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ABSTRACT

This paper introduces instructional methods using the Internet and the World Wide Web (WWW). The purpose of this paper is to specifically demonstrate the effective application of the Internet in teaching biology. Specific strategies such as accessing information via the Internet, effective search assignments, rules for appropriate use of the Internet, creating one's own web page, Internet connectivity, advanced capabilities, and individualizing instruction are discussed with effective sample instructional materials. Contains references and links to on-line resources from around the world. (Author/AIM)

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TEACHING BIOLOGY BY THE INTERNET

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ABSTRACT

An introduction to instructional methods using the Internet and World Wide Web (WWW). For teachers and others to gain experience with this cutting edge technology. Presented at the 1997 Arizona Science Teachers Association Convention in Mesa, Arizona. The purpose of this paper is to specifically demonstrate the effective application of the Internet in teaching biology. Specific strategies such as accessing information via the Internet, effective search assignments, rules for appropriate use of the Internet, creating your own Web Page, and more are covered with effective sample instructional materials. Includes references and links to fantastic online resources from around the world.

INTRODUCTION

Teaching Biology by the Internet is an introduction to instructional methods using the Internet and World Wide Web (WWW). Several exercises have recently become available on the history and general use of the Internet. The purpose of this paper is to specifically demonstrate the effective application of the Internet in teaching biology. Specific instructional strategies are presented with effective sample instructional materials that demonstrate how this cutting edge technology can be used to enhance presentation of biology content. The format is interactive, allowing you to gain practical experience and start utilizing fantastic online resources from around the world right away!

CONTENTS

1. THE INTERNET AND WORLD WIDE WEB

The concept of a global communication system accessible to the scientific research community was conceived of less than fifty years ago. At that time, technology was not advanced enough to bring the concept to reality. In the 1960's, the project gained momentum. By this time, technology had advanced, and the rudiments of the Internet began to take shape. In March 1989, the European Particle Physics Laboratory (CERN) developed a system that was able to transmit text documents between its computer networks. This simple network became known as a network of networks or Internet.

In 1991, software was introduced at a Hypertext Conference that allowed users of the Internet to transmit graphics, images, and hypertext documents. Thereafter, interest in connecting to the network began to grow, resulting in the complex pool of information we now call the World Wide Web (WWW). For more detailed information regarding the history, development, and design of the Internet and the WWW, look at these sites:

http://rs.internic.net/nic-support/15min/
http://www.mcli.dist.maricopa.edu/w3info/

http://www.w3.org/
http://www.w3.org/TheProject.html
http://www.netlingo.com/
http://www.cs.cmu.edu/afs/cs/usr/mwm/www/tutorial/outline.html

2. ACCESSING INFORMATION VIA THE INTERNET

There are several ways to access information on the Internet. The programs used are generally called Search Engines. There are Search Engine formats which allow the transmission of text only. There are Search Engine formats which allow the transmission of text and all kinds of graphics and media. The most common of these is known as Hypertext Markup Language (HTML). There are many advantages to utilizing the HTML formats. Some of these advantages include the ability to transfer and view graphics, sound, and multimedia images in a user friendly (Browser) environment.

Examples of Search Engines:

Examples of text-only Search Engines include the sites listed below. These Search Engines are free, but not very user friendly. They experience heavy use and so are often busy when you try to use them:

Gopher (http://ipac.net/)
Veronica (gopher://gopher.scs.unr.edu/00/veronica/veronica-faq)
Archie (http://www.nexor.com/archie.html/)
Biologists Search Palette (http://www.molbiol.ox.ac.uk/www/ewan/palette.html)

Examples of HTML compatible Search Engines would be:

Yahoo (http://www.yahoo.com/)
AltaVista (http://www.altavista.digital.com/)
Excite (http://www.excite.com/)
Lycos (http://www.lycos.com/)

These Search Engines are also free, and fortunately, more user friendly. They are supported by advertizing, so be ready to read banners when browsing.

