Internet for Information and Resources on Chemistry and Physics

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ABSTRACT

The huge amount of information and resources available on the Internet via the World Wide Web (WWW) makes the searching of a desired item of information a daunting task. Finding a suitable point to start the search can prove to be a bewildering experience for the Internet novice.

This presentation will describe the origin and the development of the ChemistryWeb Internet Resources and the Physics Resource Page of the Division of Chemistry and Division of Physics respectively at the National Institute of Education, Nanyang Technological University. These resource WWW pages are intended as user friendly gateways to accessing the Internet for information and resources on chemistry and physics from Singapore. The structure of these WWW pages and the guiding principles behind its development will be highlighted. These will include the intended audience and the levels of information available. These WWW pages serve not only to provide information about the division's teaching and research programmes but, more importantly, to provide an organised structure of information and resources related to Chemistry and Physics on the Internet for research and teaching. The presentation will conclude with some discussion on the problems of developing and maintaining these WWW Web pages.

INTRODUCTION

The main difficulty in searching for resources on WWW is, at present, due to the fact that information available on the Internet is generally not well structured or organised. A partial solution to this difficulty is through the use of search engines. Examples of search engines include Alta Vista (http://www.altavista.digital.com/), Webcrawler (http://webcrawler.com/) and Lycos (http://lycos.cs.cmu.edu/). These search engines are mainly designed to be used in two ways. The WWW sites that contain the required information or resources may be listed under the directories provided (organised under broad subject headings), or searched by key words and phrases.

The directories provided by these search engines are generally not constructed by subject specialists. Hence, these directories are likely to be too general for those who are looking for specific information and resources in their respective subject areas.

At the same time, the databases of these search engines are not exhaustive; that is, not all WWW information available on the particular subject is necessary captured by them. The searches performed by these search engines are generally 'dumb', as the keywords or phrases are searched without regard to the context or relevance of the information obtained. For instance, although the search might return a long list of WWW sites, only a few of these are useful.

Often, comprehensive searches for information involved the use of several search engines. This places serious limitations on the quality of search. However, these deficiencies may be overcome in the near future given the amount of research work done on intelligent information retrieval engines for the Internet (Roesler and Hawkins, 1994; Reinhardt, 1994; Watterson, 1995).

One way of helping to reduce the search time, is for the information or subject specialist to produce well-organised subject resource WWW pages that can literary provide a 'one-stop' service to the desired information. Arguably, extensive and time-consuming searches will still need to be performed in order to capture the WWW sites that contain the relevant information and resources. However, most of this searching will be done only by the webmaster, ie. the specialist maintaining the WWW pages. The webmaster will also compile and organise the WWW sites for ease of reading and access by the user. Therefore, the users of these subject resource pages will be spared the long searches, and need only do the occasional searching for additional specific information. These will save them much time and frustration, and will become an indispensable tool for teaching, learning and research. This will still be useful even if intelligent search engines are available.

Although the intention of these resource WWW pages is to provide a 'one-stop' starting point, it is not possible and indeed not a good idea to try and encompass everything available. These pages should be 'user-specific'.

This presentation will describe the range of Internet resources in Chemistry and Physics and share some central ideas in the design and organisation of these resources on WWW pages. We will use the Chemistry and Physics resource WWW pages, which we maintain, as illustrations of these ideas. We assume that the reader has some basic understanding of the WWW and the experience of accessing WWW sites using a browser software such as Netscape, Internet Explorer or Mosaic.

WWW INFORMATION AND RESOURCES FOR CHEMISTRY AND PHYSICS

There is a wealth of information and resources available for Chemistry and Physics on the WWW. The access to these information and resources may be found in our subject resource WWW pages. The Universal Resource Locator (URL) addresses to these WWW pages are listed below:

ChemistryWeb Internet Resources
http://www.nie.ac.sg:8000/~wwwchem/l-chres.htmlx

Physics Resource Page
http://www.nie.ac.sg:8000/~wwwphys/resource/main.htmlx

Figure 1 shows the ChemistryWeb Internet Resources page as an example.

