

SCIENCE AND TECHNOLOGY INFORMATION RESOURCES ON THE INTERNET

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Abstract: Qualitative improvements in scientific and technological communication are being brought about by the Internet through global connectivity of computers and the development of tools and techniques for information provision and access. From basic tools like E-Mail, File Transfer Protocol and Telnet, the Internet has progressed to Gopher, WAIS and the World Wide Web (WWW). The WWW, integrating all other access tools, provides a very convenient means for publishing and accessing multimedia and hypertext-linked documents stored in computers across the world. These include electronic journals and newsletters, tables of contents, preprints, technical reports, software and scientific data archives, library catalogues, discussion forums, reference sources, courseware, directories, etc. After a brief overview of Internet technology, we discuss features of a few S&T information resources. Trends in Internet-based scholarly information and developments specific to the Indian context are also briefly discussed. The paper includes a comprehensive list of major S&T information resources available today on the Internet.

1. INTRODUCTION

Since the advent of modern science, attempts have been made to improve the speed and efficiency of scientific communication. Scholars have evolved various formal and non-formal mechanisms including personal communication networks ('invisible colleges') towards this end. Most of the scholarly information however, has continued to be published in print, i.e., in journals, books, conferences, etc. Print-oriented publication has several advantages - media familiarity, usage convenience, personal recognition bestowed upon the author and the in-built peer review process. It has serious flaws too - publication delays, distribution costs and access time-lag. Electronic access to scholarly information was till recently limited to secondary information in the form of bibliographic databases, citation indices and abstracting journals available online and on CD-ROMs. Libraries around the world have also developed varieties of Online Public Access Catalogues (OPACs), limited once again to bibliographic details. While identification of primary literature has become easier, gaining access to the full text of the required primary publications continues to be a major problem. More importantly, these developments have had no impact on the publication process itself.

2. INTERNET AND THE WORLD WIDE WEB

The emergence of the Internet is radically changing the generation, flow and utilisation of scholarly information globally. Internet has its roots in the ARPANET project of the Department of Defence, U.S.A. in the late 1960's. Today it interconnects thousands of computer networks and millions of individual computers across the world using TCP/IP as the computer communication protocol. Starting with basic network services like E-Mail, FTP (File Transfer Protocol) and Telnet (remote login), the Internet has made quick progress with the development of tools like Gopher, WAIS (Wide Area Information Server) and the World Wide Web. The WWW, or simply the Web, is the most popular and rapidly growing service on the Internet today.

WWW is an application system implemented on computers connected to the Internet, enabling multiple

computers with disparate operating systems to communicate using Hyper Text Markup Language (HTML) as their lingua franca. WWW has made the Internet easier to use and enhanced its value as a communication medium. There are two key components to the WWW - Web servers and Web browsers. Web servers host Web documents, written in HTML, and transmit these over the Internet using Hyper Text Transmission Protocol (HTTP), which operates on TCP/IP. Web browsers are user interface software packages which receive and display Web pages from the servers. Web browsers are available for numerous operating systems including Windows, OS/2, MacOS, Unix, etc. Two very popular browsers are Netscape and the Internet Explorer. In addition to HTTP, WWW supports other access tools like E-Mail, FTP, Gopher and Telnet, making it an all-in-one Internet user interface.

'Hypertext' is the fundamental organising concept of WWW. It refers to the embedding of links within an HTML page (Web page) pointing to other documents. The linked documents could comprise text, images, graphs and charts, and audio-video clips. These documents need not exist in just one computer. They may be distributed among different Web servers located at different geographic locations. HTML supports sophisticated information display capabilities and provides wide latitude to the information providers to control the page display format. Marking up a document using HTML tags is fairly simple. Someone who already knows how to use a word processor can learn the basics of HTML within a few hours.

The growth in the variety of services and applications developed over the Web has been spectacular. Three key Web services need mention here, viz., forms-based query processing, VRML (Virtual Reality Modeling Language) and Java. WWW supports the search and retrieval of information from databases existing on Web servers using HTML-based query forms. VRML has made it possible for viewing and manipulating 2D and 3D graphics. Java is emerging as a very important high-level programming language for the WWW. Programs written in Java can be automatically transferred to the browser, where they are executed by an embedded Java interpreter.