3. INTERNET SEARCH ASSIGNMENTS

Internet search assignments are fun for students and easy to create. Rather than assigning traditional references, require students to obtain their references from the WWW. They can research a topic, locate supporting information for a specific assignment, and interact with other

students or experts. Students should reference their sources as shown in the sample Reference Guidelines (Appendix A). For an example of an Internet assignment, see Recycling (Appendix B).

Collect WWW addresses and you'll soon build a list of links to Web Pages of interest to use in your own teaching. You can use any of the Internet Search Engines suggested above to quickly find many interesting biology links. Or, check out some of the links listed in Sample Links (Appendix C).

4. INTERNET CONNECTIVITY

There are several ways to use the Internet with students, even if you do not have a computer for everyone or a connection to the Internet in your classroom:

a. Project the Internet using a projection device
b. Display the Internet on a TV (get a graphics card for your computer)
c. Network your classroom or library
d. Allow students to do assignments at home or in a library (most public libraries now have Internet connections)
e. Download information from the Internet for students to use at a reference station/computer

Everyone doesn't need his or her own computer. Use programs that capture Web Pages for your classroom such as WebSeeker (http://www.ffg.com/seeker/), WebWhacker (http://www.ffg.com/whacker/), or GrabNet (http://www.ffg.com/grabnet/) by ForeFront Inc. According to ForeFront, WebSeeker searches over 100 Search Engines to provide the most comprehensive information available. WebWhacker is an off-line browser that allows you to download information to your hard drive or disk. GrabNet is a browser companion that downloads information such as text, graphics, or URLs to your computer's desktop or files.

5. RULES FOR APPROPRIATE USE OF THE INTERNET

You will want to adopt some measures to ensure appropriate usage of the Internet by your students. Depending on the level of access your students need and their ability level, there are several ways to accomplish this goal. Some of the most common include the following:

a. Develop a written policy for your school or district regarding Internet accesses and have students sign it.
b. Using programs that capture the Web for your classroom such as WebSeeker, Web Whacker, or GrabNet.
c. Purchasing net-filtering programs that are available to limit objectionable sites, including junk e-mail and objectionable NewsGroups.

For a look at some Internet Permission Forms, visit the following links:

Anchorage School District (http://www.asd.k12.ak.us/Schools/Chugach_Optional /library/interperm.html)
Jefferson County Public Schools (http://www.jefferson.k12.ky.us/AcceptableUse/ StudentAgreement.html)
http://www.iit.edu/~steeple/accept.html
http://www.bev.net/education/schools/admin/InternetConduct.html
http://www.mindspring.com/~lmsmedia/aup.html

For examples of net-filtering programs, see

CyberSitter (http://www.solidoak.com/cysitter.htm)
NetNanny (http://www.netnanny.com/)
SurfWatch (http://www.surfwatch.com/)
CyberPatrol (http://www.cyberpatrol.com/)
Info Scan (http://www.machinasapiens.com/english/products/infoscan/infoscanang.html)
Spam Filter (http://www.scot.demon.co.uk/spam-filter.html)

6. CREATING YOUR OWN WEB PAGE

As you become more familiar with the Internet, you'll want to build your own Web Pages or assign students a Web Page project. Building a Web Page is easier now with the many resources available on the Internet. With these resources you generally can build a personal or educational page without knowing HTML programming code. In many cases, you can download the programs, including directions, from the Internet. Here are some sample links that illustrate these options:

http://learning.lib.vt.edu/webserv/
http://webreference.com/
http://www.stars.com/Tutorial/
http://hakatai.mcli.dist.maricopa.edu/tut/about.html
http://www.bev.net/computer/htmlhelp/
http://info.med.yale.edu/caim/manual/contents.html
http://www.sun.com/styleguide/
http://ncdesign.kyushu-id.ac.jp/html/html_design.html
http://werbach.com/barebones/
http://www.killersites.com/

