Although many academic libraries offer basic Internet instruction, today's searchers have become increasingly Internet savvy and have little interest in general Internet seminars and workshops. However, I've identified a growing need for locating targeted science and math resources—both general and highly specialized—especially for higher education. This level of information can be found in a broad spectrum of sources via the Web. Unfortunately, many of these sources are either challenging to find or too expensive, making it difficult for smaller college and university libraries to meet the demands of science and math students and faculty. This article outlines several search tools, presents search tips and techniques, and provides brief abstracts for some of the best free, high-quality, Web-based sources of science and math information aimed at higher-education students and faculty.

WEB DIRECTORIES AND PORTALS
Using the popular general-purpose search engines to find reliable, up-to-date, higher-level science and mathematics information is definitely not the best way to go. Oh, you will get many hits in Google, AlltheWeb, MSN, and Yahoo!, but do college students, professors, academic librarians, and other information professionals really want to sift through the hundreds of thousands of "hits" to find the hidden gems? The answer is a resounding, "No!"

Librarians, faculty, and university students that I'm in contact with agree that it takes too much time to find the "good stuff," especially in the highly specialized areas of science and mathematics. Since millions and millions of Web sites have been created in the last decade or so, and general-purpose search engines attempt to
index everything that anybody puts up on the Web, it has become increasingly hard for us to find the quality among the quantity in these general search engine results. However, many of these frustrated searchers do not know about, or are not encouraged to use, some very good, free, noncommercial Web directories that are great starting places to locate other targeted directories, databases, and sites for quality advanced science and math information.

One of my favorites is Librarians’ Index to the Internet ([www.liri.org](http://www.liri.org)), an often-overlooked starting place for beginning research of any kind, including higher-level science and math. Rita Vine, a professional librarian and Web search expert, writing in the July 21, 2003 issue of LLRX (“Selecting Web Sites for ‘Beyond Google’ Resource Discovery,” [www.llrx.com/features/beyondgoogle.htm](http://www.llrx.com/features/beyondgoogle.htm)), cites Librarians’ Index to the Internet (LII) as one of her “5-Star Subject Starters,” stating that this directory is a very useful free tool for beginning research. She selected LII as “one of the 100 top general starting points for searching the free Web,” and I wholeheartedly agree.

The mission of LII is to “provide a well-organized point of access for reliable, trustworthy, librarian-selected Internet resources.” Although a large percentage of the sites support K-12 research, there are first-rate sites listed under various sections of the “Mathematics Topics” and “Science Topics” areas. Examples include The Mathematical Atlas ([www.math-atlas.org](http://www.math-atlas.org)) and Science.gov: FirstGov for Science ([www.science.gov](http://www.science.gov)) that are proven cyberspace gems for higher-level science and math research, as well. Although LII allows you to search by keywords, Library of Congress subject headings, and other advanced search methods, I personally like the directory drill-down approach, clicking on “Science, Computers, & Technology,” then “All Science Topics,” and then choosing among the “General Resources” or specific “Science Topics” disciplines listed, such as “Biology” or “Mathematics.”

LII is useful and easy to navigate, but we are certainly not limited to LII for advanced science and math information—there are other very useful directories to explore. In his January 16, 2003, SearchDay article (“The Value of Non-Commercial Web Directories,” [www.searchenginewatch.com/searchday/article.php/2161641](http://www.searchenginewatch.com/searchday/article.php/2161641)), search expert Gary Price recommends several other noncommercial directories for high-quality information, particularly Academic Info ([www.academicinfo.net](http://www.academicinfo.net)) and INFOMINE ([http://infomine.ucr.edu](http://infomine.ucr.edu)) for college and research-level Web site resource discovery. Both of these are excellent general directories for higher-level science and math research, as is BUBL ([http://bbl.ac.uk](http://bbl.ac.uk)). A searchable annotated subject directory, Academic Info focuses on free, online academic materials that are intended for higher-education students and faculty. I hasten to add that it’s also of use to upper-level high school students. As with many directories, “Mathematics” will be listed under the “Sciences” link. In addition to the “Engineering,” “Health & Medicine,” and “Sciences” gateways, explore the “Science & Technology Directories” special resource section ([www.academicinfo.net/scimeta.html](http://www.academicinfo.net/scimeta.html)).

Built by librarians from various colleges and universities around the U.S., INFOMINE points out “Scholarly
Internet Resource Collections" resources that are very "relevant to faculty, students, and research staff at the university level." Some 100,000+ sites are grouped into 12 annotated, indexed categories for easy retrieval, with "Biological, Agricultural, & Medical Sciences" and "Physical Science, Engineering, Computing, & Math" listed, as well as links to "Instructional Resources: University."

BUBL, an "Internet-based information service for the U.K. higher-education community," offers information retrieval of academically valuable Internet resources. The BUBL Link category contains Subject Menus, where you can choose relevant categories such as "Physical Sciences," "Life Sciences," "Health Studies," and "Mathematics & Computing," drilling down through each to find annotated links for a wide variety of specialized topics in the sciences and mathematics.