Figure 1: Chemistry resource WWW page

The Chemistry and Physics WWW Resource pages are organised into three

main headings of information and resources. They include:

Chemistry and Physics specific information and resources. These include global indexes, reference materials, conference information, software information, Listservers, USENET Newsgroup, on-line journals, WWW pages of university science departments, selected bibliography and resources for teaching. Table 1 lists the subject specific information and resources.
General services. These include the search engines, libraries and general anonymous file transfer protocol (FTP) sites. Table 2 lists the general services that are useful to all Internet surfers.
Selected general information and resources. The miscellaneous information and resources are listed according to the personal preferences of webmasters and the local needs of the Institution. This category consists of science and mathematics indexes, Singapore WWW sites, Internet service providers, information on the Internet and how to explore the Internet, information on how to create WWW pages, etc. Table 3 lists selected general information and resources.

For a comprehensive and updated listing of all the information and resources available, we suggest that the reader visits the ChemistryWeb

Internet Resources and the Physics Resource pages at the URL addresses provided above.

Despite the many headings used in our Chemistry and Physics resource WWW pages, most of the information and resources available on the WWW may be classified into the following distinct groups:

On-line documents
Databases and Indexes
Virtual resource centres
Discussion groups
Search engines
Software

On-line documents

On-line documents are possibly the most frequently accessed information that is available on the Internet. Among others, these include valuable information on science education and research, which can prove to be useful for both students and teachers. Resources such as lesson plans for science subjects and articles on specialized topics can provide insightful examples, materials and models for the more adventurous teachers to adapt into their teaching. At the same time, these resources could also provide students with useful materials for project work, report or research. On the other hand, information on courses, entry requirements, lodgings, etc. that are provided by various departments in both local and overseas schools and universities can help students to decide on where to continue their education.

To supplement their own courses, or simply to pick up new scientific ideas, students and the general public can make use of the various on-line courses available on the Internet. These courses are mainly run by university departments, and are usually based on degree programmes with topics such as electricity, magnetism and astronomy. Although it is hard to envisage that such virtual learning activities will completely take over the present form of learning within the confines of a traditional campus; these virtual activities are, however, likely to become increasingly more common, and could form a substantial part of the student's learning experience. Thus, instead of going formally to attend lectures and tutorial classes, the learner can do a large part of the studying at home by taking different on-line courses from different universities.

It should be noted, however, that unlike books and articles in journals, not all the information available on these WWW pages, at present, are peer reviewed by subject experts. Their validity and accuracy have to be critically examined.

Table 1: Subject specific information and resources

Major Heading Brief Description Examples
Search Engines Listing of a range of search engines as well as indexes of search engines available on the WWW Search engines: Alta Vista (http://www.altavista.digital.com/) Excite (http://www.excite.com/) Lycos (http://www.lycos.com/) Magellan (http://www.mckinley.com/index.html) Webcrawler (http://webcrawler.com) Yahoo (http://www.yahoo.com/) Indexes: RES-Links - The All-in-One Resource Page (http://www.cam.org/~intsci/) All-in-One Search Page (http://www.albany.net/allinone/) WebPlaces Internet Search Guide (http://www.webplaces.com/)
Libraries Listing of selcted academic libraries and National Library in Singapore as well as Internet libraries The Internet Public Library (http://www.ipl.org/)
FTP Sites Listing of general anonymous FTP sites for downloading software TUCOWS' Collection of Winsock Software, Tools and Utilities for Web Development (http://www.********** ********** ********** * * * ********** * * ** ********** ********** ********* * ********** ********** ********** **********

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**********e.html)
Eisenhower National Clearinghouse for Mathematics and Science Education
(http://www.enc.org/)
The World Lecture Hall (http://www.utexas.edu/world/lecture/index.html)

The WWW Virtual Library
(http://www.w3.org/pub/DataSources/bySubject/Overview2.html)

Virtual Resource Centres
Directory of virtual resource centres around the world
Singapore Science Centre (http://www.ncb.gov.sg/vsc/vsc.html)
Exploratorium: A Museum of Science, Art and Human Perception
(http://www.exploratorium.edu/)
Cyberspace Hospital (http://ch.nus.sg/)
Hands-on Science Centers Worldwide
(http://www.cs.cmu.edu/afs/cs/usr/mwm/www/sci.html)

Internet Service Providers
Directory of Internet service providers
World List of Internet Providers (http://thelist.com/)

Exploring the Internet - Some starting points
Resources for general exploration of the Internet
NETLiNkS! Newbie Help Link (http://www.netlinks.net/)
Internet Starter Kit (http://www.mcp.com/hayden/iskm/windows.html)
BigSky Telegraph's: Self-Directed Learning Resources
(http://macsky.bigsky.dillon.mt.us/selfdirected.html)
WebCrawler's Index on the Internet
(http://webcrawler.com/select/internet.new.html)

Creating Web Pages
Resources for creating web pages
The Bare Bones Guide to HTML (HTML 3.2) (http://werbach.com/barebones/)
The WWW Help Page: Guide to creating web pages
(http://werbach.com/web/wwwhelp.html)
The Virtual Library of WWW Development (http://www.stars.com/Vlib/)

Table 3: Selected general resources.