There are many advantages to building your own Web Page, some include:

a. Provides a tool for you to publish your course description and curriculum outcomes

b. Provides a tool to give a brief description of your teaching philosophy
c. Gives you the ability to add an electronic bulletin board for students to ask questions directed to you or other students
d. Students and colleagues can access you by e-mail at any time
e. Assists students with registration since they can view the course Web Page and determine if the course fits their needs
f. Allows you to publish sample assignments and Frequently Asked Questions (FAQ) sheet

For an effective example of how to use Web Pages to enhance your courses in the ways described above, see http://www.mc.maricopa.edu/users/baker/

Web Page assignments are fun for students and easy to create. Rather than assigning a traditional paper, require students to gather information and present it as a Web Page. The assignment should require the same content, grammar, spelling, and references as a traditional paper. Students should include links to other related Web Pages of interest. The final product may be viewed using the in-class methods discussed above or published by inclusion on your school's Web Page. For an example of a Web Page assignment, see Internet Web Page Assignment (Appendix D).

Once you've created your Web Page, you'll want to promote it by listing it with Internet Search Engines (see Unit 2) so that people can access it on the WWW. Most Search Engines have easy directions for adding your uniform resource locator (URL) address on their Home Page banner. There are also companies that will list your Web Page with multiple Search Engines automatically. These may charge for their services, but offer convenience in exchange. For examples of companies that register Web Pages see http://www.123add-it.com/ or http://www.submit-it.com/.

7. ADVANCED CAPABILITIES

In addition to the advantages of building your own Web Pages, the Internet offers tools to meet the diversified needs of your learners. Once you've created your Web Page, you'll want to check out the following capabilities:

FAQs. You can create a Frequently Asked Questions hyperlink from your Web Page. Students are then able to view common problems and questions. Students can check this link first to trouble shoot assignments when you're not available. This FAQ page will save time for you and the student, by giving students access to help whenever they might be working on homework or assignments.

EBBs. You can create an Electronic Bulletin Board hyperlink from your Web Page. Students can post questions here which can be answered electronically by you or a T.A. These Q and A's stay on the bulletin boards until you delete them. Students and faculty are able to view common questions and solutions. As

with FAQs, this link will save time for you and the student, by giving students access to help whenever they might be working on homework.

UseGroups or NewsGroups. You can subscribe to these to keep well informed and updated in your field of expertise. Some of these subscriptions are moderated, therefore the information is more reliable. Some allow anyone to post information. Use caution when subscribing to these.

You can subscribe for your classroom (this would be especially effective when doing a thematic unit or special project). For example, subscribe to a news group on the unit topic and get information that students can access while completing the assignment. Remember, everyone doesn't need his or her own computer. Use programs that capture Web Pages, such as those listed above.

Some examples of links to Newsgroups and Newsgroup Search Engines include:

http://www.tile.net/
http://www.dejanews.com/
http://www.altavista.digital.com/
http://www.yahoo.com/Science/Biology/Usenet/

8. INDIVIDUALIZING INSTRUCTION

Teaching by the Internet provides you with tools to meet a diversity of needs and make instruction more accessible to all learners. The Internet is a highly effective tool for students who require enrichment. Such students can be easily accommodated with assignments such as the following:

a. Looking for more depth on an assignment
b. Contacting researchers or experts regarding a specific topic
c. Gathering and sharing information with the entire class to create a team or class learning environment

Students who would benefit from supplemental instruction can be accommodated through additional graphic images, pictures, and explanations. We use Internet exercises that allow students to:

a. Work at their specific pace
b. Select the additional media most suited to their individual needs

c. Work together with other students in the class to gain content mastery and acquire conceptual understanding
d. Participate in additional exploratory activities guided by the scientific method

We have found significant gains in student achievement using these activities in an inclusive learning environment.

