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SURFING THE CHEMISTRY WEB: AN INTRODUCTORY TUTORIAL

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INTRODUCTION

The World Wide Web (WWW) is the hypermedia information service gateway to the Internet. In a hypermedia information system, the reader may browse multimedia items of information in a non-sequential manner. This browsing is achieved by following up predefined associative links between documents containing related information. The items of information that may be linked in the WWW documents or files include texts, pictures, sound clips, video clips and interactive programs.

Through surfing or navigating the Internet via the WWW, teachers and students are able to access globally a wide range of information and resources on practically any subject. To access this information, you only need a PC (IBM-compatible or Mac) that is connected to the Internet and the relevant software for browsing the WWW.

In this tutorial, I will provide some basic information on how to get started on the WWW and the types of information and resources that are available on the Internet which are of interest to chemistry teachers and students. It is not within the scope of this short tutorial to explain the technical details for connecting your PC to the INTERNET or to install the relevant software. For such information, you should be able to consult the computer guru or expert in your respective schools. There is always at least one "lurking" around who is generally willing to help. This person may well be one of your students.

GETTING CONNECTED TO THE INTERNET

In order to get connected to the Internet, you will obviously need to get access to a PC that is already connected to the Internet. In school, you should already have computers that are connected to the Internet. If you are not sure, you should check with the Head of Department for IT or the teacher in charge of the computer systems in your school. However, to get your home PC connected to the Internet, you will need a modem, either a telephone line or cable line and an Internet account. The common types of commercial Internet connections are summarised in Table 1.

For general information browsing on the WWW, the normal dial-up Internet connection using a modem with a speed of up to 56 kbps is adequate. As teachers, you are also eligible to apply for a dial-up Internet account through the Ministry of Education rather than to sign up for an Internet account directly with one of the Internet service providers (ISP). You should check with the Head of Department for IT or the teacher in charge of the computers in your school on the application of a dial-up account with the Ministry of Education. The advantage of obtaining a dial-up account through the Ministry of Education is that you need only to pay for a modem and the telephone charges for the duration of the Internet connection. If you sign up for an Internet account with one of the ISPs, you will need to pay an additional monthly subscription charge. The subscription provides you with a number of free hours of Internet access per month. The number of free hours depends on the subscription plan that you opted for. When the number of free hours is exceeded, you generally pay connection charges by the minute.

Table 1: Common Types of Commercial Internet Connections

ISP[1]	Equipment	Connection Speed
SingNet, Pacific Net or Cyberway	PC, modem, preferably a dedicated telephone line and Internet account with one of the ISP listed.	*Normal Internet connection:* 28.8 kbps, 33.6 kbps or 56 kbps[2]
Singapore Cable Vision (SCV) and Cyberway	PC, network interface card (NIC)/Ethernet adapter with RJ-45 (UTP) connector, cable modem, cable line and an Internet account with Cyberway.	*Singapore ONE network connection:* downloading speed of up to about 5,000 kbps and uploading speed of up to about 800 kbps.
SingTel Magix (for ADSL connection) and SingNet, Pacific Net or Cyberway (for Internet connection)	Computer system, ATM network interface card, ADSL modem, telephone line and a FastNet account with one of the ISP listed.	

Notes:

1. For more information such as costs of connections, go to the WWW pages of the respective ISPs. The Internet addresses of these ISPs are listed in the Appendix.
2. A modem with a speed of 28.8 kbps should be the slowest speed that you should consider for browsing information on the WWW.

However, if you want to enjoy the full possibilities of multimedia interactivities and fast downloading of media and software on the Internet, you should get connected to Singapore ONE network. This connection is, at the present moment, relatively more expensive in terms of the cost of additional hardware needed to be purchased and the monthly subscription charges.

