Sustento del uso justo de Materiales Protegidos

derechos de autor para fines educativos

UCI
Universidad para la Cooperación Internacional

UCI

Sustento del uso justo de materiales protegidos por derechosde autor para fines educativos

El siguiente material ha sido reproducido, con fines estríctamente didácticos e ilustrativos de los temas en cuestion, se utilizan en el campus virtual de la Universidad para la Cooperación Internacional – UCI - para ser usados exclusivamente para la función docente y el estudio privado de los estudiantes en el curso Tecnología y Manejo de información perteneciente al programa académico Maestría en Inocuidad de Alimentos.

La UCI desea dejar constancia de su estricto respeto a las legislaciones relacionadas con la propiedad intelectual. Todo material digital disponible para un curso y sus estudiantes tiene fines educativos y de investigación. No media en el uso de estos materiales fines de lucro, se entiende como casos especiales para fines educativos a distancia y en lugares donde no atenta contra la normal explotación de la obra y no afecta los intereses legítimos de ningún actor .

La UCI hace un USO JUSTO del material, sustentado en las excepciones a las leyes de derechos de autor establecidas en las siguientes normativas:

a- Legislación costarricense: Ley sobre Derechos de Autor y Derechos Conexos, No.6683 de 14 de octubre de 1982 - artículo 73, la Ley sobre Procedimientos de Observancia de los Derechos de Propiedad Intelectual, No. 8039 – artículo 58, permiten el copiado parcial de obras para la ilustración educativa.

b- Legislación Mexicana; Ley Federal de Derechos de Autor; artículo 147.

c- Legislación de Estados Unidos de América: En referencia al uso justo, menciona: "está consagrado en el artículo 106 de la ley de derecho de autor de los Estados Unidos (U.S,Copyright - Act) y establece un uso libre y gratuito de las obras para fines de crítica, comentarios y noticias, reportajes y docencia (lo que incluye la realización de copias para su uso en clase)."

d- Legislación Canadiense: Ley de derechos de autor C-11– Referidos a Excepciones para Educación a Distancia.

e- OMPI: En el marco de la legislación internacional, según la Organización Mundial de Propiedad Intelectual lo previsto por los tratados internacionales sobre esta materia. El artículo 10(2) del Convenio de Berna, permite a los países miembros establecer limitaciones o excepciones respecto a la posibilidad de utilizar lícitamente las obras literarias o artísticas a título de ilustración de la enseñanza, por medio de publicaciones, emisiones de radio o grabaciones sonoras o visuales.

Además y por indicación de la UCI, los estudiantes del campus virtual tienen el deber de cumplir con lo que establezca la legislación correspondiente en materia de derechos de autor, en su país de residencia.

Finalmente, reiteramos que en UCI no lucramos con las obras de terceros, somos estrictos con respecto al plagio, y no restringimos de ninguna manera el que nuestros estudiantes, académicos e investigadores accedan comercialmente o adquieran los documentos disponibles en el mercado editorial. sea directamente los documentos, o por medio de bases de datos científicas, pagando ellos mismos los costos asociados a dichos accesos.

ELSEVIER

Toxicology 157 (2001) 121–139

TOXICOLOGY

www.elsevier.com/locate/toxicol

Using internet search engines and library catalogs to locate toxicology information

Laura Dassler Wukovitz *

Pollution Prevention Information Clearinghouse, 7407, United States Environmental Protection Agency, Ariel Rios Building, 1200 Pennsylvania Avenue, Washington, DC 20460, USA

Abstract

The increasing importance of the Internet demands that toxicologists become aquainted with its resources. To find information, researchers must be able to effectively use Internet search engines, directories, subject-oriented websites, and library catalogs. The article will explain these resources, explore their benefits and weaknesses, and identify skills that help the researcher to improve search results and critically evaluate sources for their relevancy, validity, accuracy, and timeliness.

Keywords: Toxicology; Information resources; Internet; Databases; Online systems

1. Introduction

The Internet is a powerful workhorse that can be harnessed to assist in the harvesting of a wealth of information on virtually any topic, including toxicology. However, like the farmer locked in a perennial battle with parasites and weeds, the researcher using the Internet requires persistence, creativity, judgement, and the ability to spot the symptoms of a diseased crop. While there is often no substitute for a thorough search using traditional bibliographic databases, the increasing importance of the Internet to scientific communications demands that toxicologists become acquainted with its resources. There are several classes of tools that can be used to help identify relevant information on the Internet, such as search engines, directories, and subject-oriented websites. The Internet can also be used as a way to access books and library resources on toxicology, since most libraries now have online catalogs. Studies have shown that the use of several bibliographic databases, instead of only one or two, provides the most comprehensive set of research results (Gehanno et al., 1998; Ludl et al., 1996). This also holds true for the Internet. This article will explain the essential structure of the different resources, explore the benefits and weaknesses of each, and identify skills that help the researcher to improve search results and critically evaluate sources for their relevancy, validity, accuracy, and timeliness.

* Tel.: + 1-202-2601758.
E-mail address: dassler.laura@epa.gov (L. Dassler Wukovitz).

0300-483X/01/$ - see front matter
PII: S0300-483X(00)00343-7

2. Pitfalls and promise of the internet

The Internet is a vast and ever-increasing computer network that is dramatically changing the way information is distributed and shared, and it has become an important vehicle for scholarly communications (Lawrence et al., 1999b). Unfortunately, due to the structure and nature of the Internet itself, it can be difficult to locate information relevant to a given topic. Unlike bibliographic databases and library catalogs, which index a specific set of publications using a defined structure and a controlled list of subject headings or keywords, the Internet has no definable boundaries and no standard method of organization. If you need to know whether a particular journal is indexed in Medline, you simply look at the master list of journal titles, and you have your answer, usually very quickly. There is no corresponding master list of titles for the Internet, and finding the answer to a basic question can sometimes take an unexpected quantity of time and energy.

Locating information on the Internet is complicated by the fact that it is constantly in a state of flux. This continuous change can help or hinder the researcher. Digital information has several advantages over traditional printed information — electronic data can be easily and quickly updated, and hypertext allows for interactive features, such as linking among related sources. News about the latest breakthroughs can be found on the Internet before they appear in print sources (DeWoskin, 1998). However, the dynamic nature of digital information also poses challenges. Electronic data is relatively easy to update as new developments occur, but frequent changes to sites often result in information being moved, deleted, or reorganized. As a result, search utilities will sometimes return 'dead links', or pages that no longer exist, in response to a query. Existing sites will also sometimes contain links to extinct pages or sites. In addition to keeping track of existing information, new sites are constantly being added to the Internet. In February 2000, the number of indexable webpages on the World Wide Web (WWW) was estimated to be over one billion. This number counts only pages that are accessible to search tools, and does not include all the information contained within online databases (Inktomi, 2000). Due to its size and variability, no existing search utility is capable of searching the entire WWW, and even the largest of the search tools index only about 35% of the WWW (Sullivan, 2000).

These barriers to finding information may seem formidable, but they are not insurmountable. The technology used to search and index the Internet is constantly being improved, and the number of general and subject-specialized search tools is growing. In addition, librarians and information professionals are attempting to organize and classify sites based on their content.