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One exception may be work that is considered in the Public Domain, although this is a complicated area. Works enter the Public Domain by the author giving up a copyright through explicit permission or by being dead for a set number of years. There has also traditionally been some leeway granted for the use of a copyrighted work in non-profit educational settings such as teaching, scholarship, or research. This issue, termed Fair Use, has become clouded with the advent of the Internet. For example, consider the following capabilities:

a. copying images from another site for your Web Page
b. using frames to show another site in your Web Page
c. saving a Web Page on your hard drive
d. linking to another Web Page into your page

Do these capabilities lead to copyright infringement or could they be considered fair use? It is best to get legal advice from your school or school district concerning these issues. Most schools and school districts have guidelines on what constitutes fair use. Even when using works appropriately, always thoroughly reference your sources following an accepted citation format (for example, see Reference Guidelines in Appendix A).

If your Web Page includes links to other sites, remember that the work on those sites is usually copyrighted. When visiting linked sites, you must comply with the stated copyright policy of the copyright holders.

For some information regarding fair use and Public Domain, visit the following sites:

http://fairuse.stanford.edu/
http://www.arl.org/info/frn/copy/timeline.html
http://www.benedict.com/fair.htm
http://www.benedict.com/fairtest.htm
http://www.PDImages.com/web9.html-ssi
http://www.PDImages.com/web6.html-ssi
http://www.PDImages.com/

The best material for your Web Page is material you have authored yourself, or hired someone to create for you with the understanding that it will be owned by you. If you intend to include works produced by your students or pictures that include other people, you need their permission. If your students are under the legal age to give the permission themselves, permission must come from their parent or guardian. Again, it is best to get legal advice from your school or school district concerning these issues. Most schools and school districts have the necessary permission forms or can adapt them from forms already in use for other types of publication. For some additional information regarding the use of pictures, see the following links:

http://www.PDImages.com/LawBookTOC.html-ssi
http://www.PDImages.com/web9.html-ssi
http://www.PDImages.com/LawBookPage.html-ssi

To see some permission forms being used by others, visit the following sites:

http://www.alaska.net/~aebsd/c.o.info/aebsd.forms/permission.html

http://www.inform.umd.edu/ARHU/Depts/ArtHistory/arthfac/spromey/courses/453.97/form.html

http://www.bham.wednet.edu/parent.htm

For some information regarding Public Domain images, try the following:

http://www.PDImages.com/web6.html-ssi
http://www.PDImages.com/

Of course you will want to include information on your Web Page regarding your copyright and a disclaimer regarding its use. For example, this information is copyright 1996-7 Baker, Binder & Turturice except where noted. All rights are reserved. No portion of this material may be reproduced without the express, prior written permission of the copyright holders. Please note that the instructor is not responsible for the contents of any Web Sites or for their use and/or

misuse. The instructor does not assume any responsibility for the content of any information reached through a link displayed here. Remember that the work reached via links is usually copyrighted. When visiting linked sites, you must comply with the stated copyright policy of the copyright holders. This is not a complete listing of Internet resources. Inclusion of a resource or link here does not imply endorsement. This is a Biology course and information is intended for educational purposes only and not intended as advice or professional service.

ADDITIONAL REFERENCES FOR EDUCATORS:

Ause, W. & Arpajian, S. (1996). How to use the World Wide Web. Emeryville: Ziff-Davis Press.

Castro, E. (1997). HTML for the World Wide Web (2nd ed.). Berkeley: Peachpit Press.

Hahn, H.; Stout, R. (1995). The internet yellow pages. Berkeley: Osborne McGraw Hill.

Hill, B. (1997). World Wide Web searching for dummies (2nd ed.). Foster City:IDG Books Worldwide.

Holden, G. (1997). Creating web pages for kids & parents. Foster City: IDG Books Worldwide.

Kressin, M. (1997). The Internet and the World Wide Web:a time-saving guide for new users. Upper Saddle River: Prentice Hall PTR.

Lehnert, W. (1997). Internet 101: a beginner's guide to the Internet and the WWW. Reading: Addison Wesley Longman.