SOFTWARE FOR WWW SURFING

Once your computer is connected to the Internet, you will need WWW browser software and some essential plug-ins to surf the Internet for information and resources. The two main WWW browsers available are Netscape Communicator and Microsoft Internet Explorer. You should have either one of them loaded onto your PC. Both of the software are freeware i.e. they can be freely downloaded and installed onto your PC without a need to pay for them. At the time of writing, Netscape Communicator 4.5 and Internet Explorer 4.01 are available. In order to enjoy access to all chemical information and resources, these browsers must be equipped with some essential plug-ins. These plug-ins are software modules that need to be added to the browser software so that the latter software can display different types of media such as audio/video files or interactive shockwave applications. These plug-ins are generally also freeware. The Internet addresses for the WWW browsers and the essential plug-ins are listed in the Appendix. In this tutorial, the browsing of the WWW for chemical information and resources will be illustrated using Netscape Communicator 4.

HOME PAGE

Now that you have a connection to the Internet and the software for browsing the WWW, you are ready to get started to surf the Internet for chemical information and resources. You need to enter the WWW via a suitable web page or site. This web page or site is called your home page. The home page that you selected should provide you with hyperlinks to the information or resources that you require. For information and resources related to Chemistry, a suitable home page to start from is the

one that I have created called ChemistryWeb: Internet Resources. The URL (uniform resource locator) or the internet "address" of ChemistryWeb is

http://www.ssc.ntu.edu.sg:8000/chemweb/htmlj/

The above URL address may be entered into your browser using the following procedure shown in box 1.

Box 1: Procedure for entering the URL address

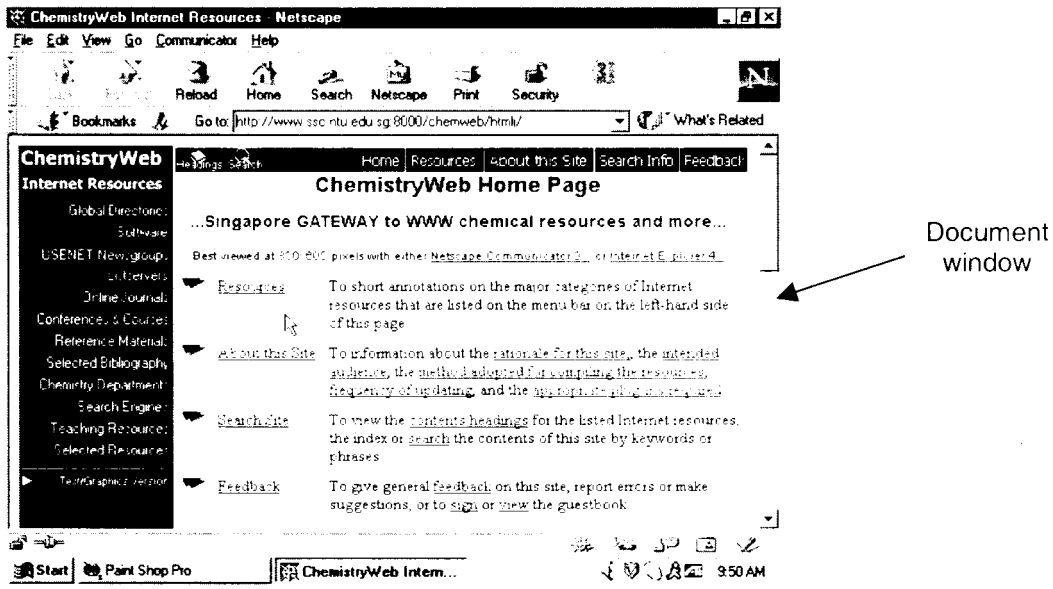
Netscape Communicator 4 **Microsoft Internet Explorer 4**

1. Move the mouse pointer or cursor into the dialog box shown above and left-button click on the mouse.
2. Type in the URL address as given without leaving any blank spaces in between.
3. Press the [Enter] key.

NAVIGATING THE WWW

Once the connection to ChemistryWeb page is made, the screen that you will see is depicted in Figure 1. If you are able to get connected to this chemistry home page at the National Institute of Education (NIE), the rest is easy. You will be surfing the WWW in no time. You merely need to use the mouse to left-button click on the various links that interest you. These links are easily identified. Text links comprise a single keyword or a phrase and are underlined and, by default, are coloured blue or pink. When you use the mouse to move the pointer or cursor over these text links, it changes from an arrow,  , to a hand,  . Links may also be in the form of graphics or icons. Similarly, when you use the mouse to move the pointer or cursor over these graphical or iconic links, it changes from an arrow,  , to a hand,  . For example, in Figure 1, some of the text links are "Resources", "About this Site", "Search Site" and "Feedback" while the graphical or iconic links are the menus at the topmost part and the left hand-side of the screen of the document window. To access these links, you just need to use the mouse to left-button click on any part of the phrase or icons to get connected to the next document containing related information.

