An Affordable Digital Micrography To Interest Children (Of All Ages) In Science

Norman Lazaroff, Foundation for Microbiological Analysis

Inexpensive fixed-focus digital cameras can be used with homemade lens attachments to obtain good quality close-up images and photomicrographs. The current availability of inexpensive digital cameras with resolutions of 1024 x 768 pixels or better is brought about by technical advance and the continual introduction of competing new models and accessories. The digital camera which I use costs less than $150 now at a liquidation sale or internet auction, and the price continues to decrease. Although more expensive digital cameras are great to have, their advanced features are not necessary for introducing young students to the digital revolution in photography and for exploring the microscopic world.

It isn't difficult to attach a bracket to one of these cameras for holding a close-up lens or microscope eye-piece in front of the camera orifice. To minimize the necessity for critical alignment, good quality bi-convex lenses are used that are at least twice the diameter of the camera lens. In fact, with a surplus three inch diameter, 75 mm copying lens (costing $8.95) it is possible to get great macro-photos even without attaching the lens to the camera.

The lens brackets are made from 1/16" scrap aluminum, cut with drill and tin snips to match a card-board template corresponding to the camera. For macro-photography, the cut out piece of sheet metal is bent in a vise, after which a lens in a plastic retaining ring (made from a bottle-cap) is fastened in place with epoxy cement. The camera's electronic flash can be used for macro-photography if a neutral density filter (made from a darkened piece of negative film) is placed over the flash opening. Alternatively, with the flash turned off, the light from a small desk lamp is sufficient for either auto or timed exposures.

For photo-micrography, an ocular adapter (flanged aluminum ring from an old camera) is fastened to the bracket and fitted with a wide-field microscope ocular in a plastic sleeve. These devices can be made by seventh graders in a home or school workshop, adding additional experience to their introduction to science. Costs for hardware are minimal. Although good new lenses can be expensive ($22 or more) if obtained from optical catalogs, there are many possibilities for getting excellent used or surplus lenses. The costs for microscope oculars are part of the cost for microscopes, but even here obtaining discarded items from surplus equipment may be the most affordable way to go.

Required also are desktop computers with at least 32 Mbytes of RAM and sufficient fixed disk space to run the camera software on a Windows 95 or 98 operating system. Again, the marketplace has been very cooperative, providing great choices in computers, monitors and printers at low prices due to the competition of new models.

An advantage of the digital camera is that, along with its small size and portability, it allows images to be quickly screened and processed in many ways that are difficult and time-consuming with film images. Once downloaded from camera to computer, digital images can be stored, studied, edited, copied, printed or e-mailed without delay. Particularly useful for photo-micrography, is having the camera tethered to a serial or USB port of a computer while a specimen is studied under the microscope. Digital photos made in

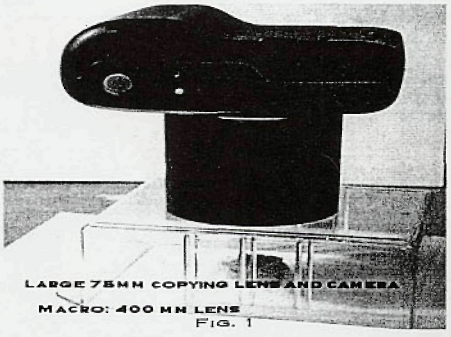

Figure 1. Arrangement for taking a macro-photo with a fixed focus digital camera and a surplus 3" diameter, 75 mm focal length copying lens. The lens and camera are placed on top of an opening in an inverted transparent polystyrene container. The specimen is approximately 2" below the lens and is illuminated from the side. This figure is photographed with the same kind of camera as the one shown but fitted with a 400 mm lens bracket and using the attenuated illumination of the camera's electronic flash.

Figure 2. Lens bracket holding a microscope eye-piece for photo-micrography. This figure was photographed with a fixed-focus digital camera fitted with a 400 mm lens bracket. Fluorescent illumination and auto-exposure.

this mode can be viewed in a minute or two while additional photos are being taken. This allows adjustment of the observational conditions until an appropriate view is achieved. Helpful is the ability to set the shutter speed with the computer's camera program and to make a timed exposure by clicking on the computer screen without having to touch the camera or microscope.

To enhance those options some additional equipment can be very useful although not essential:

DC Adapter. Although the camera runs well on AA batteries, a $25 DC adapter will save money and eliminate the need to change batteries when the camera is used indoors or tethered to a computer.

Storage Drive. A large number of images, (as from a class of students snapping digital pictures) can be managed more easily if a computer storage drive like a Zip Drive is available. This allows collections of the bulky photo files to be distributed on 100 (or 250) Meg disks for collaborative use on other computers.

Compact Flash Card Reader and extra Compact Flash Cards. Another useful option is to have a compact flash card reader attached to a USB or parallel port of a computer to facilitate rapid downloading of large numbers of images from camera memory cards. When the camera is not tethered to a computer and has collected many images, its filled flash card can be easily removed and replaced with an empty card. This allows the camera to continue to be used to collect more images even when it is not possible to download to a computer. Then while the camera continues "in circulation," the filled compact flash card can be delivered to a computer for downloading , viewing and using the images when it is practical to do so.

Shown here are digital photos of camera-lens arrangements and examples of the photos produced. Although not quite at the professional standard, I believe they would be of sufficient quality to enhance the interest and education of young students. ■

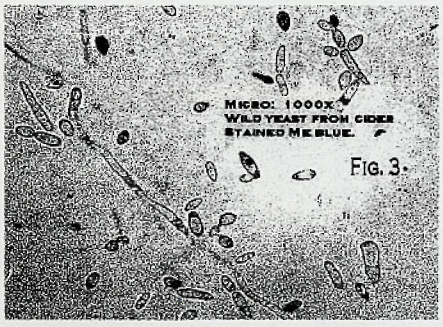

Figure 3. Photomicrograph, 1000x. Wild yeast in spoiled apple cider, stained with dilute methylene blue. Fixed focus digital camera equipped with eyepiece bracket attached to triple tubus microscope. Oil immersion objective.

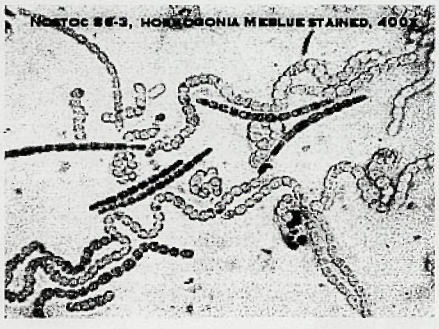

Figure 4. Photomicrograph, 400X. Nostoc sp. 86-3 hormogonia responsible for gliding motility, adhesion and aggregation in the nostocacean life cycle. Fixed focus digital camera equipped with eyepiece bracket attached to triple tubus microscope. The hormogonia are preferentially stained with dilute methylene blue.