There are three basic mechanisms for finding materials on the Internet. They are search engines, directories, and subject-oriented websites. There are fundamental differences between these three general categories, and each will yield a different set of results. When discussing these resources collectively, this paper will refer to them as search tools or search utilities. It is important to remember that all of these tools are surrogates — you are not literally searching the entire Internet each time you enter a query. Even if this task were possible, it would still likely be an inefficient, time-consuming method of finding information. We would not read every book in the library to find out information on the occupational health risks for chemical factory workers. It would be better to search the library catalog to identify potentially useful materials, and then read only those relevant items. The librarians have built the catalog by creating an electronic record (or even a printed card) that describes the content of every book in the collection. The record gives key information about each book in a short, easy-to-use format. Searching this catalog allows you to quickly identify all the books in the library on occupational exposure without having to sift through thousands of volumes of books. Internet search utilities have been built to provide a similar function.

Because the Internet is decentralized, there is currently no method for keeping track of all the information on every computer connected to the Internet. Instead, we must rely on intermediary indexes that have been compiled by humans or computers. Unfortunately, the Internet is not a library, and there is not one catalog, but dozens, and none contain exactly the same information. In a library, before a book is added to the shelves, it is given a call number to identify its location, and a record in the catalog so that it can be found again. When information is added to the Internet, it has a unique location, but no record in the search tools. The owner of a website must either submit the new pages for addition to search utilities, or wait for them to find the data on their own. Search utilities are currently only able to cover roughly a third of the material on the Internet because they must find and index information after it has been made public — a huge task, given the number of pages on the Internet. A frustrating consequence of this situation is that, with every search, there is always a possibility that significant information could be missing from your results because it has never been indexed by any search tools (Lawrence et al., 1999a). Another reality the Internet researcher must contend with is that most search tools, on average, contain about 40% original content. (Notess, 2000) As a result, there will usually be a significant amount of duplication between the results from different search tools. Using several search tools will maximize the number of unique pages found; it will also increase the number of duplicate pages.

3. Improving the odds

3.1. Evaluate the question

In order to retrieve the best information, the researcher will need to learn to use an assortment of search tools to the best advantage. This process begins before any searching starts. The prospective Internet searcher should first evaluate the information that is needed. What, exactly, is the question? What are the desired results? A search for chemical data will require different techniques and resources than one for upcoming professional conferences, or a list of recently published books. Consult the help files of each search tool before beginning a search — these files are often overlooked, and they contain vital information about the mechanics of how your search will be treated. Spending some preparation time beforehand frequently shortens the amount of time a search takes and improves the quality of the results.

3.2. Define the scope

Once the question has been clearly identified, the scope of the query should be defined. How does it fit into the larger framework of information? Is it a narrow specialty within a wider subject, or an overarching survey of available data? Answering these questions will help clarify how broad the search should be. A search for the diagram of a molecular structure can often be satisfied by a simple query in a website, like ChemFinder, while a comprehensive search for all suspected toxicological effects will require searching for several terms in multiple databases. A comprehensive search should leave out very little, but it is also more likely to include irrelevant and duplicate items. For example, a chemical may be mentioned, but not in the desired context.

3.3. Create a list of relevant terms

In addition, a list of possible synonyms, abbreviations, and keywords should be made. Are distinctive names, words, or phrases commonly used for the topic? The list should be as inclusive as possible, because excluding an important synonym from a search can mean valuable information is missed. Variant word endings, such as singular and plural forms, must also be considered. Not all of the terms from the list will necessarily be used in every search utility, but it is good planning and will help ensure that relevant terms are not inadvertently overlooked. For example, a search for information about Methyl ethyl ketone that includes only one of its chemical names could miss items that refer to it by its other common synonyms, butanone or MEK. Including all the possible terms for a substance or concept will yield the greatest number of results. The desired thoroughness of the results will dictate how extensive the list of synonyms needs to be and how many resources will need to be consulted. To retrieve a simple fact, like molecular weight or structure, one form of the chemical name may be sufficient. Other searches will require more complex combinations of terms.

4. Constructing a search statement

4.1. Boolean logic

Although each search utility has its own requirements, most allow words to be combined into a search statement using Boolean logic. Boolean logic uses the mathematical operators, 'and', 'or' and 'not' to create very specific or very broad searches. Using 'and' between your terms will yield a narrower set of results, because it requires that more than one term be present in the item. Using 'or' will broaden the results, because only one of several possible terms needs to be present. 'Not', as the word implies, commands the computer to exclude any items containing that word. Care should be used when using 'not', because there is always a danger that relevant items may be excluded because they mention the undesired word in an unrelated context. In databases like Medline, that include a field for language, 'not' can often be used to eliminate items in other languages. On the Internet, it can also sometimes be useful for eliminating items that use the same term for an entirely different topic. In some search tools, '+' and '−' can be used instead of 'and' and 'not.'

A good demonstration of the ways Boolean logic can be used to formulate a search is when seeking for information on heavy metals, a term that has two entirely different meanings. By searching for 'heavy metals OR heavy metal NOT music', the search results should logically include items that mention either the singular or plural forms of the phrase and exclude items on heavy metal rock bands. However, in practice, this is less than perfect, as not all heavy metal rock bands actually use the word 'music' in their webpages. A search using AltaVista found 303 493 websites on heavy metal, 129 856 on heavy metals, 404 879 that mention either of the two phrases, and 262 177 that mention both phrases but do not use the word music. Unless a comprehensive search for all items on all types of heavy metals is required, and an unlimited amount of time to sift through irrelevant items is available, this query needs refinement. 'Heavy metals' as a topic is too broad, and the set of results is simply too large. A better strategy would be to reevaluate the question, adding more terms in order to make the search statement more specific. Using the AltaVista advanced search, the query 'heavy metals OR heavy metal AND remediation AND NOT music' retrieves 13 847 items. This is a significant improvement, but is still too many pages for even the most thorough researcher to read. By adding the term 'pit lakes' to the above search query, the results are reduced to 20 websites, some of which really do discuss the remediation of heavy metals in the pit lakes of mining operations. By this point, excluding the term 'music' from the results has become unnecessary, and it would be better to remove it from the search statement altogether. Although there are exceptions, using 'not' as a way to exclude irrelevant items is usually a sign that the search statement itself is too general and needs to be reexamined.

4.2. Stemming and truncation

Stemming refers to a process that some search tools use when searching for terms. It automatically reduces the term to its root word, or stem, and then searches for common word endings. For example, if one of your search terms is 'react', Infoseek will search for 'reacts' 'reacted', 'reacting' and other common endings. This simplifies searching, because including a list of all variant forms in the search statement is not necessary.

Truncation is similar to stemming, and in that it will search for word variants. The major difference between the two is that truncation is controlled by the researcher, not by the computer. It is usually indicated using '*' at the point in the word where truncation is required. The letters before the asterix must be present in the word, but any ending is permissible. For example, searching for 'toxic*' in AltaVista would return websites containing any form of the word toxic, including toxics, toxicology, toxicologist, toxicological, and so on. Unfortunately, not all tools support stemming and truncation, and, sometimes, it will be necessary to use 'or' to format a query that includes all variant word endings. Read each tool's help files to be sure.