Databases and Indexes

Information databases are important research tools in science education and research. Examples that can be found on the Internet include dictionaries, protein sequence databases, toxicological databases, material properties and periodic tables. Apart from databases, there

are also many web sites around the world which maintains subject indexes in the different disciplines of science. These indexes reduces considerably the amount of time spent in searching for information. For instance, the ChemistryWeb Internet Resources page maintains a list of major global indexes for Internet resources related to Chemistry, which provides a good starting point for gaining access to important Internet resources in Chemistry.

Virtual Resource Centres

An integral part of science education is to be able to perform experiments to test physical ideas; to see the occurrence of real physical phenomenon, and to understand how these fit within the scientific theories expounded by text books. In schools and universities that have considerable limitations with regard to adequately providing students with invaluable 'hands-on' experiences (for instance, schools that are physically far from an observatory), virtual resource centres could possibly fill the gaps to some extent.

Some of the best science centres in the world maintain web sites that enable users to 'visit' their exhibits and 'see' science at work. Many of these sites are highly interactive, thus providing a sufficiently enriching experience for the virtual visitors. Apart from science centres, virtual museums too can prove to be useful places to 'visit'. Some examples of such virtual resource centres with their corresponding URL addresses are given in Table 3.

Discussion groups

Engaging in extensive discussions on scientific concepts have the twin advantages of consolidating these concepts and stimulating creative thinking. Many electronic discussion groups that focus on specific topics are thriving on the Internet, allowing exchanges of ideas across international boundaries. These groups may be broadly divided into two types, namely USENET Newsgroups and Listservers. Newsgroups are electronic discussion groups that allow an exchange of ideas and information related to the specific topic via email. These groups may be accessed by anyone who has an Internet connection and has an email account. On the other hand, listservers function just like newsgroups except that access to them are limited to subscribed users via email. These groups generally allowed more focused discussions to be carried out, since subscribers generally share a common interest in the subject discussed. The Chemistry and Physics resource WWW pages provide extensive links to these discussion groups on the Internet.

Search Engines

Search engines are very important tools for information searching on the Internet. This is due to the fact that materials on the Internet are not structured or organised. Present search engines are generally

limited in the number of databases searched. Thus, it might be necessary to use more than one search engines to ensure that sufficient number of databases are comprehensively explored. Both the Chemistry and Physics Web pages contain indexes to the more popular search engines available on the Internet, together with links to other search engine indexes for searching in more specific databases.

Software

A large number of science-related software are available on the Internet. These may be downloaded for evaluation to ascertain their suitability for use in science education. In general, three main groups of software can be found, namely freeware, shareware and demonstration software. Freeware, as its name implies, refer to software that are freely available on the Internet. Some examples can be found at, say, the Chemistry software collection maintained at Sussex University (http://nmr400a.mols.susx.ac.uk/~steven/).

Demonstration software, although freely available, are generally not fully functional. They serve only to demonstrate the essential features of their intended use, and the provider charges a specific sum for the complete version. On the other hand, shareware are generally fully functional, but their use is restricted to a trial period of no more than 30 days in most cases. Upon expiry of the trial period, the user is expected to register and pay for continued usage.

TIPS FOR AUTHORING WEB PAGES

There are some distinctive features of web pages that will enhance their user-friendliness, especially for 'one-stop' subject resource WWW pages. These features may be classifed into those arising as a result of the present limitations of the Internet and those that are based on sound principles of resource organisation and management. Table 4

provides a summary of some of these features based on the authors' experience of maintaining the subject resource WWW pages.

The experience of having to wait for ages when graphic images are being downloaded is frequently encountered for graphic intensive WWW pages. This can be rather frustrating and time-consuming, particularly for the Internet surfers who are connected to the Internet by a slow modem. Resource Web page authors should, therefore, avoid creating graphic intensive pages. The rule of thumb is to avoid using images that do not add any useful information, and keep presentation image files simple and small. However, if graphic intensive pages are designed for aesthetic reasons, the web page author should also consider creating an alternative low-graphic or text version that contains essentially the same information. This is to cater for those users who either have a slow Internet connection, or have elected to have the 'view image'

function switched off to save downloading time.

