INTO K–8 SCIENCE

By David R. Wetzel

NATIONAL SCIENCE TEACHERS ASSOCIATION
Arlington, Virginia

NSTApress®
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07 06 05 4 3 2 1

Library of Congress Cataloging-in-Publication Data
Wetzel, David R.
How to weave the Web into K-8 science / by David R. Wetzel.
p. cm.
Includes bibliographical references and index.
ISBN 0-87355-235-0 (alk. paper)
1. Science—Study and teaching (Elementary)—United States. 2. Internet in education—United States. 3. Educational Web sites—United States. I. Title.
LB1585.3.W48 2004
372.3'5'044—dc22

2004027763

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Introduction

Are you wondering how to integrate internet resources into your science curriculum? Or maybe you already are using internet resources and are looking for new strategies and resources? Are you concerned about the time or computer skills you would need to plan activities or participate in web-based projects? If you answer yes to any of these questions, this booklet is for you. Whether you are a beginner or have some experience in using internet resources, this booklet will help you integrate web-based resources into your science curriculum.

What are web-based resources in science? They are any type of source available on the internet for teaching science. They include search engines, Listservs, website directories, online data bases, lesson plans, WebQuests, content-specific websites, real-time data collection websites, virtual field trips, virtual labs, online simulations, problem-solving case studies, and multimedia presentations. As you investigate ways to integrate these web-based resources into your science teaching, you will discover that your computer is a powerful tool that will help you become a facilitator of learning and will help your students develop a better understanding of science. Although this book is targeted for elementary and middle school science, you will find the ideas applicable for any subject you are teaching.

The National Science Teachers Association's position statement, *The Use of Computers in Science Education* (NSTA 2004), recommends using the internet and its resources for networking students with scientists, teachers, and other students; gathering information and data; posting data and findings; and providing students with the most up-to-date science information. The No Child Left Behind (NCLB) Act (U.S. Department of Education 2002) stresses the need to integrate more technology in teaching to help students learn subject matter. By beginning to integrate web-based resources along with other technology resources into your science curriculum today, you can hone your web-based teaching skills at your own pace and comfort level, and your students can develop an understanding of science that will better prepare them for the NCLB science assessments that start in 2007. Research by Fullan and Hargreaves (1996), along with Becker (1991), has shown it takes two to three years for teachers to effectively integrate a new teaching strategy or program.

In this booklet you will find information on and strategies for using internet resources for teaching science. Additionally, you will find many web-based science resources you can integrate into your science curriculum, online technical help resources for beginners and experienced users, and strategies for developing your own web page. There is a companion website to support use of all the web-based resources in this book (*http://ci.unlv.edu/~dwetzel/webscience.htm*) at which you can find updated

web addresses listed by chapter and links to additional science teaching resources.

Here's a chapter-by-chapter look:

Chapter 1 covers why you should use web-based resources on the internet to teach science, what the advantages of using these resources are, how the web-based resources support national and state standards, and tips for using web-based resources.

Chapter 2 provides strategies for integrating web-based resources into a science curriculum. It includes sections on one-computer classrooms, multicomputer classrooms, wireless computers, handheld computers, web-based learning centers, WebQuests, web-based lessons, virtual tours, virtual labs, multimedia presentations, and more.

Chapter 3 provides resources for web-based science teaching and learning. This chapter includes sections about search engines and directories. The highlight is a section that provides web-based resources listed by category and science content area.

A glossary covers internet teminology. The appendixes consist of a list of online resources for teachers and instructions for developing a web page.

About the Author

David R. Wetzel is an assistant professor of science education at the University of Nevada–Las Vegas. Prior to beginning his teaching career at the university level, he taught elementary and middle school science and worked as a middle school science and technology curriculum developer for the Smithsonian Institution and National Academy of Sciences. He has published articles about the integration of technology in science teaching in NSTA's *Science Scope*: "Fan Car Physics" and "Laser Labs." Other publications include the chapter "Technology Transforms the Game of Teaching Science" in *The Game of Science Education* (Weld 2003). He has reviewed manuscripts for *Science and Children*, for *Science Scope*, and has a "Science Problem of the Week" website for K-8 students. He earned his PhD in science education from George Mason University.

Reference:

Weld, J., ed. 2003. *The game of science education.* Boston: Allyn and Bacon.

CHAPTER 1

Internet Basics for the Science Classroom

I do not fear computers. I fear the lack of them.