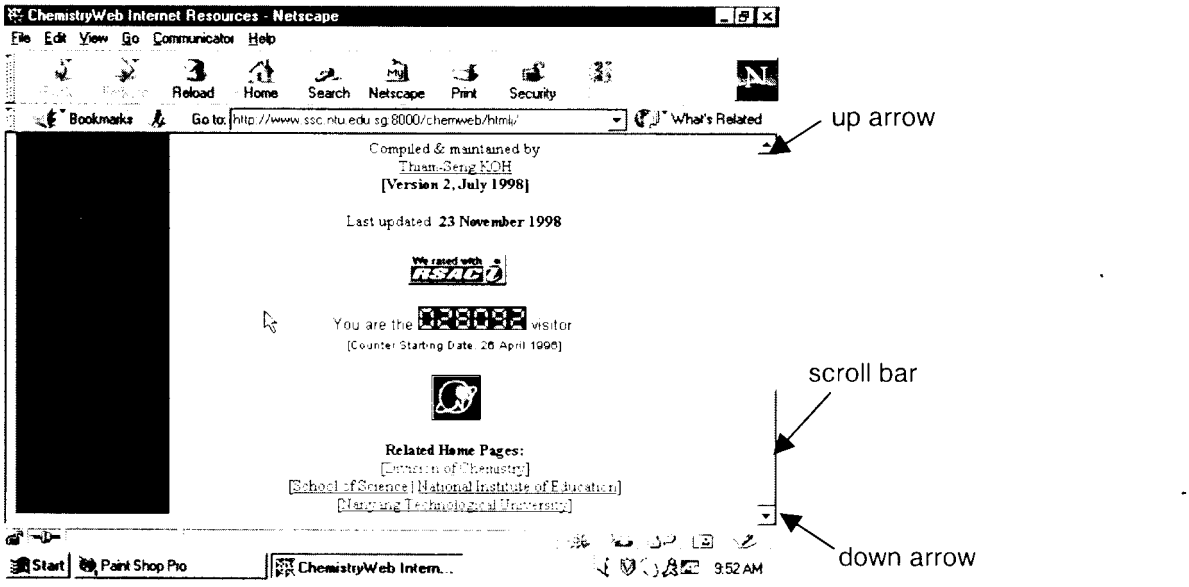
Figure 1: Top part of the ChemistryWeb home page



When you first access the home page, you will see the screen depicted in Figure 1. If the document is longer than could be shown in the document window, as it is the case of the home page, you will need to use the mouse to move the scroll bar (see Figure 2) at the right hand side of the window. When the scroll bar is moved all the way down, you will see the bottom part of the document in the document window as depicted in Figure 2. The scroll bar may be moved in a number of ways.

- You may move the mouse pointer or cursor over the up arrow or down arrow and left-button click on it. Each click of the left button of the mouse will move a line of text up or down.
- You may move the mouse pointer or cursor to any position above or below the scroll bar and left-button click on it. Each click of the left button of the mouse will move the text up or down a window page.
- You may move the mouse pointer or cursor over the scroll bar and while holding down the left button of the mouse, you can drag the scroll bar up or down to move up or down the document very quickly.

Figure 2: Bottom part of NIE chemistry home page



It is important to remember that you can only see the contents of a document that is within the document window at any one time. If the length of the document exceed this window page, you will need to use the scroll bar to see the remainder of the document. However, if the document falls within the document window, an attempt to move the scroll bar will not lead to a change in the screen display.