3. NETWORK INFORMATION REVOLUTION

The relative ease with which Web related tools may be used to publish and access multi-media information over the Internet has led to the availability of a variety of digital information sources on the Internet. 'Network information' is the term often used to represent this emerging new information world. Hypertext-linked multimedia documents on widely distributed Web servers are literally enveloping the earth with information. A variety of digital information will be mounted on Web server computers. Using Web browser programs like Netscape and Internet Explorer on their desk-tops, users will be able to seamlessly connect to and extract information from local as well as geographically dispersed Web servers.

4. S&T INFORMATION RESOURCES ON THE INTERNET

Most of the initial research and development leading to the emergence of the Internet was done at universities and research centres. In fact WWW itself was the result of efforts made by theoretical physicists at CERN, Switzerland, to improve the usability of their publications by exploiting the hypertext linking concept. E-Mail, which is used extensively on the Internet, has dramatically improved personal communication and collaborative research. E-Mail-based discussion forums have enabled faster group communication across national boundaries. Development of E-Mail based preprints registration and routing systems in the area of high energy physics and mathematics in the early days of the Internet successfully demonstrated the possibility of developing elegant, effective and inexpensive solutions to problems inherent to print publications. Anonymous FTP services and Telnet have been used to provide access to research papers, reports and scientific databases. With the availability of the WWW technology, there has been phenomenal growth in the number of Web sites providing access to a variety of S&T resources: Publishers like Elsevier, science societies like the American Mathematical Society and professional organisations like the IEEE and IEE have set up their own Web sites to deliver a variety of scientific information, including journals. Some of the key S&T resources available today on the Internet include the following :

Preprints, discussion forums, electronic journals, tables of contents (journals), technical reports, library catalogues, campus wide information services (CWIS), scientific data sets, patents and standards, directories of science and engineering institutions, associations and societies, reference sources, courseware and distance education, S&T resource catalogues (virtual libraries)

In the following sub-sections we briefly discuss features of some of these resources. An illustrative list of

several specific Web accessible S&T resources, along with their site address, is given in Appendix - 1.

4.1 Electronic journals

Popularly known as e-journals, these represent a major growth area on the Internet. Major publishers of science journals like Elsevier¹, Academic Press² and Blackwell Scientific³ have announced their commitment to provide Web access to their journals. There are two types of e-journals : electronic versions of print journals and serials published and accessed on networks with no print counterpart. Some e-journals have only text content, but the trend is towards Web access to both text and images, including 2D and 3D graphics using VRML.

Electronic journals offer several benefits. Users gain quick access to current and archival issues. Availability is very high, compared to print issues in libraries. Users have the choice of downloading only the desired articles. Keyword based search facilitates quicker and easy identification of articles. The hypertext feature used by many e-journals helps readers trace a reference quickly and gain immediate access to the full article. The production of e-journals is quicker and perhaps more economical. e-journals need not be bound by physical size or number of articles, which means no back logs or delays. Papers may be published as soon as they are accepted. Also, many problems associated with the management of print journals in libraries do not arise.

Quick access to e-journals however requires good network speeds. If users prefer print copies for serious reading, they need easy access to printers with good graphics capabilities. More importantly, licensing and authorization restrictions may prove a major hindrance for casual and ad hoc users.

4.2 Tables of Contents of Journals

Major publishers of science journals today deliver content pages of their journals by E-Mail, mostly free of cost. 'Contents Direct' service by Elsevier⁴, for example, delivers content pages of about 800 journals by E-Mail over the Internet. The service allows users to register for journals whose content pages they wish to receive. Web access to content pages is also provided by most of the publishers today. Generally, the content page data is available much earlier to the full journal. In addition to the publishers, many document delivery agencies also provide access to content pages. A very popular service is the Uncover service provided by the CARL agency, providing free access to content pages of over 16,000 journals. Institute for Scientific Information (ISI), U.S.A., has recently initiated a content page alerting service⁵.