4.3. Phrase searching

Many search utilities also allow terms to be designated as phrases, meaning that several words must appear together in the page. This is usually accomplished by enclosing the words in quotation marks. For example, searching for 'methyl chloride' as a phrase should only find items mentioning that substance, and not items containing methyl and chloride as unrelated terms, such as methyl bromide and potassium chloride. This feature can also be used when searching for proper names.

4.4. Proximity searching

An additional feature offered by a few search tools is proximity searching, or looking for terms that are close together in the page. For example, searching for 'methyl chloride NEAR inhalation' in AltaVista will return items in which the two terms are separated by no more than ten words. The assumption is that terms which are closer together are more likely to be related, making the search more accurate.

4.5. Field limiting

Some search tools allow searching for terms in a specific area of the item, such as in the title or the URL. Using this feature can be valuable when looking for very specific documents, the homepages of organizations, or other items where the title or name is known. It can also be an indicator of relevancy; a webpage with 'mercury poisoning' in the title is likely to contain a good deal of information on the topic. This feature can be useful when seeking a general overview of a topic, or when trying to limit the number of results.

4.6. Site characteristics

A few search tools offer options that allow searching for specific webpage characteristics, like the date, language, or domain name. This can be useful for eliminating outdated items or materials in languages other than your own. Searching based on the domain name looks at the URL of the item, which indicates the type of organization publishing the site. For example, URLs ending in '.edu' belongs to educational institutions, '.gov' indicates government websites, '.org' is for organizations or associations, and '.com' is used for commercial companies.

4.7. Nesting

Nesting is another powerful feature in some search tools. Nesting allows you to build more complex search statements by enclosing terms in parenthesis. This helps to prevent ambiguity in the search statement, and instructs the computer on how the terms should be grouped together. In tools where nesting is supported, the items in parenthesis are searched first, and then the other operations in the search statement are carried out. The more complex your search, the more valuable nesting becomes, and it can be a good way to search for all of the synonyms or forms of a word. For example, searching for '(inhalation OR inhaled OR inhaling) AND human AND (methyl chloride OR chloromethane OR monochloromethane)' should return items dealing with the human inhalation of methyl chloride, regardless of which variation of the name is used. If there were no parenthesis in the above statement, there is a danger that the computer could misinterpret which terms must appear together. Inhaling, human, and methyl chloride might all be treated as requirements — defeating the purpose of including the synonyms, and increasing the number of irrelevant items in the results.

Again, the individual help files for each search utility will list the searching options that are and are not available, and the proper syntax that should be used to get the best results. These help files provide vital clues about how search queries will be treated, and using this information will improve search efficiency. The goal is to maximize relevant items while minimizing the number of useless websites in the list of results. This can be done by combining keywords using Boolean logic, and other advanced options, into search statements that maximize the potential of each database and retrieve the most relevant items.

5. Search engines

Once the question has been evaluated, a list of keywords created, and preliminary search strategy developed, the actual searching can begin. One common starting place is with search engines. Search engines are large databases of websites that have been compiled automatically by computers, with no attempt at organization or classification by topic.

Because the Internet is a telecommunications network that allows many individual computer systems to link to each other, it can appear to be a seamless set of resources. This is an illusion. Each separate site is independently operated and maintained, and hyperlinks are used to allow visitors to jump from the originating site to other related sites. Search engines work by exploiting these links. Search engines compile their databases of webpages by using automated programs, frequently referred to as 'robots' or 'spiders', to browse the Internet. Each robot begins with one website as its starting point, and follows every link that leads from that site to other sites, adding pages to the database as it travels through sites. The process is then repeated at every new site encountered. Because these robots are capable of traversing through websites at a very fast rate, and many of them are sent out to different areas of the Internet, they can create a large database of websites in a relatively short period of time. The large size of search engines often makes them good for locating very specific items, since the larger the index the better the odds that the desired item will be present.

There are a few limitations to this approach, however. By relying on links in order to reach new sites, bias in the starting sites can affect the composition of the database. Also, new sites may not be found by the robots because they often do not have as many links leading to them. Another drawback is that the content of some sites, especially databases, cannot be searched by robots. This is of particular concern for scientific researchers, because scientific data is frequently presented in database format. It is easy to become overwhelmed by the sheer amount of data contained in a large search engine. The savvy Internet researcher uses combinations of words and phrases to help keep the results list manageable and relevant. Unfortunately, even this will not always prevent the occasional useless website from slipping into a results list. This is partly due to the technologies used by search engines, and partly due to website designers who have learned to exploit the traits of search engines in order to increase the visibility of their sites. When a query is entered into a search engine, it searches its database of webpages for matches, and presents the results in a list ranked by relevance. This is an ambiguous process, because a search engine's idea of relevance may be quite different from that of the searcher. It is further complicated by the fact that each search engine uses different algorithms for finding and ranking sites (Chakrabarti et al., 1999). In Google, for example, the results are ranked by the number of sites that link to them. This is based on the theory that more authoritative sites will be linked to more often, in the same way that important researchers are cited more frequently by other authors. By contrast, the AltaVista advanced search screen allows the user to specify which terms the results should be sorted by. Others use a combination of techniques, including the number of times the terms are used in the item, if all the terms are present, and their position within the text Table 1.

Some of the major search engines include:
AltaVista, http://www.altavista.com.
Excite, http://www.excite.com
Fast, http://www.alltheweb.com.
Go (Infoseek), http://www.go.com/WebDir/.
Google, http://www.google.com/.
Hotbot, http://www.hotbot.com.
Lycos, http://www.lycos.com.
Northern Light, http://www.northernlight.com.

Table 1
Comparison of search engine traits

Search engine	Size (in millions)	Boolean logic (or its equivalent)	Field limiting	Truncation/stemming	Document traits (domain, date, language, etc.)	Ranking based on	Phrase searching and nesting
AltaVista	350	And, or, and not	Yes	Yes	Yes	User specified	Yes
Excite	250	And, or, and not	No	No	Yes	Page content, link popularityy	Yes
Fast	340	And, not	Yes	No	Yes	Page content	Yes
Go (Infoseek)	50	And, not, and not	Yes	Stemming only	Yes	Page content	Phrase only
Google	512	And	No	No	No	Page content, link popularity	Phrase only
HotBot	110	And, or, not	Yes	Stemming only	Yes	Page content	Phrase only
Inktomi[a]	Over 1 billion						
Lycos	50	And, or	Yes	No	Yes	Page content; results organized by type, e.g. websites and news	Phrase only
Northern light	260	And, or, not	Yes	Yes	Yes	Page content, link popularity	Yes

[a] Inktomi provides their search engine and directory to other companies and search services, such as Yahoo!. Because the databases are searchable using different tools, the search techniques will vary (Butler, 2000; Barker, 2000 Inktomi, 2000; Notess, 2000; Sullivan, 2000).

6. Meta-search engines

As was previously noted, most search engines cover only about 35% of the materials available on the Internet, and even then there is overlap between the content of the individual tools. Using more than one tool will maximize the chances of finding the information that is sought. A specialized type of search engine has been developed to address this need.

