researchers? Do you agree with their conclusions? If your results do not agree, try to determine why not. Were different methods, organisms, or conditions employed? What were some possible sources of error?

You should realize that even some of the most elementary questions in biology have taken hundreds of scientists many years to answer. One approach to the problem may seem promising at first, but as data are collected, problems with the method or other complications may become apparent. Although the scientific method is indeed methodical, it also requires imagination and creativity. Successful scientists are not discouraged when their initial hypotheses are discredited. Instead, they are already revising their hypotheses in light of recent discoveries and planning their next experiment. You will not usually get instant gratification from applying the scientific method to a question, but you are sure to be rewarded with unexpected findings, increased patience, and a greater appreciation for the complexity of biological phenomena.

Revise original hypotheses to take new findings into account

If the data support the hypothesis, then you might design additional experiments to strengthen the hypothesis. If the data do not support the hypothesis, then suggest modifications to the hypothesis or use a different procedure. Ideally, scientists will thoroughly investigate a question until they are satisfied that they can explain the phenomenon of interest.

Share findings with other scientists

The final phase of the scientific method is communicating your results to other scientists, either at scientific meetings or through a publication in a journal. When you submit a paper to refereed journals, it is read critically by other scientists in your field, and your methods, results, and conclusions are scrutinized. If any errors are discovered, they are corrected before your results are communicated to the scientific community at large.

Poster sessions are an excellent way to share preliminary findings with your colleagues. The emphasis in poster presentations is on the methods and the results. The informal atmosphere promotes the exchange of ideas among scientists with common interests. See Chapter 7 on how to prepare a poster.

Oral presentations are different from both journal articles and poster sessions, because the speaker's delivery plays a critical role in the success of the communication. See Chapter 8 for tips on preparing and delivering an effective oral presentation.

Chapter 2

Developing a Literature Search Strategy

The development of library research skills is an essential part of your training as a biology student. A vast body of literature is available on just about every topic. Finding exactly what you need is the hard part.

In biology, sources are divided broadly into primary and secondary references. **Primary references** are the research articles, dissertations, technical reports, or conference papers in which a scientist describes his or her original work. Primary references are written for fellow scientists—in other words, for a specialized audience. The objective of a primary reference is to present the essence of a scientist's work in a way that permits readers to duplicate the work for their own purposes and to refute or build on that work.

Secondary references include encyclopedias, textbooks, articles in popular magazines, and information posted on the websites of professional societies, government agencies, and other scientific organizations. Secondary references are based on primary references, but they address a wider, less-specialized audience. In secondary references, there is less emphasis on the methodology and presentation of data. Instead, the results and their implications are described in general terms for the benefit of non-specialist readers.

You will delve into the biological literature when you write laboratory reports, research papers, and other assignments. Although secondary references provide a good starting point for your work, it is important to be able to locate the primary sources on which the secondary sources are based. Only the primary literature provides you with a description of the methodology and the actual experimental results. With this information, you can draw your own conclusions from the author's data.

Although initially it may be difficult to read primary literature, it will become easier with practice, and the rewards are well worth it. One benefit of *reading* research articles is that you will become a better *writer*. Through reading, you become familiar with the writing style and overall structure of research articles, so that you have a model when you write your own lab reports. Another benefit is that you learn how scientists approach a problem, design experiments to test hypotheses, and interpret their results to arrive at their conclusions. Emulating their writing style may help you improve your critical thinking skills. A further benefit of reading the primary literature is getting to know the scientists who work in a particular subdiscipline. You may discover that you are sufficiently interested in a subdiscipline to pursue graduate work with one or more of the authors of a journal article.

How do you find primary references that are directly relevant to your topic? The fastest and easiest way is to search article databases. **Article databases** contain a pre-screened collection of scholarly information, not web

TABLE 2.1 Databases and search engines used to find scholarly information in the biological sciences

Database or Search Engine	Description
AGRICOLA	Produced by the National Agricultural Library, this database contains citations for journal articles, monographs, government publications, and other types of publications in the field of agriculture and related areas.
Biological Abstracts	Considered the most comprehensive database in the area of biology and the life sciences, it provides abstracts and citations to journal literature.
Biological Sciences (ProQuest)	Contains abstracts and citations to journals, monographs, and other publication types for a wide range of areas in the life sciences.
BioOne	Contains the full text of peer-reviewed articles in the biosciences. Most of the journals are published by small scientific societies, other not-for profits, and open access publishers.
Google Scholar	A Web search engine for scholarly literature across many disciplines. Includes not only journal articles, but also material from websites of universities, scientific research groups, and professional societies; conference proceedings; and preprint archives (preprints are manuscripts circulated because they contain current information, but they have not yet been peer reviewed).
JSTOR	Developed as an archive of core scholarly journals, this database searches the full text of core journals in a variety of disciplines including biology and ecology. Coverage begins with the first issue of each journal. However there is a gap, typically from 1 to 5 years, between the most recently published issue and when it appears in JSTOR.