— Isaac Asimov

Why use web-based resources to teach science? This question has many answers. One is that web-based resources expand your students' access to science topics or problems. For example, students in different parts of the world can participate in projects in which they compare the length of shadows cast by a one-meter stick at different latitudes or calculate the Earth's circumference. They can explore science topics—such as weather, volcanoes, and real-time data collection from rivers and streams anywhere in the United States—in greater depth and in more interactive ways—with, for instance, simulations, online projects, and problem solving. Web-based technology helps them make connections, analyze ideas, and develop conceptual frameworks for thinking and problem solving. Students do real science along with hands-on investigations and share their findings with others.

The power of the internet eliminates the walls that surround your classroom and moves your science curriculum into the 21st century (Wetzel 2004). Using the internet, you can take your students on virtual trips to the National Zoo in Washington, D.C., or Mount St. Helens in Washington State, to an Amazon rainforest or a Caribbean reef, and to Antarctica or the tropics.

Other reasons for using web-based resources lie closer to the core of teaching practice. When you use this technology to teach science, your students develop greater understanding by making connections between hands-on science investigations in your classroom and current science information gathered from online resources. K–8 students at all levels can learn sci-

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Web-based technology opens doors for students.

ence more effectively and increase their logical problem-solving skills (Kirkwood and Gimblett 1992). Web-based technology opens doors by

- providing equal access to information,
- encouraging students to be active learners,
- boosting student motivation to learn, and
- supporting your efforts to practice inquiry-based teaching and learning.

Web-based technology helps students analyze ideas and develop conceptual frameworks for thinking and problem solving. Students can pose their own questions and investigate these questions by using internet resources to support classroom science investigations. Students learn science by doing science, and the resources found on the internet can play a vital role in supporting this approach. In Chapter 3 you will find many web-based resources for helping students do science.

Rapid advances in science make it close to impossible for anyone to be the primary source of scientific information and knowledge for students. Within a few short years, science knowledge can become outdated, and textbooks age just as quickly. To keep your science knowledge—and students' knowledge—current you need to use—and let your students use—all resources available, including web-based resources.

Developing the skills for using the internet to teach science takes time, and finding resources takes time. But, even though teachers are busy, learning to integrate internet resources found

is important. Research by Kirkwood and Gimblett (1992) cited by Apple, Inc. (2004) found that computers help elementary students learn science content and increase their logical thinking and problem-solving skills, and telecommunications projects in science help students develop both specific science concepts and global awareness. To support these aims, scientists, educators, publishers, and amateurs increasingly post websites that offer discrete, age-appropriate, and sometimes interactive information on standards-related curricula (Center for Science Education 2004).

New teaching strategies demand an initial expenditure of time for learning and understanding the basics, and then more time for implementation; this is true when integrating any new teaching strategy or technique into a science curriculum. Both steps take time, but time spent to improve our students' knowledge and understanding of a subject is time well spent. And, as you use this booklet, you will see that the internet integration strategies and techniques can apply to any subject.

Advantages of Using Web-Based Resources

You have probably found that telling your students they are going to use computers produces smiling faces and instant motivation. So one reward for integrating the internet into your science teaching is seeing your students wanting to use this technology to explore, create, and think.

In this booklet, you will find web-based resources that help students develop higher-order thinking skills by engaging them in authentic, complex tasks. These tasks include science investigations that use web-based resources in ways similar to the ways in which scientists conduct their research. Students, for example, can discover what is already known about monarch butterflies and then participate in and contribute to real-time data collection as the monarch butterflies begin their annual fall migration.

Another advantage to using web-based technology is that your students become active rather than passive learners. The near-instantaneous feedback empowers them to ask questions as they learn. Your classroom will develop an atmosphere of learning that promotes critical thinking and problem solving. As your students become more involved in the learning process, they will gain new science knowledge and develop an increased understanding of science concepts.

How Web-Based Resources Support Inquiry

The *National Science Education Standards* says that "inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results" (NRC 1996, p. 23).

The use of web-based resources by your students to research scientific ideas or concepts follows the inquiry-based teaching and learning theme of the *National Science Education Standards.* With inquiry-based teaching and learning, you become a facilitator as students observe, reflect, collect real-time data, ask their own questions, and draw conclusions based on the evidence from their personal observations and data collection. Chapter 2 provides strategies for using technology and web-based resources to support inquiry.

Where Can I Search Everything on the Internet?

Even the most comprehensive search engines are able to cover only about 60 percent of the web. The internet changes and evolves too quickly

to document its entire contents. The internet is vast and, some might say, in horrific disarray. There is no one single index or tool to find everything, but there are resources to make it a little easier. Chapter 3 provides a review of some of the different types of search tools.

How Do I Find the Right Websites for Teaching Science?

Here are five tips for searching for web-based resources to support science curriculum.