Meta-search engines are tools which allow the user to simultaneously query several search tools at once. However, they only spend a short time at each database, and may only retrieve some of the relevant items in each one. In addition, because each search tool has its own individual features and syntax requirements, searches submitted through a meta-search engine may not produce consistent or relevant results. This makes meta-search engines more appropriate for testing keywords to see if they are retrieving the type of information required, or for very simple searches when time is crucial. They can provide a very quick survey of what various search engines and directories have to offer, and give an overall idea of what search tools may be most useful for the given topic. In some cases, especially for complex searches, it may sometimes be better to query search engines individually to make the best use of search techniques to retrieve relevant items.

Examples of meta-search engines.

Chubba
http://www.chubba.com
searches AltaVista, Kanoodle, Infoseek, GoTo.com and Lycos.

Copernic
http://www.copernic.com/
a downloadable metasearch tool that queries 80 search engines and eliminates duplicates.

Dogpile
http://www.dogpile.com/
simultaneously queries three search engines at a time, and continues to search in sets of three until at least ten resources are found. Users have the option of searching the next sets of three even if more than ten items are found.

Ixquick
http://www.ixquick.com/
searches 14 other search tools, and the user has the option of selecting which will be queried. Advanced search techniques are translated to the proper syntax for the search engines with comparable search features. Duplicates are removed from results list.

Metacrawler
http://www.metacrawler.com/index.html
simultaneously queries 15 search engines, and supports some advanced search techniques. Allows results to be sorted by relevance, type of site, or by source of the citation.

Search.com (SavvySearch)
http://savvy.search.com/
simultaneously searches several search engines and returns results organized by type, e.g. webpages, directories, and headlines. Offers a search-within-search-results option to narrow results list.

MonsterCrawler
http://www.monstercrawler.com/
searches seven search engines at once. Advanced search at http://datamonster.com/ allows the user to select which of the 12 search engines to query.

7. Directories

Directories are Internet-search tools that are made up of resources that have been compiled, organized, and in some cases even annotated by human editors. They are frequently arranged into hierarchical categories, with websites on similar topics grouped together for easy browsing. This element of oversight and classification helps avoid the problem of site designers who overload pages with keywords or use other devices in order to increase the site's visibility. Directories are usually more selective about what sites are included, and can, therefore, be good resources for locating general overviews and authoritative sites. Browsing through the categories can also be a good way to quickly review popular resources, or view a list of related organizations.

As Internet-searching technologies improve, it is likely that the distinctions between search engines and directories will begin to blur. In some cases, this process has already begun. For example, the search engine, Google has added subject-browsing capabilities, and directories often also search through robot-compiled databases to supplement their resources.

The following are some useful general directories of Internet resources. They are not designed with any one subject in mind, and include resources on virtually any topic as well as scientific and toxicological information.

Argus Clearinghouse, http://www.clearinghouse.net/. It indexes and rates subject guides that identify, describe, and evaluate Internet-based information. It does not lead directly to sources and search full-text. It is good for basic information, as sources are generally high-quality, but searching on broad terms, like 'chemicals' produces better results than using narrower concepts.

Britannica's Internet guide, http://www.britannica.com/, searches websites, magazines, books, and the Encyclopædia Britannica completely. Websites are ranked by the site editors and higher-ranked results are presented first.

Galaxy, http://www.galaxy.com/, is an advanced search option which allows more sophisticated queries. Toxicology information is located at http://www.galaxy.com/galaxy/Medicine/Health-occupations/ Pharmacology/Toxicology.html.

Infomine, http://infomine.ucr.edu/, specializes in scholarly resources, compiled by academic librarians. Resources are assigned Library of Congress Subject Headings. It offers browsing by subject, keyword and title. Search features include truncation, phrases, field limits, and Boolean operators.

Librarian's index to the Internet, http://lii.org/, a searchable or browsable subject directory of Internet resources evaluated and annotated by librarians. It allows Boolean logic, stemming, field limits and restrictions by category. Results are sorted by these categories — 'Best of', directories, databases and subject-specific resources. Science information is located at http://lii.org/search/file/science and health/medicine information (including toxicology) is at http://lii.org/search/file/health.

Open Directory Project Clearinghouse, http://dmoz.org//, a no-frills site containing a wealth of annotated sites organized by volunteer editors. It aims to create the largest directory of Internet sites on virtually all subjects, and is used as a source of data for other directories and search engines, including Yahoo! and Google. Search for specific terms or browse by subject. Subjects are arranged hierarchically. It claims to index 1,908,874 sites and have 27 020 editors. Science topics are listed at http://dmoz.org/Science/.

World Wide Web virtual library, http://www.vlib.org/, compiled by volunteers, each responsible for a portion of the directory. Due to its decentralized nature, currency and appearance are inconsistent. Science information is located at http://www.vlib.org/Science.html.

Yahoo!, http://www.yahoo.com/, allows phrase searching, Boolean logic, and some other advanced search syntax. Science topics are listed at http://dir.yahoo.com/Science/ and toxicology information is located at http://dir.yahoo.com/Health/Medicine/Toxicology/.

8. Subject-specialized search engines, directories, databases, and websites

Scientific information is not always well-served by the large, general search engines and directories. As a reaction to this problem, subject-specific search tools have been developed. They usually offer a combination of search engine and directory features, and index only websites within their area of expertise. For example, Medical World Search uses a database that includes only pages from selected websites. This makes it a much smaller search engine, but it also means that searches retrieve very specific information, without including as many irrelevant links. This specificity can sometimes also be a disadvantage because their scope of resources is not as broad, but for many searches they will provide the desired information with less frustration or information overload.

The universe of subject-oriented websites is much broader and less clear-cut than other search tools. These sites are created specifically for Internet users looking for a particular type of information. They are more likely to contain their own databases, such as ChemFinder's chemical properties database, or ExToxNet's Pesticide Information Profiles. In many cases, going directly to the site is the only way to search through the information contained in these databases.

Like all other Internet-search tools, subject-based sites each offers its own individual search techniques which will vary from site to site. Some, like Toxilinks, have a very narrow scope (in this case, forensic toxicology) and offer only browsing as a way to access links. Others, like MedWeb-Plus, offer sophisticated subject directories linking narrower, broader, and related topics, or advanced search features like those available on the Open Directory Project. As with any other website, it is important to consider the source and orientation of these sites. Some, like MedWeb-Plus, ChemFinder, and SciCentral, are commercial ventures that make their money by providing advertising space or selling products and services. This does not mean the information is less valuable, but the researcher should be alert for potential bias in any site.

The advantage of these sites is that they are able to tailor their information to a particular subset of users who are interested in a specific topic. Subject-oriented websites are more likely to contain actual data, rather than simply lists of links (that sometimes lead to yet more links).

The following is a partial list of subject-specialized sites providing access to toxicology information. Some are search engines or directories that have index-only scientific sites, and others are collections of data presented by an individual or organization.

Agency for Toxic Substances and Disease Registry, http://www.atsdr.cdc.gov/, includes the ToxFaqs Fact Sheets, the HazDat Database, and other information related to hazardous chemicals and diseases. There is a browseable site index and also a search engine for the site.