4.3 Preprints

Preprints were used by scholars as a means to enhance

the speed and efficiency of scientific communication. Preprints were among the earliest to be delivered electronically over the Internet, first by E-Mail and later over the World Wide Web. Internet-based preprint service has been highly successful in High Energy Physics and Mathematics. For example the American Mathematical Society preprint server provides Web access to recent 100 preprints submitted to the server, offers field based search of the preprint archives, and facilitates forms-based submission of new preprints.

4.4 Discussion Forums and Usenet News

Discussion forums, also called mailing lists, discussion lists and listservers, are a major network resource that serve the purpose of current awareness. They use E-Mail to set up informal discussion among people of specific research interests via the Internet. Forum software (e.g. Listserv) maintains a list of E-Mail addresses of all subscribers/members and the messages posted to the forum are distributed automatically to all subscribers. Joining (subscribing) and leaving (signing off) the forum and posting messages are carried out through E-Mail. Participating in discussion forums does not require dedicated Internet connectivity which can be very expensive. Most forums archive the messages and allow searching and extraction of earlier discussions. Forums may be moderated or unmoderated. On moderated forums, the messages posted to the forum for distribution are screened by a human expert, before they are distributed.

Participation in discussion forums has several advantages. Forums are not bound by geographic distances. They help the participant to keep up-to-date with current developments in a field, which are often not reported fast enough in print media. One can pose professional questions and seek solutions and participate in discussions on specific topics in a short period of time. Forums are a great place to identify peer workers. It may also be mentioned here that a good number of messages received from forums may be irrelevant. Users also may have to contend with the advertising, canvassing and commercial uses of discussion forums.

Unlike discussion forums, Usenet News is not delivered to the user's E-Mail box. Instead, News reading software is used to access News from the nearest Usenet News feed computer. News (and E-Mail) reading facility is now supported by Web browsers like Netscape. Usenet News groups are hierarchically structured, e.g., sci.physics.fusion is the news group for discussions related to nuclear fusion. Since the number of messages posted every day to these groups is very large, setting up of News feed sites is quite expensive requiring high-band width connectivity and powerful News server computers with large disc storage. For this reason we do not have many News sites in India. However, archives of most of the News groups can be

searched using Web search tools like Altavista (discussed in more detail below).

4.5 Technical Reports

Technical reports provide details of on-going or completed R&D projects and Ph.D theses. They usually provide more details than papers published in journals and conferences, and serve as very valuable tools for scientific communication. Departments in research institutes and universities are good sources of technical reports. Thanks to the Internet, a large number of these reports can be easily accessed, often free of cost. Web servers of universities and research institutes often point to such reports and publications. For example, a well developed system called NCSTRL (Networked Computer Science Technical Reports Library) now exists for world wide access to technical reports in computer science research.

4.6 Library Catalogues

A large number of library catalogues can be accessed online via the Internet. Generally available free of cost, these are useful for finding books not available locally, to identify and select books for local acquisition, bibliographic data verification and to search holdings of periodicals. Most do not need any login, some accept 'guest' logins and a few require authorisation. Access modes include Telnet, Gopher and the WWW. While there is a large variation in the Telnet based search interfaces across different OPACs, their on-going transition to the Web will ensure a common search interface. Catalogues of very large libraries like the University of California ('Melvyl') and the Library of Congress ('LOCIS'), are examples of Internet-accessible library catalogues.

4.7 Campus Wide Information Services (CWIS)

These are online information services of universities providing Web based access to a variety of information. In addition to research literature, these provide access to faculty and student directories, course details and research projects, campus computing, library catalogues and other databases, admission regulations and policies, placement information, campus phone directories, etc.

5. KEEPING UP TO DATE WITH INTERNET RESOURCES

Looking for a specific piece of information on the Internet is quite like searching for a needle in a hay stack. With thousands of sites out there how do we know which site contains the information we are looking for? Search tools, resource directories and current awareness services offer some solution. A useful list of such resources is given in Appendix - 2.