CHEMICAL INFORMATION AND RESOURCES ON THE WWW

In the course of your surfing the WWW, you will encounter a wide range of information and resources on chemistry. In ChemistryWeb, the information and resources relevant to chemistry and other selected resources are organised into twelve categories. A listing of the content headings of ChemistryWeb is summarised in Table 2. *It is important to note that much of the information that is found on the WWW is not peer referred before it is deposited on the Web. You should critically review the information that you retrieve from the Web.*

Table 2: A listing of content headings of ChemistryWeb

- **Global Directories**
  - General Directories
  - Specialised Directories
  - Teaching Resources Directories
- **WWW Sites for Chemistry Related Software**
  - Download Sites for Chemistry Software
  - Directories of chemistry-related software
  - General Software Download Sites
- **USENET Newsgroups**
  - Short Notes on Newsgroups
  - Selected Chemistry-Related Newsgroups
- **Listservers**
  - Short Notes on Listservers
  - Selected Chemistry-Related Listservers
- **Selected Online Chemistry-Related Journals**
  - Chemical Education
  - Chemical Research
  - Directories for Chemistry-Related Publications
  - Directories for Science-Related Publications
- **Chemistry Conferences and Courses**
  - Virtual Conferences and Online Courses
  - Directories of Conference Announcements
- **Reference Materials for Chemistry**
  - Periodic Tables
  - Databases
    - Analytical Chemistry
    - Biomolecules
    - Chemical Databases
    - Chemical Information
    - Chemical Structures
    - Cystallographic Data
    - Material Safety Data Sheets (MSDS)
    - Physical Chemistry
    - Polymers
    - Spectroscopic Data
  - Conversion Factors and Constants
    - Conversion Factors
    - Physical Constants
  - Chemical Catalogues and Companies
    - Purchase of Chemical Reagents
    - Directories of Chemical Companies
  - IUPAC Recommendations
    - IUPAC Recommendations
    - IUPAC Provisional Recommendations
  - Dictionaries and Encyclopedia
    - Dictionaries for Chemistry-Related Subjects
    - Encyclopedia for Chemistry-Related Subjects
  - Nobel Prizes
    - Nobel Prizes in Chemistry
    - Nobel Prizes in Other Subjects
- **Selected Bibliography on Computing in Chemistry**
  - Books
    - Chemical Education
    - Chemical Research
  - Journal Articles
    - Analytical Chemistry
    - Chemical Education
    - Chemical MIME
    - Computational Chemistry
  - Electronic Conferences
    - Electronic Publishing
    - General Chemistry
    - VRML
  - Conference/Symposium Papers
    - Chemical Education
    - Chemical Research
  - News Reports
    - 1998
    - 1997
    - 1996
    - 1995
  - Others
    - Talks and Presentations
    - Unpublished Articles
    - Theses
- **Chemistry-Related Departments**
  - South East Asia, East Asia & Australasia
  - Country/Regional List
  - World List
  - University Home Pages (World List)
- **Search Engines**
  - Singapore-Based Search Engines
  - General WWW Search Engines
  - Newsgroup Finders
  - People Finders
  - Program Files Finders
  - Business Finders
  - Metasearhing Sites
  - Indexes of Search Engines
  - Introductory Articles on Searching
  - Advanced Articles on Searching
- **Teaching Resources**
  - Curriculum Materials for University Level
    - Analytical Chemistry
    - General Chemistry
    - Inorganic Chemistry
    - Organic Chemistry
    - Physical Chemistry
    - Interactive Applications
  - Directories to Teaching Resources
  - Curriculum Materials for Secondary School/Junior College Level
    - General Chemistry Topics
      - Instructional Resources for Teachers
      - Digital Textbooks
    - Specific Chemistry Topics
      - Acid-Base
      - Chemical Bonding
      - Polymers
      - Redox Reactions
      - Environmental Chemistry
      - Material Science
      - Physical Chemistry
    - Demonstrations and Experiments
    - Directories to Teaching Resources
  - General Resources for Science Teaching
    - General Science Resources
    - Humour
    - Answers to Common Science Questions
    - Inquiry-Based Science Education

Table 2 (Continued): A listing of content headings of ChemistryWeb

- Use of IT in Education
  - University Level Resources
  - School Level Resources
  - Technical Resources
- Databases for Science Education
  - Ask the Experts
  - Journals/Magazines for Science Education
  - General Educational Databases
- Directories to Educational Resources
  - Science-Based Directories
  - Directories to All Subjects (Including Science)
- Centres and Institutes for Chemistry/Science Education
  - United States of America
  - Europe
  - Israel
  - Australia
  - New Zealand