BioBot, http://www.nbii.gov/search/biobot/search.html, designed to improve access to biological information, allows users to search the national Biological Information Infrastructure website as well as retrieve biology information on the Internet through other search tools, such as AltaVista, Yahoo!, and BioLinks. It permits Boolean and phrase searching, and users can opt to see all results, on only the best or fastest three resources.

Biocrawler, http://www.biocrawler.com/, is a combination search engine and directory of life sciences information. It includes information sheets on the resources listed in the directory that lists keywords, the subject category the site has been classified in, and a list of pages that cite the resource.

Biocrawler List of Life Science Databases, http://www.biocrawler.com/cgi-bin/directory?vkid = 1, is a subcategory of the Biocrawler website that provides access to an array of commercial and non-commercial databases.

Bioethics Resources on the Web, http://www.georgetown.edu/research/nrcbl/scopenotes/sn38.htm, gives access to bioethics and genetics information from the National Reference Center for Bioethics Literature at Georgetown University. It also links to directories, journals, and other digital publications.

Biolinks, http://www.biolinks.com/, is a combination search engine and directory of science resources that allows the user to search all sites, or only those which have been indexed. It also includes a browseable subject index, and extensive links to journal websites.

BioMedNet Web Links, browses biomedical sites by topic or use the search feature. Use of the site requires registration, and some areas require a fee or subscription. Sites are reviewed, annotated, and given a rating from one to four stars, one being good, and four being indispensable. It is one of the few sites that specifically list resources by organism, such as mouse, rat, and human. The site also includes news about current events, job postings, a bookstore, and laboratory supplies, and a customizable interface.

ChemFinder, http://www.chemfinder.com/, provides a searchable database of chemical structures and properties, with links for additional information on health effects, regulatory oversight, or other topics when available. The list of indexed sites at http://www.chemfinder.com/siteslist.asp also contains a wealth of links to sites providing chemical information. Although the chemical database and list of indexed sites are available to anyone, other areas of the ChemFinder site require a subscription or fee.

Contaminant Hazard Reviews, http://www.pwrc.usgs.gov/new/chrback.htm, gives access to 34 detailed contaminant hazard reviews made available by the USGS Patuxent Wildlife Research Center on common chemicals like mercury, lead, dioxin, and PCBs.

Environmental Contaminants Encyclopedia, http://www1.nature.nps.gov/toxic/, an environmental toxicology encyclopedia from the National Park Service, includes entries for 118 chemicals, and describes their effects on wildlife and the environment.

Extension Toxicology Network (ExToxNet), http://ace.ace.orst.edu:80/info/extoxnet/, features toxicology and pesticide information. It includes the University of California, Davis Environmental Toxicology Newsletter, pesticide information profiles, toxicology information briefs, and other information.

The Genome Database, http://gdb-www.gdb.org/, provides access to the database of genetic information from the Human Genome Project.

Global Information Network on Chemicals Web Sites on Chemical and Safety Information, http://www.nihs.go.jp/GINC/webguide/index.html, provides a browseable list of resources from the National Institute of Health Sciences, Japan. It features an extensive list of international, government, and non-government organizations. There are links to chemical safety information; journals and publications; and a short list of other search tools and databases. Site is accessible in English or Japanese.

Healthfinder, from the US department of Health and Human Services. Homepage, http://www.healthfinder.gov/. It includes information on a wide range of topics of interest to consumers and health professionals. A short list of the available subjects is given on the home page, but viewing or searching the full index is a better indication of the materials on the site. Links to other government sites are indicated with a flag, and annotations are provided in the 'Details' links. The destination of links is not always apparent from the title, forcing the visitor to view the details first or to simply follow links wherever they lead. Two subject categories of interest to toxicologists are 'Toxic Substances' and 'Poisons'. The direct URLs to these pages are given below.

Toxic substances, http://www.healthfinder.gov/Htmlgen/HFSrchFT.cfm?Keyword = 866&ShowPg = ALL&Population = all&Resource = All.

Poisons, http://www.healthfinder.gov/Htmlgen/HFSrchFT.cfm?Keyword = 669&ShowPg = ALL&Population = all&Resource = All.

Healthfinder Links to Databases, http://www.healthfinder.gov/HTMLGen/HFKeyword.cfm?Keyword = DATABASE&ShowPg = ALL. An extensive list of databases on all aspects of health, from a variety of government and non-government sources. Links are arranged alphabetically.

Health Sciences Library System Internet Resources, University of Pittsburgh, http://www.hsls.pitt.edu/intres/, includes Internet guides and links of health resources organized by topic. It is also available as an alphabetical list.

HealthWeb, http://healthweb.org/, a collaborative project by more than 20 health libraries provides links to evaluated non-commercial, health-related Internet resources. It searches or browses the list of subjects. Due to the nature of the project, the actual pages of subject resources are hosted by different organizations, and the appearance differs in each. Toxicology links are located at http://www.medlib.iupui.edu/hw/tox/home.html.

Insect Databases on the InsectWeb Server, http://insectweb.inhs.uiuc.edu/index.html, provides access to several entomology databases, including insect pathogens.

Karolinska Institute Medical Library, Sweden, http://www.mic.ki.se/Diseases/index.html, provides extensive list of medical, health, and science resources on the Internet. It includes a wide array of topics, and resources organized by MESH headings. It browses through narrower, broader, and related topics, or search for specific terms.

Librarian's Index to the Internet, Toxicology Information, http://lii.org/search?query = Toxicology&subsearch = Toxicology&searchtype = subject, a searchable or browseable subject directory of Internet resources evaluated and annotated by librarians. Includes links to directories, databases, and subject-specific resources. Not as extensive as other directories, but with an emphasis on food safety.

Medical World Search, http://www.mwsearch.com/, offers full-text searching of selected medical websites. Supports Boolean logic, and uses a controlled vocabulary thesaurus. It will also perform search in other sites, including Medline and AltaVista.

MedlinePlus Poisoning, Toxicology, Environmental Health Topics, http://medlineplus.nlm.nih.gov/medlineplus/poisoningtoxicologyenvironmentalhealth.html, is a browseable list of topics related to poisoning, toxicology, and environmental health. Subjects include air pollution, lead poisoning, pesticides, poisoning, and others. Resources within each subject are grouped by category, such as 'general overviews' and 'children'.

Medicinal and Poisonous Plant Databases, http://www.wam.umd.edu/ ~ mct/Plants/, links to databases of information on both medicinal and toxic plants.

MedWeb, from the Emory Health Sciences Center Library, http://www.medweb.emory.edu/MedWeb/default.htm, offers advanced searching or browsing by subject. Toxicology is listed as a heading in the 'Browse By Subject', and the 'Focus Farther' option allows the visitor to view subtopics within toxicology, such as biotechnology and endocrinology. Some subtopics only have one or two resources, but others contain many useful links.

MedWebPlus, http://www.medwebplus.com/subject/Toxicology.html, searches for specific terms or browses by subject. It includes online and print resources, organized using MESH Subject Headings. Sites are graded by availability, the highest grade being an 'A', with 90% of random attempts to access the site successfully. Sites with less than 50% of successful connects are usually not listed. Journals and organizations/associations are well represented.