Search tools use spider programs (robots) which

periodically visit Web sites around the world, gather the Web pages, index these pages and build a database of information in these pages.

They provide a forms-based search interface for the user to enter the query consisting of one or more keywords and their combinations (e.g. 'plastic wastes and recycling'). The search results are returned in the form of a list of Web sites matching the query. Using embedded hypertext links one can then connect to each of these sites. There are very powerful Web search tools today with varying indexing and search capabilities. Alta Vista⁶ developed by the Digital Equipment Corporation is perhaps the most powerful search service, allowing full-text searching of over 30 million Web pages on over 2,75,000 Web servers. Its search capabilities include truncation, Boolean, proximity, parentheses and specific field (title, URL, host, links) searching. There are also search services which send queries to several individual search systems. Metacrawler⁷, for example, sends queries to nine individual services simultaneously : Alta Vista, Excite, Galaxy, InfoSeek, Inktomi, Lycos, Open Text, WebCrawler and Yahoo. Results are organised into a uniform format with duplication removed.

Internet resource directories, which are also called as 'meta sources', 'virtual libraries' and 'resource guides', catalogue Internet resources and provide hypertext links to these sites. They are very useful for resource identification and navigation. These catalogues categorise resources by subject and/ or resource type. Broadly, there are two types of resource directories - Omnibus and subject/ resource specific. Omnibus directories attempt to cover several areas. Examples include Yahoo, EINET Galaxy, WWW Virtual Library and Planet Earth. Subject or resource specific directories are usually maintained by science and engineering societies and organisations (e.g. American Mathematical Society and American Chemical Society), departments or libraries in universities and research institutes.

A few resources on the Internet serve the purpose of current awareness by reporting new Internet sites. These include mailing lists (e.g. NewJour which announces new journals available on Internet) and newsletters (e.g. Scout Report, a weekly publication describing new resources). Most of these are available freely and can be subscribed to using E-Mail.

6. TRENDS IN INTERNET BASED SCHOLARLY INFORMATION

With Intranets (use of Internet technology within institutional and corporate networks) catching up with university campuses, we are beginning to see Web sites being set up at department levels. Academics have taken actively

to publishing on these sites and experiment with new technologies (e.g. special mark up language for 3D manipulation of chemical structures⁸). Several digital library projects⁹ have been launched around the world. Publishers, universities and research institutes and laboratories are cooperating in many of these projects to create large digital collections. Elsevier, in association with seven U.S. universities, has recently concluded TULIP¹⁰ (The University Licensing Project), which aims at providing desktop access to primary journals on campus networks. An Electronic Thesis and Dissertations (ETD) project¹¹ has recently been launched in the U.S., with participation by universities around the world. Secondary database publishers like the Institute for Scientific Information (ISI)¹² and OCLC¹³ are expanding their roles to electronic delivery of primary publications.

With the spread of the Web, traditional online database vendors like the Knight Ridder¹⁴ and STN International are now providing Web interface to their databases. Silver Platter, a major CD-ROM database publisher, now provides WWW gateway to CD-ROM databases mounted on Unix servers using its ERL (Electronic Reference Library) software. Cambridge Scientific Abstracts, another major publisher of science databases, was among the first to provide Web access to its databases. ISI has recently announced an Intranet solution to the Science Citation Index¹⁵.

The many exciting developments on the Internet also have several problems associated with them. One such problem has to do with the uncertainty about the quality of the information and durability the Internet sites. Given the ease and speed with which information can be published on the Internet, the quality of many free sites is suspect. Thankfully, a solution to this is emerging in the form of rating services like Point and Magellan (see Appendix - 2). Directories that evaluate resources included in their catalogues also serve a quality control function. Many high quality free Internet sites, particularly those maintained by individuals, disappear or shift their location, depending on the interests and movement of the individual. Another serious problem is the poor response time. With the increasing use of Internet for business and commerce and delivery of multimedia files, network pipes are getting choked, causing large delays in information transmission. There are moves to create Internet II, a very high speed network for the exclusive use of the scientific community¹⁶