Tip Number One. Have a good idea what you are looking for. If you start a search with too broad an idea, you may find yourself doing more surfing than finding what you need. Web links can send us off on a tangent completely unrelated to the original search. Then we must go back to the initial searching point and begin again. That can be fun. But, if time is short, focusing on what is important becomes essential. Remember that the internet is vast and a more focused search will have greater success.

Tip Number Two. Be aware that anyone can publish anything on the internet. So make sure that the science is correct on any website you use. Look for evidence that the author or organization that sponsors the site is knowledgeable and reliable. Locate the author's name, title, and position or the organization's name to ensure that they are relevant to the science content being presented. Check that a reliable organization sponsors the website—such as the National Science Teachers Association (NSTA) or the National Science Foundation (NSF), universities, government agencies, science education collaboratives, and other state or national organizations. If the site is maintained by a single author, look for biographical information. Examine the author's education, training, and experience pertinent to the science content and review the author's contact information. If the author does not provide contact information, you may want to avoid that site. Check the last time the website was updated. If it has been several months or years, then the site may be abandoned and out of date. Contacting the site's webmaster may help ensure the authenticity of the information.

To develop your sense of what reliable websites should be, you might want to browse through the sites listed in Chapters 2 and 3 and in Appendix A in this booklet. You will find as you look that the sites are sponsored by reputable organizations and by highly credentialed individuals. To avoid having to key in the address for each site, go to *http://ci.unlv.edu/~dwetzel/webscience.htm*, where you will find up-to-date links to virtually all the sites in the booklet.

Tip Number Three. NSTA provides tested rubrics to help you evaluate which websites are exemplary and which are inappropriate, particularly for use in an educational setting. The rubrics provide criteria for inquiry, interactivity, and resource integration. They are located at *http://Webwatchers.nsta.org/about/rubrics.html*. Rubrics are helpful for evaluating which websites are exemplary and which are inappropriate. One rubric used by NSTA to determine the suitability of a website to meet this criteria is the Evaluating Essential Features of Classroom Inquiry in Instructional Materials Rubric (*www.inquiryscience.com/documents/MaterialsR.pdf*) that was developed by the Council of State Science Supervisors (CSSS) and the Networking for Leadership, Inquiry and Systemic Thinking (NLIST). Using this rubric will help you determine if a website clearly and explicitly encourages students to ask questions, plan and conduct investigations, use appropriate tools and techniques to gather data, think

critically and logically about relationships between evidence and explanations, analyze alternative explanations, or facilitate communicating scientific arguments for debate and critique.

Tip Number Four. Create bookmarks of websites in folders in your browser. Bookmarks save websites in your browser after you select "Favorites" on your toolbar and save the uniform resource locator (URL) of the website you want to return to. Organizing your bookmarks in folders will save time in the long run, but establishing the folders requires some thought. Decide first about how you plan to use the web resources, and then organize the folders. Are the folders going to be accessed by students or only you? Will you use the websites bookmarked for professional development, for instance, or for lesson planning? The folders should reflect your science curriculum. Create separate folders for topics such as projects, lessons, assessment, and content area. Plan to review, edit, and modify the folders routinely to maintain the most current information.

Edit website titles as you bookmark them. Both Netscape and Explorer use the title of bookmarks from the name that appears in the title bar for the site or page, but that title may not mean anything to you later. Make your bookmark titles work for you by making sure the title you use reflects the content of the website and changing the titles while the site's content is fresh in your mind.

Tip Number Five. When you ask students to do research as part of a project, ask them to provide a list of the websites and pages they used. This accomplishes two things: You can visit the sites when you assess student projects, and you can add to the database of appropriate websites for future student projects. Ask students also to provide a critique about how easy the sites were to navigate, how understandable they were, and how they supported—or didn't support—their investigations.

How Do Web-Based Resources Support National and State Science Standards?

The use of web-based resources by students for the data collection, synthesis, and display of evidence is part of the inquiry-based learning encouraged by the National Science Education Standards and the National Educational Technology Standards (NETS) of the International Society for Technology in Education (ISTE 2000). The *National Science Education Standards* (NRC 1996, p. 43) Teaching Standard D states that teachers should "make the available science tools, materials media, and technological resources accessible to students" to support learning science. Additionally, this Standard says that teachers should "identify and use resources outside the school" to help their students develop a greater understanding of science.

Using the internet allows your students' learning to follow the "active process" the Standards recommend. With active learning, there is a shift away from demonstrations and the presentation of information toward student-centered teaching and facilitated learning. Learning should be not only hands-on but also minds-on as you involve students in inquiry-based investigations that result in more critical thinking and problem solving. Using web-based resources to investigate science supports minds-on learning and teaching by facilitating critical thinking and problem solving. The National Research Council says it best: "Learning science is what students do, not something that is done to them" (NRC 1996, p. 2).