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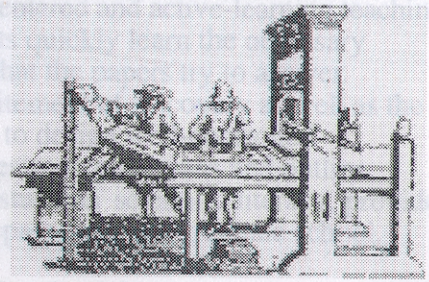
Virtual Reprints as Reading Assignments



by A. Malcolm Campbell

(Posted May 29, 1998 · Issue 31)

Though textbooks will likely continue to be medium of choice for undergraduate biology courses, original scientific papers better allow students to analyze data, learn how to read critically, and see that what is written in the active literature is not as black and white as in textbooks. The Internet's accessibility to both students and teachers presents an exciting new way to distribute primary scientific literature. Papers placed online by publishers - and even those existing solely in print - may now be shared via the World Wide Web.

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The traditional reprint method - photocopying - has always had limits. Original documents deteriorate from heavy usage. Photocopying does not display subtle aspects of original figures, such as faint bands on a gel or immunofluorescence micrograph. And color figures do not photocopy at all without the use of expensive color copiers. Much of a teacher's class time might be spent just describing which part of a figure at which everyone should be looking. All such problems are solved by using virtual reprints. Documents may be duplicated one or one thousand times with no effect on the original physical copy. On-screen and hardcopy versions of figures can accurately reproduce the originals. Color may be used to enhance original figures when bar graphs or line drawings use shading that is difficult to discern.

Virtual reprints are superior to old-fashioned printed distribution.

By making original papers more accessible, virtual reprints help achieve many common teaching objectives and lend themselves to both student-centered and active-learning teaching approaches. By reading a series of related papers, students quickly learn the necessary vocabulary and can concentrate on the central questions that the papers try to answer. Students learn to read critically, and to appreciate the excitement of discovery as well as the amount of work required by experimentation. They learn to design well-controlled experiments, interpret new data, and to creatively hypothesize explanations and outline potential future research. All of these goals contribute to students' scientific literacy, provide good practice for standardized tests, and substantially prepare them for graduate school.

To create a virtual reprint, start by choosing a series of related articles (two to five should do) that were critical to discovering the answer to an interesting and fundamental question. Papers that might be considered classic are good choices because they are relatively simple, make good use of fundamental methods, and are focused on a fascinating question that has now been answered, at least in part.

When selecting these papers, factor in which journals will allow you to reproduce their work on the Web. Ironically, the American Association for the Advancement of Science does not allow, under any circumstances, any electronic reproductions of Science. Cell allows reproduction of any articles predating their online articles, but they want to keep the files on their server. The Journal of Biological Chemistry and Human Molecular Genetics allow posting of virtual reprints on one's own Web server. Many journals allow

Which journals will allow you to reproduce from the Web?

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allow posting of virtual reprints on one's own Web server. Many journals allow reproduction of older papers so long as access is restricted to campus computers. This author was once asked by a journal to pay a per-page charge, but instead opted not to use their articles, since so many other journals allowed free reproduction of pages.

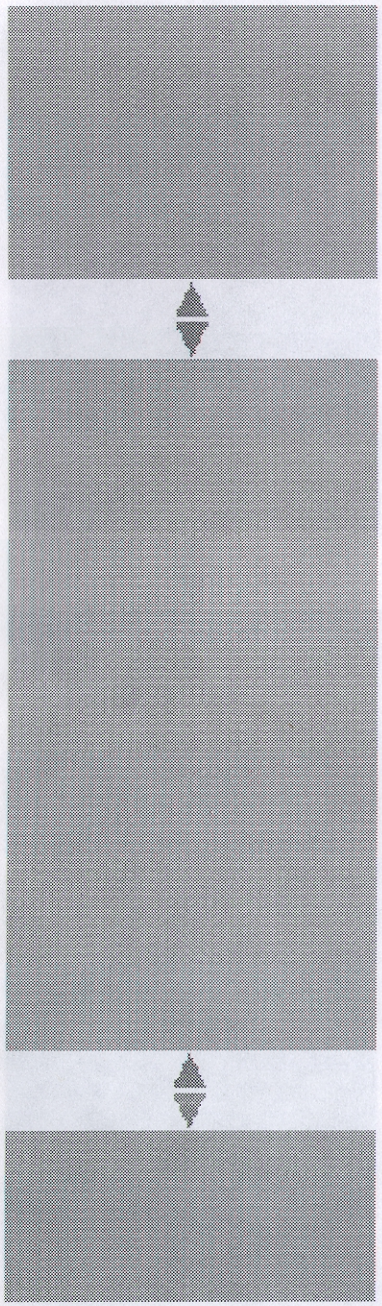
To get permission for specific articles, contact the copyright owner. Most copyrights are now shared by the authors and the publisher; earlier policies may vary among journals. For example, before 1990, only the authors retained copyrights to individual articles in the Proceedings of the National Academy of Sciences.

If an article is not already online, a few steps are necessary to convert to an electronic format. Teachers can learn these steps themselves, or request that the work be done by commercial or institutional document services, or enlist the aid of Web-savvy students.

To begin, scan the pages of the original paper, using the original copy that is bound in the library copy of the journal. An optical character recognition (OCR) program, used in conjunction with or after scanning the pages, converts the printed text into electronic text that can be spell-checked with any word processor. The accuracy of OCR, rarely perfect to begin with, is compromised by odd typefaces and characters, so proofread the original document, word by word, against your text file.