pages that anyone could have created. Article databases are owned by companies or organizations that employ experts to read scholarly articles and then enter information about the articles into the database. To find scholarly information on a particular topic, instead of "googling" the entire Web, you will typically search one or more databases.

Most databases (PubMed being the notable exception) are by subscription. Companies that own these databases sell licensing agreements to university libraries and other institutions. If you are affiliated with such a university or institution, then you can use fee-based databases for free. On the other hand, search engines such as Google Scholar and Scirus, which scan the Web for scientific information, are free and available to the general public. Table 2.1 describes some of the databases and scholarly search engines that you may have access to.

TABLE 2.1 *Continued*

Database or Search Engine	Description
NCBI (National Center for Biotechnology Information)	A division of the National Library of Medicine. Produces searchable databases on nucleotide and protein sequences, protein structures, complete genomes, taxonomy, and other molecular biology information.
PubMed	Produced by the National Library of Medicine, PubMed is the public access version of MEDLINE, the premier database for medicine and related fields. It contains abstracts and citations to the worldwide journal literature.
Science Direct	Provides access to journal articles and books published by Elsevier. Although multidisciplinary, most references are in the areas of science, medicine, and engineering.
Scirus—for scientific information only	A Web search engine and database of scientific information resources, covering websites to journal articles. Like Google Scholar, this search engine is free and some of the content may not be peer-reviewed.
Scopus	The world's largest abstract and citation database of peer-reviewed literature across the scientific, technical, and medical fields, the social sciences, and arts and humanities.
Web of Science	An interdisciplinary database for peer-reviewed articles from core journals in many subject areas. The Cited Reference Search allows you to identify articles that cite a particular author or work.

Source: Bucknell University, Library and Information Technology [Internet]. Lewisburg (PA): Bucknell University; c2008 [cited 2012 Oct 28]. Available from: http://www.bucknell.edu/script/ISR/Databases/

Most of this chapter describes how to find primary references using databases. If you do not have access to these databases, however, you can still locate references the old-fashioned way. This method involves building a bibliography from sources cited in books, journal articles, and other literature. Books such as *Annual Reviews* are considered secondary references, but the Literature Cited section in review articles often is an excellent source of primary references. Building a bibliography without the use of a database is laborious and time-consuming, but the end result is often the same. An advantage of using this old-fashioned method is that you may find older, seminal papers that may not be indexed in databases. If your assignment requires a thorough search of the literature, you will most likely use a combination of database and manual searches. Don't forget about your human resources—seek assistance from your reference librarian during all stages of your research project.

Databases and Search Engines for Scientific Information

Familiarize yourself with the databases and search engines recommended by your professor or a reference librarian and which are available through your academic library. All of the databases have some overlap in terms of the journals they index, but there are also unique listings. Results may also vary depending on subject and publication year.

Comparison of databases

One of the great things about electronic databases is that they are continually updated and improved, giving you access to the most current scientific information available on the Internet. But with so many choices and so little time, what's the best strategy for tracking down a few good primary journal articles for your topic? The answer to this question depends on who you ask, how comprehensive your research needs to be, the subject matter, and personal search preferences. Nonetheless, knowing a little about the strengths and weaknesses of some of the major databases and search engines may help guide your strategy (Table 2.2).

Librarians have published a number of recent papers on this topic (see, for example, Falagas and others [2008], Shultz [2007], Bakkalbasi and others [2006], and Giustini and Barsky [2005]). While these published comparisons are as transient as the databases they describe, it is nonetheless instructive to look at some of the data.

