Not* *200 as previously stated in error*

Prices do not include VAT which will be charged at the ruling standard rate. Cash with order only when the total value is less than £5 and please add £1 for carriage solely to these small orders (except where an inclusive price is indicated eg kits, etc). For orders totalling more than £5 please do not send payment etc but await delivery and then pay on our advice note or invoice.

A fully illustrated version of this list is posted on the "Shop" section of the SSERC members' website.

This Newsletter and previous issues can also to be found in web page format on

the Improving Science Education 5-14 website at: www.ise5-14.org.uk

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