Another problem relates to the copyright of network resources. Many believe that the publishers, who have control over most of the high quality print information resources (e.g. journals), would not only like to retain the control in the network environment, but perhaps exploit it further to their advantage using electronic technology to

restrict access to information¹⁷. It is believed that the publishing lobby is behind the recent move to get a new intellectual property treaty ratified by the WIPO, further restricting the 'fair use' of copy righted and public domain material for research and education purposes¹⁸

7. INDIAN SITUATION

Education and Research Network (ERNET)¹⁹ has been quite successful in creating awareness of the Internet among the higher education and research community in the country. So far, the usage of Internet has been limited to E-Mail exchange and for accessing external information using tools like FTP, Telnet and the WWW. Only a few universities and educational institutions (e.g IITs, IISc, Punjabi Univ.), research institutes (e.g. IUCAA, National Chemical Laboratory) and government S&T departments (e.g. Dept. of Electronics) have their own Web sites. The reasons are many. There are only three Internet service providers in the country today - ERNET, VSNL²⁰ and NIC²¹. The cost of setting up a Web site with a reasonable bandwidth of 64 KbPS is very high. Besides, the telecommunication tariff in India is among the highest in the world. Such high costs discourage developments related to the setting up of Campus Wide Information Services, Web accessible databases (e.g. library catalogues, theses), publications and resource directories, discussion forums, mirroring of useful Internet sites and other such efforts.

The National Centre for Science Information (NCSI)²² at the Indian Institute of Science, Bangalore, has made a modest beginning in this direction by setting up a structured catalogue of key Internet sites in science and engineering and providing access to a few databases, including a union catalogue of journals held in the five IITs and IISc. The Centre was among the first to set up and operate a discussion forum LIS-FORUM²³ for providers and users of library and information services in the country.

8. CONCLUSION

We have made an attempt in this paper to give an indication of developments that are taking place in the generation and dissemination of science and technology information on the Internet. Many believe that Internet is a new paradigm in global communication and information flow, equal in significance to that of the invention of paper, printing and computing technologies. Internet is collapsing national boundaries, albeit in a virtual environment, and bringing together the scientific community in a way that has begun to fundamentally alter the way research and education is conducted.

Bibliographic Notes :

1. Elsevier : <http://www.elsevier.nl/>
2. Academic Press journals : <http://www.idealibrary.com/>
3. Blackwell Scientific journals: <http://www.blacksci.co.uk/uk/journals.htm>
4. Contents Direct service from Elsevier : <http://www.elsevier.nl/>
5. ISI's table-of-contents alerting service (Journal Tracker): <http://www.isinet.com/jtrack>
6. Altavista : <http://altavista.digital.com/>
7. Metacrawler : <http://metacrawler.cs.washington.edu:8080>
8. Chemical markup language for 2D and 3D chemical structure handling on the Web : <http://www.venus.co.uk/omf/>
9. Digital library projects : <http://sunsite.berkeley.edu/>
10. The University Licensing Project(TULIP) of Elsevier : <http://www.elsevier.nl/>
11. Electronic Thesis and Dissertations project : <http://etd.vt.edu/etd/>
12. ISI-IBM electronic library project : <http://www.isinet.com/>
13. Electronic journals from OCLC : <http://www.oclc.org/menu/ejo.htm>
14. ScienceWeb from Knight-Ridder : <http://www.krinfo.com/>
15. Intranet access to citation index databases from ISI : <http://www.isinet.com/>
16. Internet II : <http://www.internet2.edu/> and very high speed backbone network for Internet II : <http://www.vbns.edu/>
17. Ken Rouse. The serials crisis in the age of electronic access. Newsletter on Serials Pricing, No. 177, May 1 1997 (<http://sunsite.uc.edu/reference/prices/1997/PRIC177.HTML>). (To subscribe to this newsletter, send the E-Mail message "subscribe prices your name" to listporc@unc.edu).
18. James Love. A primer on the proposed WIPO treaty on database extraction rights that will be considered in December 1996 (<http://www.essential.org/cpt/ip/cpt-dbcom.html>)
19. ERNET : <http://www.ece.iisc.ernet.in/>
20. VSNL : <http://www.vsnl.net.in/>
21. NIC : <http://www.nic.in/>
22. NCSI: <http://www.ncsi.iisc.ernet.in/>
23. LIS-FORUM. To subscribe to this forum send the E-mail message "subscribe lis-forum your name" to listserv@ncsi.iisc.ernet.in