Another unique interdisciplinary resource for educators is the Gateway to Educational Materials [www.geminfo.org], sponsored by the U.S. Department of Education. Known as GEM, its goal is to improve access and organization to uncataloged educational Web resources from government, higher-education, non-profit, and commercial sites. The collection can be browsed through a keyword or topic index, as well as through full-text, keyword, title, or description searches on its "experimental search engine." GEM also has useful limiters to target results by educational level, such as "Community College" and "Higher Education."

**SPECIALIZED SEARCH TOOLS AND AWARD WINNING SITES FOR SCI-MATH**

In addition to the exceptional portals and general Web directories listed above, there are some superb specialized search tools and sites for locating quality science and math information on the Web targeted to a higher-education community. One specialized search tool that should be of particular interest to those searching the Web for higher-level science and math information is Elsevier Science's free specialized search engine, Scirus, powered by the FAST search engine.

Scirus [http://scirus.com] promotes itself as "the most comprehensive science-specific search engine on the Internet," and I agree with this statement. In fact, when I first noticed Scirus it was highlighted at the 2002 Computers in Libraries Conference as a Search Engine Watch.com award-winner for "Best Specialty Search Engine" for 2001 and 2002. This science search engine continues to get better. For instance, Péter Jacsó applauded Scirus in his November/December 2002 ONLINE column ("Peter's Picks & Pans," pp. 73-76), stating that the science search engine has significantly improved recently, offering excellent advanced search options for a wide variety of information types and sources of materials on the Web, including journals. He noted that its "search and display process is smooth and simple," and that now Scirus also "elegantly handles the links to free documents cited in MEDLINE."

When you visit Scirus, you will see on its "About" page that quite a range of scientific content is provided. Scirus covers journal and Web content sources and lists MEDLINE citations; ScienceDirect full-text articles (subscription required); U.S. Patent & Trademark Office patents; Beilstein abstracts (via ChemWeb.com); E-Print ArXiv e-prints; NASA technical reports; CogPrints e-prints; BioMed Central full-text articles (via MEDLINE); Mathematics Preprint, Chemistry Preprint, Computer Science Preprint Servers preprints; the Society for Industrial & Applied Mathematics (SIAM) articles; and more among its sources.

Much of this information is very difficult to locate using a general-purpose search engine, whereas Scirus is very successful at pinpointing science-specific data, reports, articles, and university and scientists' Web pages, although other nonprofessional sites appear in their results, too. I highly recommend checking it out, and I agree with Jacsó's remarks that we should "keep an eye on Scirus. It is likely to become increasingly useful as some abstracting and indexing services provide less and less current or adequate coverage of their prosessed fields of specialization." For mathematical information, use the advanced search page to narrow your results to various areas of the sciences, including "Mathematics."

Still, as many serious Web searchers know, there is no one single best search tool for finding quality information on the Web, including higher-level science and math, and Scirus is no exception to that rule, although I believe that it is one of the best science specialty search engines out there for locating free, quality sci-math resources.
SITES FOR INDIVIDUAL SCIENTIFIC DISCIPLINES

BiologyBrowser [www.biologybrowser.org], a new free Web site service from BIOSIS, enables you to access free unique resources for biologists while connecting with other researchers. The site offers thousands of "quality-controlled science links, updated daily." You should explore its interactive forum connecting scientists around the world, its Index to Organism Names verification tool, and its animal classification guide.

Featured in the Institute for Scientific Information's (ISI) premium collection of evaluated scholarly Web sites, Chemdex [www.chemdex.org] calls itself, "The directory of chemistry on the World Wide Web." There are almost 7,200 links here, so this really is the starting place for finding chemical sites. Some features require registration, which is free.

The Eisenhower National Clearinghouse (ENC) for Mathematics and Science Education has collected effective curriculum resource sites and created high-quality professional development materials to improve K-12 mathematics and science teaching and learning. ENC Online [www.enc.org] is actually very useful for higher-education students and faculty, too. Besides the "Science Topics Web Links" and "Math Topics Web Links" sections, check out the "Student/Classroom" and the "Reference Sources" sections.

Eric Weisstein's World of Science [http://scienceworld.wolfram.com/] provides a superb public service science education site that is a very good "comprehensive and interactive science and mathematics encyclopedia intended for students, educators, math enthusiasts, and researchers." It contains searchable encyclopedias of astronomy, scientific biography, chemistry and physics, and mathematics. The mathematics site, also called Eric Weisstein's World of Math or MathWorld, has been published as the CRC Concise Encyclopedia of Mathematics. Eric Weisstein's World of Math [http://mathworld.wolfram.com/], indexed by subject, includes Algebra, Applied Math, Calculus, Geometry, and more.

EEVL Mathematics Section [www.eevl.ac.uk/mathematics/], a U.K. site, known by many as Mathgate, is an outstanding index to math Internet resources. Part of the EEVL Internet Guide to Engineering, Mathematics, and Computing, this free, award-winning service targets students and researchers in higher education, providing "quick reliable access to resources which have been evaluated and categorized by mathematics experts." You can search by subject, alphabetically by title, or browse by resource type (i.e., "Journals-Full Text").

