

# Use of a Consumer-Grade Digital Camera to Archive Written Exams

By Morris Maduro

*The use of a photocopier to archive exams consumes photocopier resources and generates a large amount of waste. As an alternative, I have been using a consumer-grade digital camera to document exams in an upper-division biology course. The approach is inexpensive and offers a number of advantages over photocopies.*



Many instructors give exams or assignments that require short or long answers. As grading of these is often subjective, students often have disputes with how a question was graded and wish to have their exams reevaluated after they have been returned to them. One of the problems with this situation is that it can be difficult for an instructor to establish whether or not a cheating attempt has been made. For example, a student may alter an answer so that it appears as if a question was given fewer points than merited. A more insidious tactic is to make changes that have a large effect on the total points, such as replacing pages with those of another student, or with pages from a stolen blank exam that was filled in to appear consistent with the remaining pages. In order to combat such tactics, many instructors have taken to making archival photocopies of assignments or exams. Here I describe the use of a consumer-grade digital camera to make such archives, which offers a number of unique advantages over the use of photocopies.

## Equipment

Archiving requires a tripod, digital camera with memory, and a small desk or table as a work surface (Figure 1). Tripods cost approximately \$20 and a suitable digital camera that can make images at a size of ~1.2 megapixels (MP) can be purchased for less than \$200. Memory for such cameras can be obtained for less than \$40. A basic computer is used to view images from the archive, and a CD-R writer and blank CD-R media are used for permanent storage.

## First-time setup

The optimum camera settings are best determined by trial and error. Use of the flash is not recommended, as it consumes battery power rapidly and will require waiting for the flash to recharge

between images. Rather, ambient room light, either artificial or natural, will work fine. A tripod is strongly recommended for stabilizing the camera. I set my camera to macro focus mode and a manual exposure setting of F4.5 at 1/25 second (ISO 100). Lower f/ratios are not recommended, as the images are less likely to be focused across the entire frame. These are only recommended settings; alternate exposure times, which depend strongly on the available light, and f/ratios should be tried to achieve the sharpest, best-exposed images possible. Once good settings are obtained, it is straightforward to duplicate them later.

Although most digital cameras are capable of much higher resolution, an overall image size of 1.2 megapixels (1,280 × 960 mode) saved at standard jpg compression will give good results (Figure 2). With my camera (a 4MP Sony, model DSC-S85), each image occupies approximately 320 KB of space.

## Creating the archive

Prior to use, the camera battery is charged. The camera and tripod are set up. Exams are first alphabetized by student last name. Each exam is then photographed one page at a time. If a student has written on the back of some pages, these are also imaged. With my setup, I can obtain archival images at the rate of about nine pages/minute (~7 sec/page). For example, an archive of a five-page exam from a class of 30 students will take about 17 minutes to complete and will consume about 50 megabytes (MB) of memory.

After the images are obtained, they are transferred to a computer. The entire set can be kept on the hard drive until all course grades have been finalized, but

---

**Morris Maduro** (mmaduro@citrus.ucr.edu) is an assistant professor in the Department of Biology at the University of California, Riverside.

FIGURE 1

### Tripod and camera setup.

The tripod shown is a Velbon Videomate 400, although any tripod of appropriate size will suffice. The lens of the camera is approximately 35 cm from the table surface.