Molecular Modeling Databases, http://cmm.info.nih.gov/modeling/databases.html, links to molecular structure databases, organized by type of molecule, such as proteins, nucleic acids, and small molecules.

National Biological Information Infrastructure Metadata Clearinghouse, http://www.nbii.gov/search/clearinghouse/, provides access to biological data sets and information products from many different sources inside and outside of the government. The NBII website offers four search tools, they are the NBII website, the BioBot Search Engine, the NBII Metadata Clearinghouse, and BioNews.

National Center for Biotechnology Information, http://www.ncbi.nlm.nih.gov/, provides access to biomedical and genetic databases, as well as PubMed.

National Library for the Environment, http://www.cnie.org/. Presented by the National Council for Science and the Environment, this site contains links to information on an array of environmental topics, including Congressional Research Service reports, national and international State of the Environment Reports, and an extensive list of researcher's bookmarks organized by type of source and topic.

Open Directory Project, Toxicology Information, http://dmoz.org/Science/Biology/Toxicology/. Volunteer editors have created this list of toxicology sites. The 'see also' links to other areas of the directory provide useful additional information.

Pesticide Publications, Databases, Links, and Other Resources, from the Pesticide Action Network of North America, http://www.panna.org/resources/resources.html, is an extensive list of reports, articles, guides, videos, databases and links to other resources related to pesticides. Some anti-pesticide bias is evident in links, but nevertheless does include many valuable resources. PANNA resources are listed first, followed by links to information produced by outside organizations.

SciCentral, http://www.sciquest.com/cgi-bin/ncommerce3/ExecMacro/sci_index.d2w/report, features browseable subject index, links to conferences and associations, and current news items.

Scorecard, http://www.scorecard.org/, contains data on a variety of environmental issues, such as air pollution, land contamination, and chemical releases. Although the site is provided by the Environmental Defense group, the data is generally derived from government sources, such as the Environmental Protection Agency's Toxic Release Inventory.

Society of Toxicology, http://www.toxicology.org/, provides news, events, and other professional information for toxicologists.

Toxicology Links from the University Maastricht, Netherlands, http://www2.unimaas.nl/~farmaco/links/Links_Toxic/index.htm.

Toxilinks, from the Society of Forensic Toxicologists, http://www.soft-tox.org/toxilinks/, focuses on forensic toxicology. Links are organized using pull-down menus based on topic or organization. It includes links to related government and academic sites, forensic toxicology journals, associations, and other information.

University of Iowa Hardin Library's Directory of Internet Health Sources, http://www.lib.uiowa.edu/hardin/md/. 'We List the Best Sites that List the Sites' is the motto on this website. Don't expect to find hard data on this site Its purpose is to identify other large and reliable sites than link to health-related information. Only sites with connection rates of over 80% are listed.

US Environmental Protection Agency, http://www.epa.gov/epahome/topics.html Browse for information by subject at this site, or use the search engine to find specific terms. The databases listed at http://www.epa.gov/epahome/comm.htm also allow searching for data by community.

Virtual Library of Energy, Science and Technology, http://www.osti.gov/. This site from the US Department of Energy offers several collections of resources, including the PubScience database of peer-reviewed literature, the DOE Information Bridge of research and development reports, and the PrePrint Network of prepublished information.

Yahoo! Toxicology Resource Listing, http://dir.yahoo.com/Health/Medicine/Toxicology/, offers a short annotated list of toxicology websites, along with links to the following categories within toxicology. Environmental toxicology, forensics, institutes, journals, organizations, and schools, departments and programs.

9. Evaluating and using sites

Once a search tool has presented a list of potentially relevant resources, the next step is determining which are useful, accurate, and trustworthy. Sometimes this will be apparent from the title, but it may not always be obvious. This process of evaluating information on the Internet is not significantly different than that used for gauging traditional print materials. The author's credentials, the publisher's authority, the age of the item, and the objectivity or bias evident in the writing all remain significant factors in judging information, regardless of its format. Because anyone with a computer and an Internet connection can post just about anything on the Internet, authority is a much larger issue than it is for journals and books, which commonly undergo a peer review process. Some Internet sites, especially online journals, have instituted peer review processes, but unless a site clearly indicates that it has been peer reviewed, it is safer to assume otherwise.

This makes the question of who is presenting a site, their credibility, and the sources of their information an extremely important issue. When critically evaluating a site, there are several key items to look for.

9.1. What is the origin of the information

It may not be the same as the website publisher or the page author. Is it cited? Are there any explanations for how the data was derived? Are any credentials given for the author or publisher? The site should leave no doubts as to the source of the data.

9.2. Who published the information

Look for an author or organization's name on the page; the authorship should be made clear and contact information provided. Examining the URL can reveal a great deal of clues about a site. A page with a '.edu' has been published on an educational institution's website. This does not necessarily mean that the data is reliable, any more than it means that information from a commercial website (.com) is unreliable. A '.gov' site has been published by a government entity. If it is a long URL, try going back a directory level (indicated by the '/' in a URL) for a perspective on the overall site.

9.3. Is the information current and well-maintained

Look for a 'last updated' or 'copyright' date on the page. Not all pages within the same site will have the same date; look at each page's date to be sure it is still current. Are there any dead links on the page? This may be a sign that the information is outdated, forgotten, abandoned, or an indication that the author is not perhaps as serious as one would wish.

9.4. What is the site's purpose? Is there a bias or slant

Every organization or individual has goals and a purpose, and some are more straightforward regarding their intentions than others are. Examine the presentation and focus, read the mission statement, and look for information that describes the author's aims and purposes. This will provide insight regarding any bias that may or may not be present.

The page located at http://www.epa.gov/opptintr/exposure/docs/efast.htm can be used as an example to demonstrate these evaluation techniques. The page describes a downloadable software package, called the Exposure, Fate Assessment Screening Tool (E-FAST), which provides screening-level estimates of the concentrations of chemicals released to air, surface water, landfills, and from consumer products. At the top of the page the visitor immediately encounters two logos, one for the Environmental Protection Agency and another for the Office of Pollution Prevention and Toxics. The URL supports the fact that the page is indeed on the EPA website, since its domain is 'epa.gov.' The text of the page indicates that some portions of the software have undergone peer reviewing, and provides a name, telephone number, and address for more information. At the bottom of the page are links that tie the page in with the rest of the website, and a last revision date. By going back two directory levels (to http://www.epa.gov/opptintr/exposure/) it is clear that E-FAST is part of a larger project to develop exposure assessment tools and models. Going back yet another directory level at http://www.epa.gov/opptintr/, the office home page is encountered, where the whole organizational structure of the office can be explored, if desired. If a site leaves any of these questions unanswered, it may warrant further fact-checking, or searching for a more reliable source of information.

10. Citing internet resources

Once an Internet site has been located and evaluated, it may be used as part of a research project, an article, or other publication. As with printed sources, different organizations have determined their own formats for Internet citations, and this process is still being sorted out. The American Psychological Association has published a guide to their recommended format at http://www.apa.org/journals/webref.html, but not all organizations will require identical references.