To convert printed figures, scan them and save the scanned images. A program such as Photoshop, or any number of simpler, more accessible packages, allows editing of the image. It is important to clean up the electronic version so that it resembles the original as closely as possible. This can involve painting out scanning errors, rotating the image to make it level, and cropping it to eliminate irrelevant portions. As mentioned above, one can also adjust contrast and add or adjust color to make figures more readable than they were in even the original versions. Figure legends

One can also adjust contrast and color to make figures more readable than they were in even the original versions.



in even the original versions. Figure legends are best processed as text, with OCR. After editing, figure images can be converted by the editing program to either JPEG or GIF, the two predominant image formats on the Web. GIF files tend to be smaller, taking up less disk space and traveling faster online. However, JPEG files tend to better render photographs, as opposed to line art.

Many programs are available to convert word-processing files into HTML, the format required for Web browsers to be able to read the document. After the conversion of text to HTML, figure GIFs or JPEGs may be added to the document, and links added that tie together appropriate pages. Some Greek letters and other special symbols are not guaranteed to be represented accurately by all Web browsers. One solution is to create a small GIF figure that is the size of the text characters, and to insert it where necessary. Another is to spell out the name of the letter, e.g., "alpha," a common convention in online scientific documents.

This completes the creation of the virtual reprint as a browser-readable file. It is then necessary to post it to the Web so others may access it. Institutional or private Internet providers maintain Web servers on which files are physically located; once the file is uploaded to the server, the virtual document will be accessible to anyone to whom its Web address (also called a URL) is given. Should changes be required, corrected files may be uploaded to the server at will. Virtual reprints should be fully proofread before uploading.

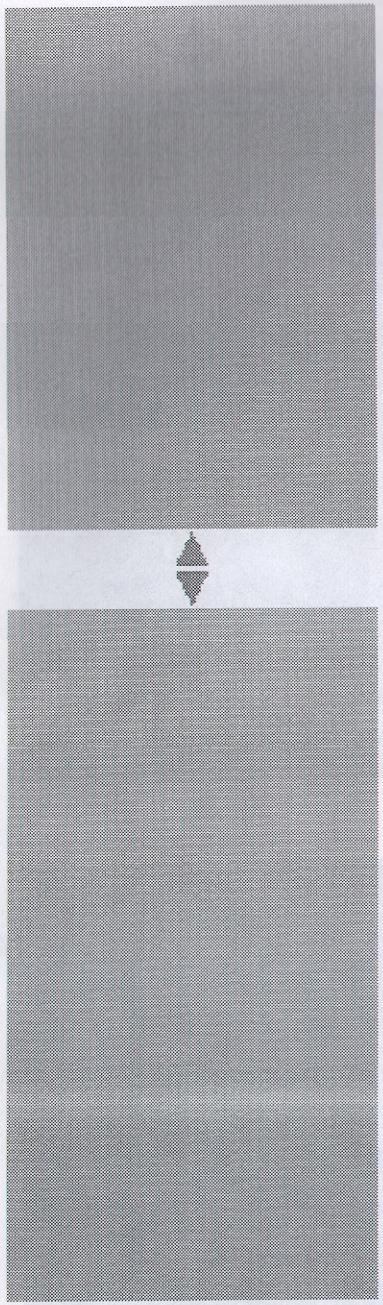
Virtual reprints have been unanimously hailed as the most popular and educational learning tool of this author's courses. By presenting information using such up-to-date technology, teachers can grab the attention of a wider range of students while offering them a clearer picture of the benefits of learning.

A. Malcolm Campbell, Ph.D., is an assistant professor of biology at Davidson College. He has made numerous presentations about teaching as an "alternative" career option, and has written How to Get a Teaching Job at a Primarily Undergraduate Institution .

Endlinks

Center for Investigative Neuroscience Online Reprint Database - contains bibliographic information and abstracts for about 5,000 neuroscience articles.

Bio 380 (Tele)Communicating Biology Syllabus - much more than a course syllabus. William Graziadei of the State University of New York at Plattsburgh has created a series of



informative pages, including Changing Nature of Instructional Delivery, for those seeking to use the Internet to teach science more effectively.

Electronic Publishing in Science - a discussion from *Science*'s Next Wave about the future of electronic publishing.

BioMedNet Library - provides free access to abstracts and some full-text articles from more than a hundred journals. Other articles can be accessed following a journal subscription or on a pay-per-view basis.

Bio/Chemical Journals and Newsletters - alphabetized list of links to home pages for online journals. From Pedro's BioMolecular Research Tools.

Science, Technical, Medical (Peer-Reviewed) - another list of online journals. From the WWW Virtual Library.

Other Useful Sites for Courseware Developers - long list of annotated links to sites related to the use of technology in teaching.

HMS *Beagle* has published several articles exploring the use of journals online:

- Scientific Publishing on the World Wide Web: The BioMedNet and HMS *Beagle* Models - a report by Sarah Greene and Matthew Cockerill on the growth of online journals, rich in links to journal sites.
- Lively Links: Ramping Journals onto the Highway - why should journals be online in the first place? Robert Ubell writes about the new economic of online scientific publishing.
- Notice the Library Sprouting on Your Desktop? - Ellis Rubinstein on the joys of science-paper hyperlinks.
- Evaluated MEDLINE - HMS *Beagle* review of BioMedNet's annotated MEDLINE service. The editor of BioMedNet has also written a profile of Evaulated MEDLINE and of the evolution of its predecessors.

Webmonkey - Hotwired's eye-catching HTML resource site complete with HTML reference guides, information about Web-related tools, and links to cutting-edge Web sites.

Tell us what you think.

Feedback

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