Selected General Resources

- General Software Download Sites
  - Singapore-based software download sites
  - Software/shareware libraries
  - World list of FTP sites
- Global Directories for Science and Mathematics
  - Biological Sciences
  - Chemistry
  - Physics
  - Mathematics
  - Education
- Selected Reference Materials
  - Computing-Related Resources
  - Dictionaries and Encyclopedia
  - Virtual Reference Desk
- Selected Singapore Libraries
  - Selected Academic Libraries in Singapore
  - Singapore National Library
  - WWW Libraries
- Virtual Science Resource Centres
  - Selected Science Centres
  - Directories of Science Centres
- Selected Singapore WWW sites
  - Education-Related Sites
  - Singapore Media
  - Directories
- Exploring the Internet
  - Internet Training Workshops
  - Introduction to the Internet
  - Directories on Internet
- Internet Service Providers
  - Singapore-Based ISPs
  - Directory of ISPs
- Creating Web Pages
  - Home Pages for Singapore-based Accounts
  - Software for Web-Based Publishing
  - References for Web-Based Publishing
    - HTML
    - Clip Art
    - Frames
    - Forms and CGI
    - Search Engines
  - Newsgroups for Web-Based Publishing
  - Directories to Web-based Publishing
- Interactive Web Technologies
  - ActiveX
  - Dynamic HTML
  - Internet Relay Chat
  - Java
  - JavaScript
  - MOO/MUD
  - Shockwave

Global Directories of Chemistry Resources

This category provides a selection of global directories that list extensive compilation of WWW links to chemistry and chemistry related resources on the Internet for chemical researchers and educators. It is further sub-divided into general directories, directories on selected chemistry specialisation and directories to teaching resources.

Among the general directories, the two most comprehensive and current listings are the *ChemDex* maintained by Dr. Mark Winter at Sheffield University, UK and *WWW Links for Chemists* maintained by Dr. Michael Baker at University of Liverpool, UK. For directories to teaching resources, *Tutorials for Chemistry* and *Chemistry Resources on the Web* maintained by Bob Jacobs at Walton High School, US are good starting home pages. The *Chemistry Place* is a site that is specifically targeted at chemistry teachers and students. It provides a range of resources that include recent research news suitable for student reading, a reviewed list of web resource, "Best of the Web", for chemistry education and web-based investigative learning activities and interactive tutorials that are intended for classroom teaching. It also provides an electronic forum for the sharing of teaching ideas, lesson plans and teaching strategies among educators. *Unfortunately, access to the resources on this site requires subscription.*

WWW Sites for Chemistry-Related Software

The software category lists WWW links to information on sites where a wide range of chemistry-related software may be downloaded. These software packages include demonstration software of commercial packages, shareware and freeware. Demonstration software may either be merely software demonstrating all the features found in the software product or an actual functioning software with important features such as printing and/or copying across applications being disabled. Shareware are generally fully functioning software that may be downloaded and installed into your PC for the purpose of evaluation. Typically, you may use shareware for up to 30 days to evaluate their usefulness and suitability. If you are satisfied with the software and want to continue to use them after the evaluation period, you are expected to register the use of these software with the respective authors or manufacturers and pay a specified sum.

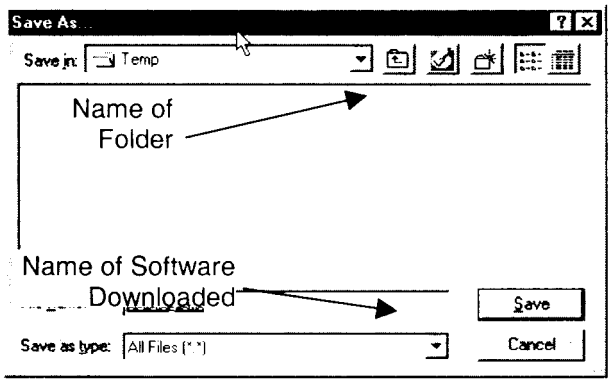
In order to download software from the Internet, you only need to click on the link that points to the desired software. See Box 2 for the procedure for downloading software to your PC. You should be aware that many of the software placed on these WWW sites are compressed files i.e. the original files have been compressed to reduce their sizes to speed up their transfer across the Internet. One very common type of compressed file is the zip file i.e. files ending with the 'zip' extension, for example, "orgtut.zip". Once these zip files are downloaded or transferred to your computer, you will need to unzip or decompress them before using them. A common program for decompressing zip files is ***winzip*** (see the Appendix for the site to download the program).