Digital information is not fundamentally different from print resources: there is an author or publisher, a title, a date, and a source. These should all be essential parts of any reference. The purpose of a citation is to allow others to locate the information again, and a scientist can reasonably expect that a 1996 issue of Nature will always have exactly the same words printed on page 25. This is not necessarily true of information on the Internet. Because data on the Internet frequently changes, it is important that the date the page was viewed be included in the citation.

The general recommended APA format for an Internet document is — electronic reference formats recommended by the American Psychological Association (1999), Washington, DC, American Psychological Association. Retrieved November 20, 1999 from the World Wide Web, http://www.apa.org./journals/ webref.html.

For an online journal, the format would be — Jacobson, J.W., Mulick, J.A., & Schwartz, A.A. (1995). A history of facilitated communication: Science, pseudoscience, and antiscience: Science working group on facilitated communication. American Psychologist, 50, 750–765. Retrieved January 25, 1996 from the World Wide Web: http://www.apa.org/journals/jacobson.html.

11. Library catalogs

Despite the enormous growth of the Internet, libraries continue to play an integral role in the storage and dissemination of information. Libraries are valuable repositories of scientific data, both recent and old. This is especially important because, while older data is frequently still relevant, it is not likely to be found anywhere on the Internet. Most libraries have online catalogs that can be searched directly through the Internet. This is useful for busy professionals who do not have the time for wild-goose chases, but it can be a drawback. Librarians usually know their catalogs and their collections very well. Do not hesitate to consult their expertise, even if you are not physically in the library. Most will be willing to offer advice for using the catalog, developing search strategies, and suggesting useful resources for the topic.

As previously mentioned, library catalogs contain a record for every book in the collection. The same basic search techniques that apply to the Internet are also relevant to library catalogs. Most catalogs allow searching by author, title, subject, or keyword, and limiting by various aspects, such as date. Although the syntax may differ from one catalog to another, the essential search mechanisms are very similar. A search for library materials should be approached in fundamentally the same way as an Internet search, by considering the question, scope of the desired results, and key terms related to the topic.

One difference between library catalogs and the Internet is that library materials, unlike most webpages, have been assigned descriptive terms by a librarian. These descriptive terms are derived from controlled vocabulary lists, or thesauri, that are hierarchical sets of terms showing the relationships between broader, narrower, and related concepts. This allows searching a spectrum of broader and narrower levels of specificity. The two most commonly used sets of controlled terms are the Library of Congress Subject Headings (LCSH) and the Medical Subject Headings (MESH) used by the National Library of Medicine. Depending on the library in question, either set of headings may be encountered. However, MESH headings are more likely to be used in medical or health-related setting because they have been designed specifically for accurate and detailed subject indexing of medical topics. Both lists of terms are continually updated to incorporate new topics and changing ideas.

Subject headings can be put to good use by the searcher, because all materials on the same topic should have similar subject headings. However, human inconsistencies and changes in the list of headings over time can result in similar items receiving different headings. When using a library catalog, it is frequently helpful to look at the subject heading that have been assigned to relevant items and use these to refine the search. Also remember that a library catalog is not a full-text search; only the item records are searched, and not the full items themselves. When a librarian creates a record and adds it to the catalog, only a few subject headings are assigned. The general rule of thumb is that about 20% of an item must be on a given topic in order for a subject heading describing that topic will be assigned. An obvious disadvantage to this approach is that a very relevant item will sometimes be missed if only a small portion of the item is about the topic. To minimize this problem, it is better to start out with a broad search than a very narrow one. It is more efficient to refine a comprehensive search than it is to expand a search that was very limited to start with.

11.1. Library of congress subject headings

Library of Congress Subject Headings are constructed of one, two, or three parts. These consist of a major heading or term, and one or two additional subdivisions that further categorize the topic. For example, the subject heading 'Air — Pollution — Health Aspects' contains three separate terms combined to describe one concept, and each one further narrows the definition. 'Air' is the broadest term, and used alone is not very helpful, because it could include anything having to do with air. Adding the subdivision 'Pollution' makes it clear that items with this subject heading are about air pollution, not air flow, weather, or the atmosphere. 'Health Aspect' indicates that the item discusses the effects of air pollution on health.

This is just a sampling of some of the Library of Congress Subject Headings and Medical Subject Headings that may be useful for toxicology research. Many others exist, and they will vary from search to search. Use the keyword list developed before searching as a starting point, and examine the subject headings that have been assigned to especially useful items in order to retrieve other potentially relevant materials.

11.2. Library of congress subject headings related to toxicology

Behavioral Toxicology.
Biological Monitoring.
Chemical — Safety Measures (or other relevant subdivision).
Environmental Exposure.
Environmental Health.
Environmental Monitoring.
Environmentally Induced Diseases.
Fetus — Effects of Chemical On (subdivision can be used with names of other organs, systems, or organisms).
Hazardous Substances.
Health Risk Assessment.
Industrial Hygiene.
Industrial Toxicology.
Lead — Physiological Effect (subdivision can be used with other names of substances or chemicals).
Medicine, Industrial.
Mutagens.
Neurotoxic Agents.
Occupational Diseases (also search under the subdivision 'Diseases' by occupational group).
Occupational Mortality.
Pesticide Residues.
Poisons.
Pollutants.
Pollutants — Toxicology (subdivision can be used with other substances or chemicals).
Pollution — Health Aspects.
Printers — Diseases (subdivision can be used with other occupations or professions).
Reproductive Toxicology.
Risk Assessment.
Solvents — Toxicology.
Teratogenic Agents.
Threshold Limit Values.
Toxicity Tests.
Toxicological Interactions (also search under subdivision 'Health Aspects' or 'Adverse Effects' by industry, process, or substance, e.g. 'Pesticides — Adverse Effects').
Toxicology.

11.3. Medical subject headings

A searchable and browseable list of the MESH terms is available at http://www.nlm.nih.gov/mesh/MBrowser.html and at http://www.ncbi.nlm.nih.gov:80/entrez/meshbrowser.cgi. Both of these two tools allow the user to search and browse through the hierarchical structure, or tree, of the thesaurus in order to find broader, narrower, and related terms. The structure of

MESH headings is different from that of LCSH because the subject headings are not organized, grouped, or constructed in the same way. Whereas in LCSH an item will generally be assigned about three subject headings, MESH allows as many headings as are necessary to adequately represent the item's content. As can also happen in Internet directories, concepts are not always grouped together in the same way by two different resources. The groupings of subject terms are often entirely different in MESH and LSCH, which will affect the way a search is refined or broadened, depending on which tool is being used. The following is a partial list of MESH headings of interest to toxicologists and other researchers (National Library of Medicine, 2000).

