

Library Instruction for the Biological Sciences



Carolyn Dickerman

Carolyn Dickerman has an M.L.S. in Library Science and a B.S. in Biological Sciences. Prior to her present position as assistant professor (Life Sciences Reference Librarian) at the Univ. of New Mexico, Albuquerque 87131, she was lecturer in biology at Lehman College, Bronx, New York. Because of her interest in bibliographic instruction, she teaches library use to biology graduate and undergraduate students, in the classroom and in the library. Her current field of research is the history of botany and botanists of New Mexico.

As a life sciences reference librarian in a university, I see upper level and graduate biology students come to use the library, and I am dismayed at the difficulty they have in finding information. On the one hand, instructors who send students out to find information do not always prepare the students for library work, and on the other hand, these students demonstrate reluctance in asking librarians for help.

I am writing this article for life sciences instructors (who may have acquired library skills by trial and error during their graduate years) to present them with an outline of information on literature searching to give their students. If, in reading this, the instructor becomes aware of new research tools and methods, then I will have achieved an additional purpose.

Before intelligent use of the library can be made, a user must be familiar with basic library skills such as using the catalog to find call numbers, locating books on the shelves, and looking up articles in a periodical index, then finding them in the library. A teacher or librarian must initiate learning about the library as the students will not take it upon themselves if they do not understand the importance of library research skills.

Since most academic libraries have freshman bibliographic instruction programs to acquaint students with the general procedures of the library, you can see that your students have this instruction before you assign library work to them.

After students have learned the fundamentals, sessions on literature searching in the life sciences should be given in a context where students can make immediate use of what is learned. I have found that the optimum time to give students a class in advanced library use is precisely while they are researching a paper since, if they have been having problems in finding information on their own, they will be most receptive to learning better ways to do

this. Ideally, a session in literature searching would be held in the library so that students can see the materials in place. If the class is too large, or if the library is too far, the instruction may be done in the classroom and handouts or transparencies used in place of actual books.

When a student is researching a subject for an upper level course, it is effective for instruction in library searching to come from the classroom professor who has given the assignment and is familiar with bibliographic sources of the specific field. Frequently library instruction is accompanied by a text or assignment (for example a bibliography). This can work well only if the students perceive it as a useful exercise.

The more important sources of information on biological sciences are *Biological Abstracts* and other subject indexes, *Science Citation Index*, government publications, the subject catalog of book holdings, and online databases.

Biological Abstracts (BA) is the most comprehensive of the indexes of the life sciences. The multiple access provided by the five indexes is a major strength of this work, but they must be used with understanding.

Unlike many other controlled term subject indexes that students are accustomed to consulting, the BA subject index is a Key Work in Context index, that is, a permuted, natural language index. In it, each important word in the title appears, along with the words that precede and follow it. For titles that do not convey the total concept of the article, additional keywords are added, and these also appear in the index. Natural language means that the words are those that the author used in his title. Use of natural language, that is, the author's exact wording, avoids outmoded terms and placing new concepts in a format of old terms. On the other hand, the researcher may have to look under several synonyms

in order to locate all papers on a subject. Whereas new terminology is usually not reflected in controlled index terms for several years, it is immediately accessible through key word searching.

Students should be reminded that generic and specific names are not found in the subject index. Rather, they are collected in the Generic Index, where under each species the citations are subdivided by major concept. Another index that can be of great help is the *Bio-systematic Index* which provides quick access to studies grouped according to taxonomic position of the organisms under investigation. References in each semimonthly issue of BA are arranged in general categories, and this is another basis for locating articles.

When a citation is located, the user can read the abstract and decide if he wants to obtain the article. Most libraries subscribe to the companion of BA, BA/RRM which has the same format, but by abstracting reports, reviews and meeting papers, gives access to a different body of literature from BA.

Another subject index, *Zoological Record* (ZR), has not been used for recent information because of delays in publication of up to five years. This drawback is now being corrected, and ZR is now the most important literature source for systematics and taxonomy, new genera, new species and literature keys. It is particularly good for systematics and taxonomy, and less so for physiology, pathology and molecular biology.

Each volume of ZR consists of a separate section for each major taxonomic group and sections on comprehensive geology, new genera and subgeneric names. Sections are divided into five indexes: author, subject, geographical, paleontological and systematic.