Google Scholar. Google Scholar was introduced by Google in 2004. Its strengths are name recognition, a simple query box, and the fact that it's free. In terms of content, Google Scholar is thought to provide greater access to older

TABLE 2.2 Comparison of features of selected biology databases and search engines

	Biological Abstracts	Google Scholar	PubMed	Web of Science	Scopus
Resource type	Database	Search engine	Database	Database	Database
Access (free or fee-based)	Fee-based (usually institutional subscription)	Free	Free	Fee-based	Fee-based
Years covered	1926 to present	Unknown	1950 to present	1900 to present	1823 to present
Sources retrieved	Journal articles	No information provided, but retrieves journal articles, books, preprints, abstracts, technical reports, and other electronic media	Journal articles, literature reviews, clinical trials	Journal articles and conference proceedings	Articles, conference papers
Content (number of journals indexed)	Searches more than 4,200 journals in the life sciences	Unknown	Biomedical journal citations and abstracts from more than 5,000 journals	Searches more than 10,000 journals (all disciplines) and 110,000 conference proceedings	Nearly 18,000 titles from more than 5,000 international publishers from all subject areas
Reliability (peer-reviewed materials)	Most journals are peer-reviewed	Unclear whether all journal articles are peer-reviewed	Most journals are peer-reviewed	All journals are peer-reviewed	All journals are peer-reviewed

Source: Kathleen McQuiston, Research Services Librarian, Library and Information Technology, Bucknell University (2012 Oct 28) and respective database or search engine websites.

records and to material not easily located through conventional channels such as publishers' websites. Some of Google Scholar's weaknesses include the scope of its coverage (it finds too much information), uncertainty about the scholarly value and currency of some of the records, and the sorting of records according to how relevant and popular they are (not how current).

PubMed. PubMed is *the* most recommended database for researchers in medicine who require advanced search functions. Like Google Scholar and Scirus, PubMed is free and its advanced search feature makes it possible to limit searches by author, publication, and date. PubMed provides a variety of options to retrieve only certain formats (full text, free full text, or abstract), types of article (clinical trial, review, clinical conference, comparative study, government publication, etc.), language, and content (journal group, research topic, humans or animals, gender, and age). Another feature that makes PubMed so powerful is its search algorithm, which is based on concept recognition, not letters or words. Every document indexed for PubMed has been read by experts, who tag the document with controlled vocabulary (Medical Subject Headings or MeSH) that accurately describes the paper's content. "False hits" due to homographs (e.g., swimming pool rather than gene pool) are thus eliminated in PubMed searches. Furthermore, MeSH solves the problem of ambiguity concerning scientific and popular names of organisms, synonyms, and variations in British and American spelling.

Web of Science. Web of Science is fee-based, so you may only have access to this database if your university has a subscription. Web of Science covers a larger period of time than either PubMed or Google Scholar. It has depth and scope and is useful for finding information on topics of an interdisciplinary nature. The greatest benefit of this database, however, lies in the fact that once you have found a good journal article, you can expand your bibliography quickly based on common references. With Web of Science, it is possible to search *forward* in time to find more recent papers that have cited the paper of interest. It is also possible to search *backward* to find papers cited by authors of the paper of interest.

Scopus. Like Web of Science, Scopus has a tremendous scope in terms of years covered and sources retrieved, and it is fee-based. Scopus, like all of the databases in Table 2.2, has an advanced search feature, provides links to full-text articles, and allows references to be exported to reference management software (see p. 24). In addition, graduate students and career researchers will find the email alerts feature of these databases handy for staying current with the literature. When registering for email alerts, you can enter keywords that are relevant to your research. When a new article containing these keywords appears, the database administrator will send you an email alert.

Database Search Strategies

Finding just the right journal articles on your topic can be a daunting task. This section will help you get started.

Understand your topic

A productive and efficient search begins with a **basic understanding of your topic**. If you don't even know where to start, look up the most specific term you can come up with in the index of your textbook. Open the book to the pages that contain this term. Read the chapter subheadings and the chapter title to learn how this term fits into the bigger picture. Read the relevant pages to find out what subtopics are associated with this term.

Your library's stacks are another good place to find general information. Search the library's catalog to locate a book on your topic. Write down the call number and find this book on the shelf. Browse the titles of other books in the vicinity. Because the Library of Congress cataloging system groups books according to topic, you can often find additional sources shelved nearby.

Encyclopedias and dictionaries may also help you clarify your topic. Check your library's homepage for references that you may have access to, both electronic and printed sources. Websites such as Wikipedia (http://www.wikipedia.org/), WebMD (http://www.webmd.com), and others may be a good place to start, but evaluate Internet sources critically. Whereas journal articles and books have undergone a rigorous review process, information on the Web may not have been checked by any authority other than the owner of the website.

A first step in evaluating a website's reliability is to look at the ending of the URL address (Table 2.3). Is the sponsor of the website a company or organization that is more interested in trying to sell a product or idea than in presenting factual information? To become a savvy website evaluator, check out the tips on your library's homepage or take one of the tutorials listed in the Bibliography.