11.4. Medical subject headings relevant to toxicology

Age Groups (subtopics include, Adult, Aged, Middle Age, Child, Adolescence, Child, Preschool, Infant, etc.).
Air Pollutants (subtopics include types of pollutants, e.g. Air Pollutants, Environmental and Air Pollutants, Occupational).
Body Burden.
Carcinogenicity Tests.
Conservation of Natural Resources.
Cytotoxicity Tests, Immunologic.
Disorders of Environmental Origin.
Environment and Public Health.
Environmental Exposure.
Environmental Health.
Environmental Illness.
Environmental Medicine.
Environmental Pollutants, Noxae, and Pesticides.
Environmental Pollution.
Hazardous Substances.
Hazardous Waste.
Heavy Metal Poisoning, Nervous System.
Industrial Waste.
Inhibitory Concentration 50.
Investigative Techniques.
Irritants.
Lethal Dose 50.
Maximum Tolerated Dose.
Medical Waste.
Mutagenicity Tests.
Neurotoxicity Syndromes.
No-Observed-Adverse-Effect Level.
Occupational Diseases.
Occupational Exposure.
Occupational Health.
Pesticides.
Pharmacokinetics.
Plants, Toxic (subtopics include individual species, e.g. Belladonna, Digitalis, and Hemlock).
Poisoning (Subtopics include types of poisoning, e.g. Lead Poisoning, Arsenic Poisoning or Drug Toxicity).
Psychoses, Substance-Induced.
Public Health.
Radioactive Pollutants.
Radioactive Waste.
Risk Assessment.
Risk Factors.
Sewage.
Soil Pollutants.
Solvents.
Substance-Related Disorders.
Toxicity Tests.
Toxicology.
Toxins (subtopics include toxin types, e.g. Bacterial Toxins, Cytotoxins or Neurotoxins).
Waste Products.
Water Pollutants.

There are also common terms or subtopics which may be combined with main terms using a slash, e.g. Waste Products/prevention and control. Not all of these subtopics are applicable to every term; so, using the MESH browser and examining the subject headings assigned to other relevant items will provide useful information about additional terms that could be used to refine a search.

administration and dosage.
adverse effects.
analysis.
blood.
chemical synthesis.
chemistry.
classification.
economics.

history.
immunology.
isolation and purification.
metabolism.
pharmacokinetics.
pharmacology.
poisoning.
prevention and control.
radiation effects.
standards.
statistics and numerical data.
toxicity.

As a supplement to their printed collections of journals and books, many libraries have also added electronic resources. These can be subscription-based commercial database services, or materials freely available on the Internet. The library should not be overlooked as a resource for finding materials on the Internet. Some libraries have begun adding records for documents available on the Internet to their regular catalogs, and others offer access to databases, like Toxicology Abstracts, which indexes Internet materials. Many libraries have also compiled 'virtual libraries' and subject guides of Internet resources that the librarians have found to be useful and reliable. For example, the National Reference Center for Bioethics Literature at Georgetown University offers the online guide 'Bioethics Resources on the Web'.

List of Useful Library websites.

Environmental Protection Agency Online Library System, http://cave.epa.gov.

The catalog includes items in all of the EPA regional and laboratory libraries. It also provides access to the catalog of EPA documents available from the National Service Center for Environmental Publications, the Environmental Financing Information Network database, the National Enforcement Training Institute database, and resources from the Subsurface Remediation Information Center. Search by title, keyword, author, report number, or call number. Searches can be limited by library, and sophisticated searches can be formulated using the advanced search option (Environmental Protection Agency, 2000).

Library of Congress,
http://www.loc.gov

provides several way to search the Library of Congress catalogs. Visitors can search or browse by keyword, title, author or subject using several different interfaces. The command searching allows the most sophisticated searches. Extensive collection of current and historical resources. The website for the Science Reading Room, which features science and technology materials, is located at http://lcweb.loc.gov/scitech/.

National Agricultural Library
http://www.nal.usda.gov/

The Agricola system provides access to library holdings and the Journal Article Citation Index. Search or browse by keyword, author, title, subject, call number, or use the advanced search. Features a large collection of resources on agriculture and allied disciplines, including animal, plant, and environmental sciences. The NAL site also links to the Agriculture Network Information Center (http://www.agnic.org/) that provides access to additional agriculture-related information.

National Library of Medicine
http://www.nlm.nih.gov/

searches the library holdings or the bibliographic databases. LocatorPlus, at http://www.nlm.nih.gov/locatorplus/locatorplus.html is the main catalog of library materials. The catalog can be searched by keyword, title, author, subject, or call number. Additional features include and advanced menu and a keyword combination feature that permits Boolean operators, truncation, and nesting. Extensive medical and health-related materials.

For additional websites from medical and health sciences libraries, the University of Iowa's Hardin Library offers links to library websites at http://www.lib.uiowa.edu/hardin-www/hslibs.html.

12. Conclusion

There are any number of predictions about how the Internet will revolutionize publishing, information sharing, and research, but it is safe to assume that, regardless of whether or not these predictions are accurate, the Internet will continue to be integral vehicle for scholarly communications. The technology will no doubt evolve, but it may be some time before search if tools are able to catch up with the phenomenal growth of the Internet. In the meantime, researchers will do well to familiarize themselves with the resources that are available and the techniques to use them effectively.

By preparing for a search, choosing the appropriate resources, and capitalizing on their features, the scientist can improve the quality and quantity of information retrieved. As this paper has explained, there are many techniques that can be used to find the most relevant resources. Although the syntax and exact features may vary, a researcher who masters these techniques can confidently search almost any database, catalog, or other bibliographic tool.

References

American Psychological Association, 1999. Electronic reference formats recommended by the American Psychological Association. Retrieved July 10, 2000 from the World Wide Web: http://www.apa.org./journals/webref.html.

Barker, J., 2000. Finding Information on the Internet: A Tutorial. Retrieved June 16, 2000 from the World Wide Web: http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/FindInfo.html.

Butler, D., 2000. Souped-up search engines. Nature 405, 112–115.

Chakrabarti, S., et al., 1999. Hypersearching the Web. Scientific American, June 1999.

DeWoskin, R.S., 1998. Toxicity summaries and data on the internet: a baseline assessment on the transition from paper to electronic access. Toxicol. Lett. 95, 87.

Environmental Protection Agency, 2000. About the EPA Online Library System (OLS). Retrieved June 16, 2000 from the World Wide Web: http://www.epa.gov/natlibra/aboutols.htm.

Gehanno, J.F., et al., 1998. Assessment of bibliographic databases performance in information retrieval for occupational and environmental toxicology. Occup. Environ. Med. 55, 562–566.

Inktomi, 2000. Web Surpasses One Billion Documents. Retrieved June 14, 2000 from the World Wide Web: http://www.inktomi.com/new/press/billion.html.

Lawrence, S., et al., 1999a. Accessibility of information on the Web. Nature 400, 107–109.

Lawrence, S., et al., 1999b. Searching the web: general and scientific information access. IEEE Commun. 37 (1), 116.

Ludl, H., et al., 1996. Searching for information on toxicological data of chemical substances in selected bibliographic databases — selection of essential databases for toxicological researches. Chemosphere 32, 867–880.

National Library of Medicine, 2000. Fact Sheet: Medical Subject Headings. Retrieved June 16, 2000 from the World Wide Web: http://www.nlm.nih.gov/pubs/factsheets/mesh.html.

Notess, G.R, 2000. Database Overlap: Overlap of Five Searches. Retrieved June 28, from the World Wide Web: http://www.searchengineshowdown.com/stats/overlap.shtml.

Sullivan, D, 2000. Search Engine Sizes. Retrieved June 28, 2000 from the World Wide Web: http://searchenginewatch.internet.com/reports/sizes.html.