A good WWW site to visit is the one at *CTI (Computers in Teaching Initiative) Centre for Chemistry* at the University of Liverpool. The Centre maintains a catalogue of chemistry-related software in addition to demonstration software, shareware and freeware that may be downloaded to your computer. The 5th edition of the former catalogue provides detailed information on over 500 chemistry-related software. The details captured in the latter database include the price, the authors and publishers, the platform (Mac, IBM, etc.) for the software, the intended audience or users, a short description of the software and references to literature reviews (if any) of these software.

Discussion groups on chemistry related topics

USENET newsgroups and listservers are electronic discussion groups that allow the users to exchange information with one another on the Internet on chemistry-related topics via the email. The essential difference between a newsgroup and a listserver is that the latter requires the user to be subscribed to it. However, the subscription to a listserver requires you to have a personal email account and is generally free. For further information such as how to access these discussion groups, you should visit the ChemistryWeb site.

Box 2: Procedure for downloading software using Netscape Communicator 4



1. Left-button click on the WWW link for the software to be downloaded.
2. When the "Save As" dialog box shown above pops out, select a folder to save the software and type in the name of the software. Generally, you can use the default name given. In the above example, it is "catalog.exe". Note that you must **not** change the extension part of the name i.e. "exe". The name, "catalog" can be changed.
3. Left-button click on the [Save] button.

Some of the relevant newsgroups to chemistry teachers and students include *sci.chem*, *sci.edu*, *sci.chem.analytical*, *sci.chem.organomet* and *sci.polymers*. For example, if a teacher has some questions pertaining to general chemistry, then, he or she may wish to post or email the question to the *sci.chem* newsgroup to get the answers. However, if the teacher has some questions pertaining to analytical chemistry or polymer chemistry, then, he or she may post the question to the *sci.chem.analytical* and *sci.polymers* newsgroups respectively for the answers. These newsgroups may be accessed using the WWW browser. An example of a listing of postings and a sample reply on sci.chem newsgroup are shown in Figures 3 and 4 respectively.