S&T Information Resources on the Internet : Some Examples

These are examples of specific S&T resources. Resource guides and finding aids are listed in Appendix - 2.

Information Source Type	Examples
Preprints	American Mathematical Society preprint server http://www.ams.org/preprints/ LANL preprint server http://xxx.lanl.gov/ ; Covers 11 areas including high energy physics, nonlinear sciences, computation and language, etc. Mirrored in about 10 countries.
Technical reports	NASA Technical Reports http://techreports.larc.nasa.gov STAR - Scientific and Aerospace Reports File http://www.sti.nasa.gov/rselect/star.html Networked Computer Science Technical Reports Library (NCSTRL) http://www.ncstrl.org/ International collection of computer science technical reports from computer science departments and industrial and govt. research labs.
Theses and dissertations	Electronic thesis and dissertations project (ETD), Virginia Tech university, USA. http://etd.vt.edu/etd/ UMI's Dissertations Explorer. http://www.umi.com/hp/support/dexplorer Recent three months's dissertations available free.
Discussion forums	GENTALK - Forum for discussion of genetic problems, lab protocols, current issues dealing on genetics & genetic engineering in general. Subscription to: 'listserv@usa.net' HUM-MOLG - Discussions, non-commercial ads, announcements and questions related to the field of human molecular genetics. Subscription to : 'listserv@nic.surfnet.nl'
Content pages of periodicals	Uncover provides free access to content pages of over 16,000 journals. Supports forms based search interface. Uncover http://uncweb.carl.org ESTOC - Elsevier Science Tables of Contents Service http://www.elsevier.nl/estoc/ Provides access to the tables of contents of approximately 900 Elsevier Science primary and review journals. This service is available by E-Mail also, to registered users.
Science journals	Physics Express Letters http://www.iop.org/PEL Free access to abstracts and full text of 12 Institute of Physics Publishing Journals. Science http://www.sciencemag.org/ Weekly journal from the American Association for the Advancement of Science National Geographic http://www.nationalgeographic.com/
Conferences and meetings	World Wide Web Virtual Library on Conferences http://conferences.rpd.net/
Library catalogues	Melvyl - University of California libraries catalogue of books and journals http://www.library.ucla.edu/catalog/melvyl.html Telnet access at melvyl.ucop.edu Library of Congress http://lcweb.loc.gov/catalog/ Book catalogue since 1898 to date.
Patents	USPTO and AIDS patents http://patents.uspto.gov/ Provides free access to bibliographic data of US patents issued since 1/1/76 and the full text of AIDS related patents issued in US, Japan and Europe. IBM Patent Server http://patent.womplex.ibm.com/ Provides access to over 26 years of U.S. Patent & Trade-mark Office (USPTO) patent descriptions and last seven-teen years of images.
Reference sources	The Merck Manual http://www.merck.com/ The Merck Manual is one of the most widely used medical text in the world. Written by

over 300 experts, it covers all but the most obscure disorders.