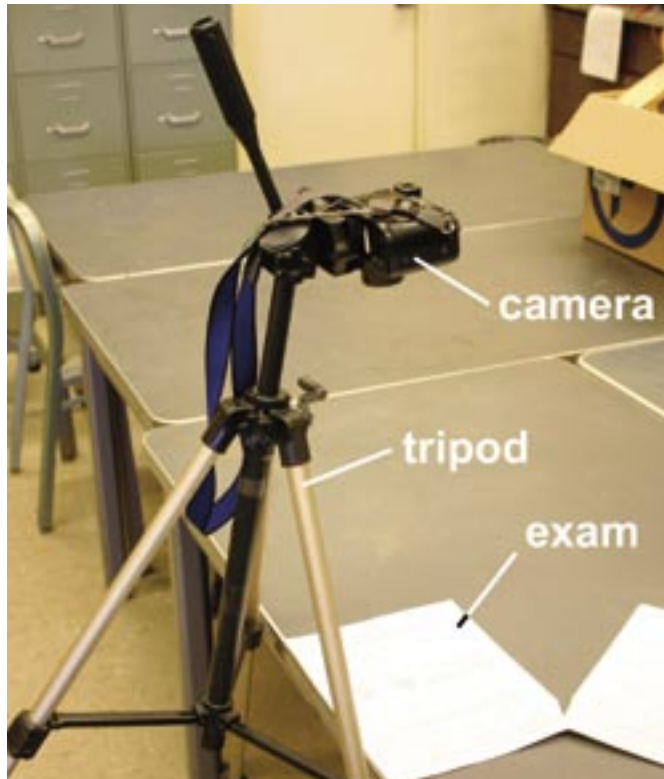
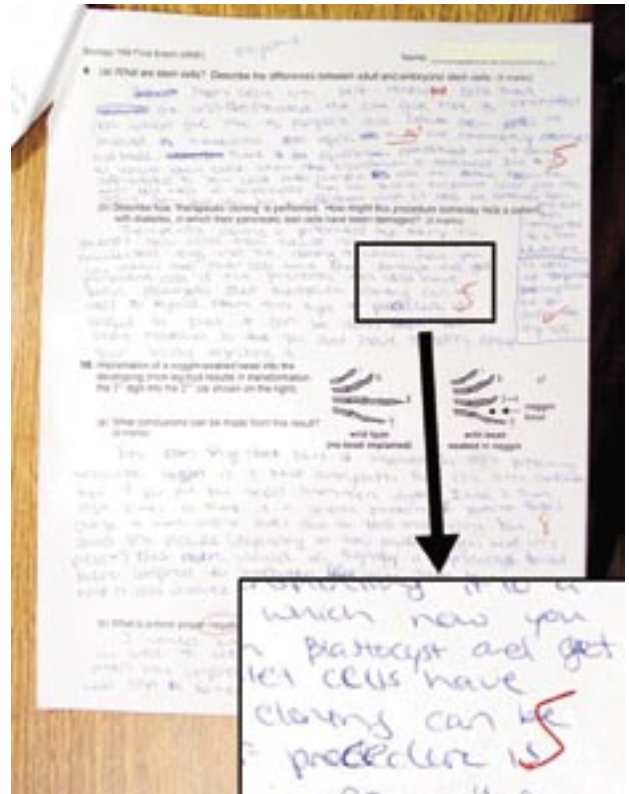


FIGURE 2

Example of a 1.2 MP image (1,280 x 960 pixels) of an exam page, with inset detail to show resolution of image.



for safekeeping a copy of the archive is made onto inexpensive CD-R media and stored in a safe location away from the computer. I usually include on the CD a spreadsheet file containing all the student grades, as well as an image set of the exam grading key. Because a single CD-R can hold up to 700 MB (more than 2,200 images at 320 KB each), many sets of exams can be accumulated on a single disc for long-term storage.

### Retrieving from the archive

Digital cameras typically number their image file names consecutively, and each file is imprinted with a creation date. Because the exams were alphabetized before the archive was taken, there is no need to rename individual files. Rather, to retrieve a particular exam, the alphabetical position of a student is determined from a gradebook. By multiplying the number of pages per exam by this position minus one, the approximate number of the

images from the first image in the archive can be determined. Pages can be viewed onscreen, or printed directly to the computer from an image preview program. Alternatively, images can be imported into another program such as Microsoft PowerPoint for cropping and resizing for printing as desired.

### Advantages over photocopying

Most of the advantages of using a digital camera for document archiving are self-evident, such as low cost of production and replication, the ability to make the archive just about anywhere, and the small amount of space taken up by digital images. Other advantages include the following: there is no need to remove staples; the images are in color, allowing writing of weaker contrast to be imaged, and for grader's markings to be distinguished from the student's; and the order of pages is made more secure by the camera's sequential

numbering system and the date/time stamp of every image.

I have found that other applications of such an archive are simpler if it exists in digital form. For example, it is easy to post sample answers directly to an online site such as Blackboard, or to show in a PowerPoint-based lecture. Grade disputes can be resolved rapidly by e-mail. Finally, if I am writing a letter of recommendation for a former student, I can look up their exam from CD-ROM long after the course is over and make meaningful comments about their insight and writing abilities directly, rather than having to rely solely on memory.

### Conclusion

The availability of inexpensive digital cameras and CD-R drives has brought digital archiving well within the capabilities of any instructor. Using this technology to make exam grading more secure adds to the arsenal of tools in the ongoing fight against academic dishonesty.