Maran, R. (1997). Teach yourself Internet & World Wide Web visually. Foster City:IDG Books Worldwide.

McCormack, C. & Jones, D. (In Press). Building a Web-based education system. New York: Wiley Computer Pub.

Robinette, M. (1997). Macs for teachers (3rd ed.). Foster City:IDG Books Worldwide.

Shafran, A. (1997). Creating your own Web pages (2nd ed.). Indianapolis: Que.

Toliver, P. & Kellogg, C. (1997). PCs for teachers (2nd ed.). Foster City:IDG Books Worldwide.

Waters, C. (1996). Web concept & design:a comprehensive guide for creating effective Web sites. Indianapolis: New Riders.

Williams, B. (1996). Internet for teachers (2nd edition). Foster City:IDG Books Worldwide.

Williams, B. (1996). The world wide web for teachers. Foster City:IDG Books Worldwide.

Williams, B. (1997). America online for teachers. Foster City:IDG Books Worldwide.

Williams, B. (1997). Web publishing for teachers. Foster City:IDG Books Worldwide.

APPENDIX A

SAMPLE REFERENCE GUIDELINES FOR THE INTERNET ASSIGNMENT

A major objective for this course is that students learn to access resources relating to biology on the World Wide Web (WWW). Use your Internet Search Engine to find answers to the assigned application questions. Reference all answers as follows:

If the reference is an article from the Internet, please list the author(s), title, date and Internet address. Follow the example below:

Feliciano, R.M. Human error: designing for error in medical information systems.Feb 7, 1995. Internet URL: http://camis.stanford.edu/people/feliciano/hci/humanerror/

If the reference is an organization accessible via the Internet, please list the URL Internet address. Follow the example below:

American Cancer Society. Internet URL:http://www.cancer.org/

Please note that the instructor is not responsible for the contents of any Web Sites or for their use/misuse. The instructor does not assume any responsibility for the content of any information reached through a link displayed here. This is a biology course and information is intended for educational purposes only and not intended as advice or professional service.

APPENDIX B

RECYCLING INTERNET SEARCH ASSIGNMENT

Name _____ Date _____

Use your Internet Search Engine to find answers to the following questions. Reference all answers as described in the sample available on this Web Page. Please note that the instructor is not responsible for the contents of any Web Sites or for their use/misuse.

1. Where can I find out which type of recycling is the most common in the U.S.?

2. What are two organizations that follow statistics on recycling?

3. Where can I find information concerning the benefits of recycling?

4. Locate 2 sources of free information on how to compost. Please list the Internet address along with a brief description of the type of information available at this site. In your description, include whether this information is for companies or consumers.

5. Locate 2 sources of free referral information for car pooling in Phoenix. Please list the Internet address along with a brief description of the how the service works.

6. Locate one site with a free guide on creating your own recycling club that can be downloaded or obtained through e-mail. Please list the Internet address along with a brief description of the type of information at this site and how you obtain this information.

7. I was watching a story on the evening news about alternative fuels that looked interesting. Where can I find information concerning alternative fuels?

8. I was watching a story on the evening news about the dangers of alternative fuels. Where can I find information concerning the dangers and risks of alternative fuels for the home.

9. List at least two research journals that contain articles on new approaches to conserving energy. Both journals you list should be refereed journals.

10. Using the journals you listed above locate a research article that reports on a new strategy for disposing of toxic home chemicals. Please list the author(s), title, date, and Internet address along with a brief description of the article in your own words.

11. You have just been asked how a person finds out about participating in a recycling program locally. What are the 2 closest sites for such programs? Please list the Internet URL address along with a brief description of how a person can sign up.