Encyclopaedia Britannica Online <http://www.eb.com/>

Nobel Prizes <http://www.nobel.se>

Science news services	EurekAlert! http://www.eurekalert.org/ This is a comprehensive news service for up-to-date re-search in science, medicine, and engineering.
Databases	Molecular Biology (gene, enzyme and protein data banks) http://www.unl.edu/stc-95/ResTools/cmshp.html
Internet based education	The Globewide Network Academy http://www.gnacademy.org/ Offers distance education with over ten thousand courses and degree programs
Science books	National Academy Press (NAP) http://www.nap.edu/readingroom/

Appendix - 2

Information Resource Finding Aids

Resource Guide Type	Examples
Search tools	
Use spider programs to gather millions of Internet resources and build large searchable indexes. Good for locating specific sources.	Altavista http://altavista.digital.com Includes Usenet News group articles. Indexes over 30 million Web pages Open Text Index http://index.opentext.net
Subject directories + Search tools	Lycos http://www.lycos.com
Provide both browsable subject directories and large indexes of Internet sources gathered by spider programs.	Excite http://www.excite.com InfoSeek http://guide.infoseek.com
Subject directories (multi-subject)	Argus/Univ. of Michigan Clearinghouse http://www.clearinghouse.net
Offer browsable hierarchical subject arrangement of Internet sources. Place to start if you do not have specific resources in mind. Many support keyword searching of resources they cover.	A collection of topical guides which identify, describe and evaluate Internet based resources World Wide Web Virtual Libraries http://www.w3.org/hypertext/DataSources/bySubect/Overview.html A distributed subject catalogue of Internet sites Yahoo http://www.yahoo.com A comprehensive subject directory of over 80,000 Internet resources Einet Galaxy http://galaxy.einet.net/ Planet Earth http://www.nosc.mil/planet-earth/ OCLC NetFirst (fee-based) http://www.oclc.org/oclc/netfirst.htm Catalogues selected sites. Bibliographic information plus abstracts. Subject headings and LC and DDC classification numbers.

Rating services	Point http://point.lycos.com/categories/index.html Provide ratings and descriptions to the top 5% Web resources Magellan http://www.mckinley.com Provides ratings and detailed descriptions to resources in its subject directory
Subject/resource type specific guides	Scholarly societies, academies and federations http://www.lib.uwaterloo.ca/society/overview.html
Organisations	Colleges and Universities home pages http://www.mit.edu:8001/people/cdemello/univ.html
Discussion forums/lists	Diane Kovac's list of scholarly electronic conferences http://www.mid.net/KOVACS/ Liszt http://www.liszt.com/ Directory of E-Mail discussion groups. Covers over 54,000 listserv, listproc, majordomo and independently managed lists from over 1800 sites.
Electronic journals	ARL directory of electronic journals and newsletters gopher http://arl.cni.org:7011/scomm/edir/ Directory containing scholarly serials and electronic newsletter titles.
Courseware	The World Lecture Hall http://www.utexas.edu/world/lecture/ Contains links to pages created by faculty worldwide who are using the Web to deliver class materials. For example, you will find course syllabi, assignments, lecture notes, exams, class calendars, multimedia textbooks, etc.
Physics	TIPTOP - The Internet Pilot to Physics http://www.tp.umu.se/TIPTOP/
Biology	Biology resource guide at Harvard http://golgi.harvard.edu/ National Biological Information Infrastructure http://www.nbs.gov/nbii/
Chemistry	Chem Center of the American Chemical Society http://www.ChemCenter.org/
Engineering	WWW Virtual Library - Engineering http://arioch.gsfc.nasa.gov/wwwv_engineering.html Mathematics Mathematics on the Internet http://e-math.ams.org/
Medicine	WWW virtual library - Medicine http://www.ohsu.edu/clinweb/wwwvl/
Mailing lists and newsletters	Scout Report http://rs.internic.net/scout/report
For staying up to date on new Internet resources	A weekly publication offering a selection of new and newly discovered resources of interest to researchers and educators. SENN - Scientific and Engineering Network News http://www.senn.com/ A fee based, monthly guide to Internet resources for scientists and engineers. Internet Resources Newsletter http://www.hw.ac.uk/libWWW/irn/irn.html Monthly publication with similar scope as Scout Report InfoWatch http://www.ncsi.iisc.ernet.in/ncsi/infowatch.html Monthly publication reporting selected new resources on the Internet NewJour Subscription address : mjd@ccat.sas.upenn.edu Announces new Internet available journals BestWeb Subscription address : listserv@trcearnpc.ege.edu.tr Discussion of the best Web sites