Although BA and ZR are the most important general tools to consult for finding life sciences information, an instructor may want to steer students towards smaller more specialized subject indexes held by their library.

Early in their educational career students have learned to use subject indexes. When they have identified a key paper, they have used its bibliography to lead to older papers of interest, even though what they really want are newer articles treating the same subject. But with a citation index, however, it is possible to find these newer papers.

To use a citation index, an article rather than a subject term is used as a starting point. The premise of a citation index is that a paper citing a relevant article will itself be relevant. Thus, *Science Citation Index* (SCI) is a listing of the bibliographies of all articles appearing in 3,000 scientific journals so that, by looking up a relevant article, all articles citing that key article can be found. Because no word or subject headings have been used, the search is independent

of special nomenclature, and since the more recent articles would not necessarily be classified under the same subject nor have any title key words in common, they might not be found using conventional indexing.

Although SCI has shallower coverage than BA (it covers only one-third the number of the sources, and these are distributed among all fields of science), it should be used along with BA since the two are likely to turn up different citations. Any paper that has been published in the last five centuries can be looked up in each volume of SCI. If found, the bibliographical citation for at least one article that has cited it in its list of references will be listed.

One of the three divisions of SCI, the Source Index, lists, alphabetically by author, articles appearing in the current year. It gives a little more information about the article (title, institution, address of the senior author) and it may list other recent articles by the same author. The third division, the Permuterm Subject Index, pairs each significant title word but this is almost never as productive as the subject index of BA, because the key words are not given in context, and as a result, the coverage of the field of biology is shallow.

An underused wealth of life science material are the publications of the Government Printing Office, the largest publisher in the world. Most libraries shelve this material apart from the rest of the collection, according to a separate classification system, and it is not accessed through the card catalog. Information is found in the *Monthly Catalog* in which one can look up by subject, publications of the Department of Agriculture, Public Health Service, National Park Service, Smithsonian Institution and many other agencies that issue publications of biological interest.

The newest addition to library searching capabilities is online searching, which became possible with the development of electronic printing in the 1960s, when the text of standard indexes such as BA and SCI was put into machine readable form for editing before printing. At the same time the capability of interacting online with machine readable material was developed, and these two technologies permit a text in machine readable form that can be searched by computer in ways that cannot be done manually.

By now, several commercial systems lease databases and provide the software for searching words in any of the dozen or so fields of a record and combining these words with Boolean operators. BIOSIS (the machine readable form of BA and BA/RRM) is the principal one used for life science information, although there are many others.

Online computer searching offers many advantages over manual searching. One is the ability to conduct a more thorough and comprehensive search

than is possible with printed indexes. The computer can search for subject words in the titles, abstracts or annotations, as well as in the subject index, providing greater chance of finding all the bibliographic entries pertinent to a topic. Terms can be combined in ways that are not possible in a manual search of the printed indexes to result in a very precise search.

Other advantages are rapidity and promptness; a computer search runs for only a few minutes, at most, while the time it takes to accomplish the same search in the printed pages can be measured in hours, and material is available in the computerized database weeks before the hard copy appears in the library.

On the other hand, databases served by machine searching go back only to the 1960s, and the expense is significant (although the cost has greatly decreased with the progress in computer technology).

Computer searches are now generally carried out in libraries by library specialists who consult with the patron to develop a "search strategy", a list of terms to search in the records. As the command language becomes simplified, people acquire their own per-

sonal computers with modems and computer costs go lower, more users will search online without the mediation of a librarian.

The result of a search is a list of citations (including title, bibliographical information and usually an abstract). The library patron will have to locate the article in the library or have it ordered on interlibrary loan.

Even though a student has mastered adequate library skills (and most upper level college students have not), a basic familiarity with *Biological Abstracts* and other subject indexes, an understanding of citation indexing and a grasp of the fundamentals of on-line database searching are essentials to the education of life science students. By ensuring that his students possess these, an instructor will reap the immediate reward of seeing his students write better informed papers and reports.

A course in searching the biological literature consisting of one or more sessions, in consultation with the science librarian, will provide the students with an invaluable skill, one that will serve them throughout their scientific career.

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