APPENDIX C

SAMPLE BIOLOGY LINKS LISTED BY TOPIC

General Biology:

For a really great comprehensive list of links with suggestions for classroom activities try
http://eruditio.asu.edu/~smckeeve/scilinkindex.html

here's a site where students can email questions to researchers and others:
http://www.campus.bt.com/CampusWorld/pub/ScienceNet/

or try these sites that maintain links to other science sites, journals, and data bases:
http://devbio-mac1.ucsf.edu/sciencesites.html
http://www.gene.com/ae/
http://spacelink.msfc.nasa.gov/html/scifairt.html
http://php.indiana.edu/~jracy/

Yahoo maintains a section for news groups you can browse:
http://www.yahoo.com/Science/Biology/Usenet/

and try pictures or lab experiments in these virtual lab websites:
http://www.sidwell.edu/sidwell.resources/bio/VirtualLB/
http://www.biology.yale.edu/animationDemo-Selection.html
http://www.biology.yale.edu/animatedMitosis.nclk
http://www.sunynassau.edu/webpages/biology/EMGallery.htm
http://www.epa.gov/vislab/svc/projects/past_projects.html
http://www.amc.anl.gov/docs/anl/TPM/TPMHomePage.html

For Medical Information and Reference:
try the American Cancer Society http://www.cancer.org/frames.html
or UCSD's center for genetics at http://biochemgen.ucsd.edu/
the NIH's National library of medicine web page http://www.nlm.nih.gov/
or the NIH Home page http://www.nih.gov/
the Center for Disease Control web page http://www.cdc.gov
National Cancer Institute site http://wwwicic.nci.nih.gov/nci.htm
and try CancerNet at http://wwwicic.nci.nih.gov/

For Genetics and data from the Human Genome Project:

try the NIH at http://www.nhgri.nih.gov/
or Baylor College of Medicine http://kiwi.imgen.bcm.tmc.edu:8088/home.html and
http://gc.bcm.tmc.edu:8088/bio/bio_home.html
or the Department of Energy http://www.er.doe.gov/production/ober/bioinfo_center.html
http://www.genlink.wustl.edu/mmp/chrX/chrX.fam.html

For sites on Ecology:

try http://eagle.bio.unipr.it/EcoWWW.html

For Biotechnology Information and Genetics:

try the National Center for Biotechnology Information
http://www.ncbi.nlm.nih.gov/Omim/

AND Just for Fun:

Worm World is always a favorite at http://www.nj.com/yucky/worm/

APPENDIX D

INTERNET WEB PAGE ASSIGNMENT

OBJECTIVE: To improve your scientific reasoning and communication skills.

PROCEDURE: Your lecture grade will be based in part on an Internet Web Document you create. The topic must be Laboratory 13, "Plant Variation." The Web Document will be developed in the style described in HTML for Dummies (2nd ed.) or an acceptable equivalent style. A sample of an acceptable style will be given. The Web Document is due on December 1 at 10:30 a.m. Your Document must also be grammatically correct, with proper spelling for full credit.

You should include a concise, but comprehensive discussion of your topic as well as links to related information on the WWW. You are encouraged to submit your document early for review by me. All Web Documents are due for final grading by December 1 at 10:30 a.m. Please note that assignments will not be accepted after this time.

The Web Document should be at least 3 to 4 Web Pages in length with working links. Your references must include at least 8 sources, with a minimum of 5 of these 8 as journal articles or Internet sources. You must use the required headings shown on the sample Web Document and in the Guidelines below. You must use all headings as shown in this example.

GUIDELINES: The Web Document should be 3 - 4 Web Pages long. It must include the following:

Approved Topic	2
Format	10
Grammar and Spelling	10
Title and Headings	5
Discussion of topic	10
Graphics	10
Links to related material on the WWW	10
References	3
Total points possible	60

REFERENCES: When citing References from the Internet, please list the author(s), title, date and Internet address. Follow the example below:

Feliciano, R.M. Human error: designing for error in medical information systems. Feb 7, 1995. Internet URL: http://camis.stanford.edu/people/feliciano/hci/humanerror/

Be sure to see me if you have further questions and see the sample Web Document available on the WWW.

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