I believe that Math Forum [http://mathforum.org/] is the best general math site on the Web—truly a gold mine for undergraduate and graduate students—as well as a great source of quality online mathematics education for professors. In addition to relevant links on the "Home" page, under the "Student Center" section, check out the "College" and "Graduate" links; under "Teachers' Place," explore the "College & University" links; and under "Research Division," there are links of interest to research mathematicians. Drexel University should be proud of its "online mathematics education community center."

The new, as of May 2003, streamlined version of SciCentral [www.sicentral.com/] is an impressive "gate-
Some Specific Favorite Sites Recommended by Rider University Faculty Members

- AAAS History & Archives [http://archives.aaas.org/resources/]
- American Mathematical Society [www.ams.org/]
- Atlas of Rock, Minerals, & Textures [www.geolab.unc.edu/Petunia/IgMetAtlas/mainmenu.html]
- Biochemistry I [www.bio.cmu.edu/courses/03231/]
- ISI Highly Cited [www.isihighlycited.com/]
- Mathematics Archive [http://archives.math.utk.edu/]
- NCBI Literature Databases [www.ncbi.nlm.nih.gov/Literature/]
- Science NetWatch [www.sciencemag.org/netwatch/]
- SciNet Science Search [www.sciinet.cc/]
- The Toxikon Multimedia Project [www.uic.edu/com/er/toxikon/]
- Wayne's Word [http://waynesword.palomar.edu/]

sciences
mathematics
geology
biochemistry
sciences and mathematics
mathematics
biomedical
sciences
sciences
sciences and mathematics
botany, biology, ecology

way to the best scientific research news sources, providing selective access to area-specific research news in the “Biosciences,” “Health Sciences,” “Physics/Chemistry,” “Earth & Space,” and “Engineering” fields, as well as links to “locate prime research tools and resources,” such as a large archive of free and “pay-per-view” full-text life science research articles. Explore other valuable resources with Sci-Central’s “Literature Search,” “Journals,” and “Databases” links.

Originally funded by the NSF, NASA, and the University of Texas, S.O.S. MATHemetics [www.sosmath.com/] is now an independent commercial site that “offers straightforward technical assistance primarily to high school and college students, although some of its sections will be useful to both adult learners and professionals.” It focuses on traditional math, such as simple fractions, algebra, calculus, differential equations, and matrix algebra, to name a few, along with the “cyberexams collection of potential self-tests with solutions available”—and much more for math enthusiasts, undergraduate students, and professionals.

GENERAL SEARCHING TIPS FOR BETTER RESULTS

In my Sci-Math World [http://library.rider.edu/scholarly/rackle/sci/1] workshops, I emphasize that when hunting for that perfect site or search tool for higher-level science and math information, researchers should not get too bogged down using one particular search tool or site, even if it looks very promising at first glance. Try different, related words or phrases, remembering to look for any advanced searching features (truncation, subject guides, or thesauri) that may help you expand, limit, or generally refine your search statement. If you are not successful after several minutes, move on to another resource. However, once you have located an excellent Web resource that meets your needs, add it to your “favorites list” so you will not forget it the next time you conduct similar searches. Another tip I learned from search experts at Information Today-sponsored conferences is that once you have found a few favorites, find out what relevant sites link to your favorite sites by typing its URL into the “Page-Specific Search: Links” section on Google’s Advanced Search page, for example. This can be an effective, effective method for finding other great sci-math search tools and sites.

Another very useful strategy is to not “reinvent the wheel” in your search approach. Many well-known college and university libraries have excellent Internet Resource sections on their home pages, many broken down into relevant subject areas, superb for finding free directories, databases, and sites geared toward higher-level topics. If you are not familiar with a library’s site or what you can freely access, try asking the reference librarian on duty in person, by phone, or via available online methods. I have found that we can all (yes, even those of us who are librarians) save a great deal of time if we would swallow our pride and ask a librarian—or a teaching faculty member with personal experience with subject-specific higher-level Web resources, for that matter—for recommendations or assistance with their unique subject areas or collections.

The “Favorite Sites” list above shows some of the results of an informal poll that I conducted asking various Rider University biology, chemistry, geology, math, physics, and education faculty to recommend Web sites that they find particularly useful in preparing for classes or highly recommend for students in their classes. I thank them all for their responses—here are some of those “favorites.”

HIDE AND SEEK FOR GROWN UPS

The Web can be a valuable resource for scholarly research and information retrieval, but many find themselves playing “hide and seek” when looking for the higher-level science and math resources. There is no one perfect tool or method for finding this elusive information on the Web. However, I hope that this article provides information professionals with a guide for locating some of the best free, quality sources of science and math information available on the Web of interest to higher-education students and faculty. While the tools and tips presented here do not offer a total substitute for well-known, expensive commercial sources for sci-math information, the sources should satisfy some demands, allowing individual researchers and smaller libraries to spend their money on information resources that are not freely available on the Web.

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Comments? E-mail Letters to the Editor to mmarylor@msn.com.