Figure 3: A listing of postings on *sci.chem* newsgroup

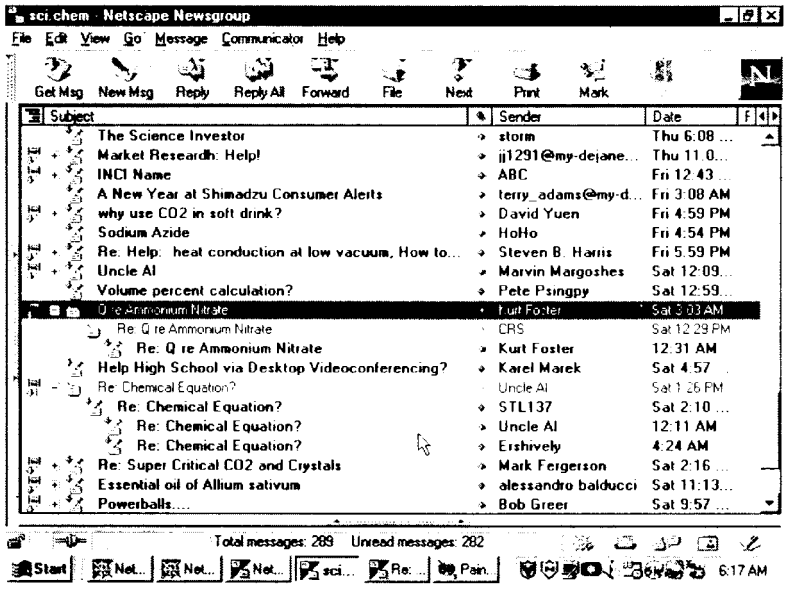
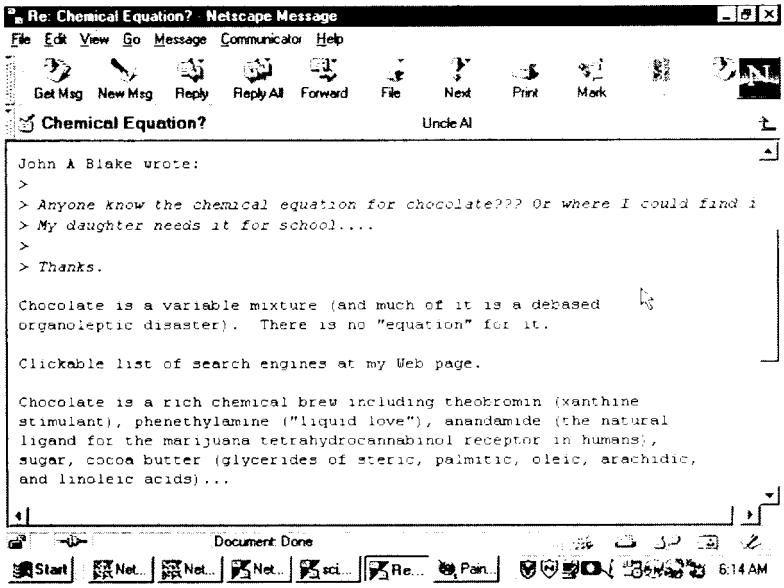


Figure 4: A sample reply to a question posted on *sci.chem* newsgroup



Online Information Services

A wide variety of information services on chemistry for teaching and research may be retrieved from the WWW. These services include online journals, information on conferences and courses, chemistry departments at universities worldwide and online reference materials.

All major chemistry-related journals maintain WWW pages. On these web sites, you can at least retrieve the table of contents of the journals. However, in order to obtain full access to the journal articles online, many of the journal publishers require you to be a subscriber.

Increasingly, the WWW has been used as a platform for on-line courses and conferences. These courses and conferences are announced on the WWW from time to time. The WWW browser is used to view the lessons for the course or the paper presented at the on-line conference. The participants interact with one another via email. In 1998, there are several chemistry related courses and conferences conducted. Examples include a course on *Computational Chemistry for Chemical Educators* conducted by North Carolina Supercomputing Centre (NCSC), an undergraduate online course unit on environmental chemistry sponsored by the American Chemical Society and *ChemConf 98*, an on-line conference on chemical education. These courses and conferences allow you to interact with chemical educators and researchers worldwide without you having to leave your home.

Many university chemistry departments around the world provide up-to-date information on their faculty research and teaching. The number of chemistry departments around the world which maintain WWW sites is well in excess of 1000. The wealth of information maintained on these sites is particularly useful to career guidance counsellors and Singapore students who intend to enrol in chemistry at an overseas university. The relevant information can now be accessed from their computers either at home or in school at a click of a button.

A host of reference materials are deposited on web sites. Some of the materials that are particularly useful to you as a teacher and your students include the *periodic tables*, chemical databases such as *physical, chemical and toxicological properties* of chemical substances, and *online dictionaries*. If you wish to keep up-to-date on Nobel prizes for chemistry, the *Nobel Prize Internet Archive* site announces the current year prize winner way ahead of the local media.

Search Engines

There is a range of tools or engines available on the WWW for the searching of chemistry related information by keywords or phrases. Two useful search engines are *Alta Vista* and *HotBot*. Once a connection to the home pages of the latter search engines is made, the searching process is easily accomplished by typing in the keywords or phrases into the respective dialog boxes and clicking the [Search] button. The search engine will then display the results by listing the web sites that contain the documents or files that include the keywords or phrases entered. For example, Alta Vista and HotBot search engines found, at the time of writing, about 62,900 and 16,900 web pages respectively that contain the phrase, "organic chemistry".