As there are a range of Web browsers used, it is sometime advisable to avoid writing the resource web pages using the highest version of the HTML language available. This will ensure that those users, who have older browsers that do not recognise the higher version of the HTML language, may also be able to access the information on the web pages without undue difficulty. However, if the new features are essential or useful to the presentation of information, it would be helpful to warn the user to use the appropriate browsers or plugins. For instance, a simulation written using JavaScripts may only be viewed with higher versions of the Netscape browser.

Useful tips for authoring WWW pages

Owing to present limitations of the Internet:

Avoid graphic intensive WWW pages, ie. use images sparingly and appropriately.

If the WWW pages are graphic intensive, provide alternative low-graphics or text versions of the WWW pages.

Avoid the use of the latest version of HTML language.

Warn users about specific requirements for reading web page.

Keep usage of frames to a minimum and use them appropriately.

If frames are used, ensure that there are non-frame versions for browsers that do not support frames.

Check your WWW pages with different Web browsers.

Based on sound principles of resource organisation and management:

Provide avenue for comments and feedback.

Provide short annotations to links.

Use similar WWW page layout to ensure consistency and ease of navigation.

Give some thought to the layout of text and images to ensure ease of reading.

Sign web page.

Provide the date of last updating of the WWW page.
Provide multiple entry points to a particular resource page.
For the ease of updating, avoid duplicating a set of URL links in different resource pages.

Table 4: Some general guidelines to enhance user-friendliness of resource WWW pages.

It is also useful to view the resource WWW pages using different browsers. This is to ensure that the colours of the links and the general layout of the WWW pages, which will appear differently in different browsers (such as Netscape, Internet Explorer and Mosaic), are not inappropriately displayed.

Providing an annotation for each link that points to a remote site is probably one of the most useful feature for a resource web page. This way, the user does not have to waste time visiting sites that that are of no interest to him/her. In addition, giving personal ratings for sites of similar nature could also be an invaluable guide for the user.

It is important to sign off a web page and allow avenue for comments and suggestions. These practices will encourage users to provide feedback which may improve the quality, content and appearance of the resource web pages. It is also useful to provide the date of the last updating, as it gives the users an indication of the currency of the WWW pages.

Since the information and resources on the WWW pages are organised via hypermedia, it is a good practice to provide access to a particular resource page from a number of other WWW pages. For instance, it is convenient for the users to have access to Library URL links from both the "Selected Resources" and "Resources for Teaching" pages (see Figure 1). This means that the user, who is already at either of these pages, need not go back to the main resource page to gain access to the page containing the Library URL links. This is illustrated in Figure 2 below.

Figure 2: Providing multiple access to the Library URL links page.

Providing a separate resource page on a particular subject topic, where other WWW pages can point to, will also help to reduce the amount of updating required. Thus, instead of listing the Library URL links in both the 'Selected Resources' and 'Resources for Teaching' pages, it is better to create a separate page containing the links as shown in Fig.(2). In this case, only the Library URL links page needs to be updated to accomodate any changes.

CONCLUSION

In the present information age, the continued growth and development of information technologies is rapidly defining new shifts in the learning paradigm with regard to education. Resource specific web pages, whether provided by libraries or university departments, should aim to accelerate and not impede the learning process by providing user-friendly, 'one-stop' web pages. In response to this need, we have discussed the various features of useful resource web pages that can fulfil partially the present needs of a science education for students and exploratory tool for researchers.

In future, information providers such as librarians might have to start providing customised resource web pages for individual users. This may be done, for example, by creating a web page-creation template that allows the user to search, select and organised the desired materials into a web page for his/her own use. Such customised resource pages are not only more useful for the user, it will be a step in the right direction in the use of the Internet for individualised learning.

Apart from the disorganised nature of information on the Internet, several other factors that inhibit the potential of the Internet include network congestion and lack of intelligent search engines. With the number of Internet users almost doubling every year, 'traffic' congestion is a problem that has to be dealt with. There are two fundamental ways to tackle the problem: an effective charging system and improved technologies. In the short term, charging users the true cost of Internet usage, at least for the more popular or important services, or at peak hours only, could help to re-distribute some of the information load from congested period to less congested periods. At the same time, improved technologies too can increase both the quantity and rate of transfer of information.

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