These search engines are useful to you and your students if you are interested in a fairly comprehensive search of resources on the Internet on a particular chemistry topic. They provide a convenient route of researching a particular area of chemistry for project work or for teaching a particular chemistry topic. The resources obtained on a particular topic from these searches generally complement and in some cases, supplement the information found in the libraries. However, as the search results obtained are dependent on the scope of the databases of the respective searching engines, it is important to use several search engines if a complete search of nearly all the available resources on a particular topic is required.

Teaching Resources

Perhaps, the WWW is most useful to the teacher as it provide access to a rich worldwide repository of teaching resources. You can retrieve sample lesson plans, teaching ideas, course notes and interactive applications on chemistry-related topics at all levels of schooling. You should visit the "Teaching Resources" section of the ChemistryWeb to get a sense of the range of resources available. If you are teaching at the secondary school or JC level, you should not avoid the university level materials. Many of the curriculum materials designed for university instruction may be adapted to secondary or JC teaching of chemistry.

SOME CONCLUDING REMARKS

The WWW is an extensive global source of educational resources that is open to exploration and application by chemistry teachers and students. In order to discover the richness of the resources available on the WWW, you have to start investing some time in browsing the WWW. Hopefully, this short tutorial has provided sufficient information to get you started on surfing the WWW and generated enough interest to do so. So, happy exploring. If you should encounter any problem surfing the chemical net, you may contact me via email at kohts@nie.edu.sg.

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APPENDIX

World Wide Web sites for chemistry and selected resources

The selection of WWW links highlighted in this appendix is intended to get you started only. For the full range of web resources, you should visit Chemistry Web Internet Resources at the NIE web site.

Internet Service Providers

SingNet	http://www.singnet.com.sg
PacificNet	http://www.pacific.net.sg
Cyberway	http://www.cyberway.com.sg
Singapore Cable Vision	http://www.singa.pore.net/
SingTel Magix	http://www.magix.com.sg/

Singapore ONE Network

Singapore ONE Network	http://www.s-one.gov.sg/html/

Download Sites for Browser Software and Essential Plug-ins

Download Sites: Software and Plugins
http://www.ssc.ntu.edu.sg:8000/chemweb/htmlj/cw_plugins.html

Global Directories

Sheffield ChemDex	http://www.chemdex.org/
WWW Links for Chemists	http://www.liv.ac.uk/Chemistry/Links/links.html
The Chemists' Net	http://www.chemists-net.demon.co.uk/
Tutorials for Chemistry	http://w3.nai.net/~bobsalsa/tutorial.htm
High School Chemistry Resources on the Web	http://w3.nai.net/~bobsalsa/high.htm

WWW Sites for Chemistry-Related Software

CTI Centre for Chemistry Software Catalogue	http://www.liv.ac.uk/ctichem/catmain.html
InfoChem: Software for Chemistry	http://www.infochem.co.uk/software/software.htm
ChemDex: Software	http://www.shef.ac.uk/chemistry/chemdex/software.html

Chemistry-Related Newsgroups

General Chemistry	news:sci.chem
Science Education	news:sci.edu

Online Courses and Conferences

Computational Chemistry for Chemistry Educators
http://www.shodor.org/compchem/
Online Course on Environmental and Industrial Chemistry
http://wey238ab.ch.iup.edu/olccii/
ChemConf 98: On-Line Conference on Chemical Education
http://www.inform.umd.edu/EdRes/Topic/Chemistry/ChemConference/ChemConf98/
ChemWeb Virtual Lectures
http://chemweb.vei.co.uk/

Reference Materials

WebElements	http://www.shef.ac.uk/chemistry/web-elements/
Pictorial Periodic Table	http://chemlab.pc.maricopa.edu/periodic/periodic.html
CS ChemFinder	http://chemfinder.camsoft.com/
Chemistry WebBook	http://webbook.nist.gov/chemistry/
Envirofacts Warehouse	http://www.epa.gov/enviro/html/emci/chemref/index.html
Nobel Prize Internet Archive	http://nobelprizes.com/nobel/Chemistry.html

Search Engines

Alta Vista	http://www.altavista.com/
Excite	http://www.excite.com/
Hotbot	http://www.hotbot.com/
Lycos	http://www.lycos.com/

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