Define your research goals

Once you have a basic understanding of your topic, try to **define your research goals** with statements such as

- I would like to compare or contrast methods.
- I'm looking for a cause and effect relationship.
- I want to understand more about a process.

TABLE 2.3 Identifying sponsors of sites on the World Wide Web

Type of Web Page	Purpose	Ending of URL Address	Examples
Informational	To present (factual) information	.edu, .gov	Dictionaries, directories, information about a topic
Business/ marketing	To sell a product	.com	Carolina Biological Supply, Leica
Advocacy	To influence public opinion; to promote the exchange of knowledge and provide resources for its members	.org	Sierra Club, Association for Biology Laboratory Education
News	To present very current information	.com	CNN, *USA Today*
Personal	To present information about an individual	Variety of endings, but has tilde (~) embedded in the URL	

Source: Alexander and Tate (c1996–2005).

- I am interested in how an organism carries out a particular function (e.g., obtains nutrients, reproduces, moves, responds to changes in its environment, etc.).

Subdivide your topic into concepts

Once you have formulated the goals for your topic, start **defining smaller concepts**. For example, if the methods you wish to compare have to do with measuring the amount of protein in a sample, then one of the concepts is protein quantification. Another concept would include the specific names of protein quantification methods, such as Lowry, biuret, Bradford, BCA, and so on. A third concept might relate to the types of protein samples that were analyzed.

Another way to organize concepts related to your topic is to use PubMed's Medical Subject Headings (MeSH) database, a kind of thesaurus for the life sciences. Words entered in the search box are translated into standardized descriptors, which are then listed in a hierarchy of headings and subheadings.

Let's say, for example, that you would like to find concepts related to the topic "How do *Tetrahymena* move?" Go to the PubMed home page

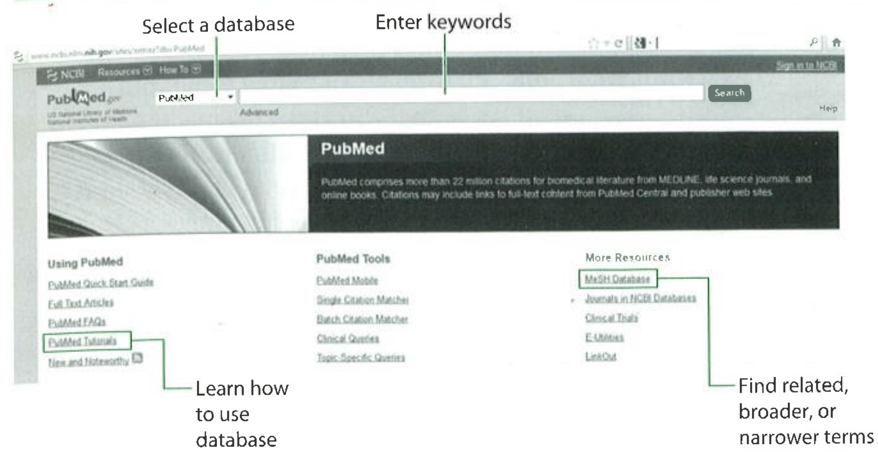

Figure 2.1 PubMed home page provides tutorials and options for searching different databases.

(http://www.ncbi.nlm.nih.gov/sites/entrez?db=PubMed) and select **MeSH Database** under **More Resources** (Figure 2.1). A search for the term *motility* lists *cell movement* as the first result (Figure 2.2); clicking this descriptor opens a page that gives a definition of *cell movement* (not shown in Figure 2.2), entry terms, and the MeSH tree for this concept. The headings below *cell movement* in the tree are narrower concepts and the headings above are broader. Write down the entry terms and headings that are relevant to your topic. While the entry terms are automatically searched in databases that use MeSH, they may be useful keyword alternatives in databases or search engines that do not.

Choose effective keywords

Effective keywords are neither too broad nor too narrow in scope. Keywords that are too broad will retrieve an unmanageable number of articles that, for the most part, are not relevant to your topic. On the other hand, keywords that are too specific may not get any results. For each concept in your topic, therefore, try to come up with moderately specific terms, synonyms, and related descriptors (Figure 2.3). Consider different word endings (photosynthetic versus photosynthesis), abbreviations (*HIV* for *human immunodeficiency virus*), and alternative spellings (American versus British English). **Avoid vague terms** like *effect* and *relationship between*.

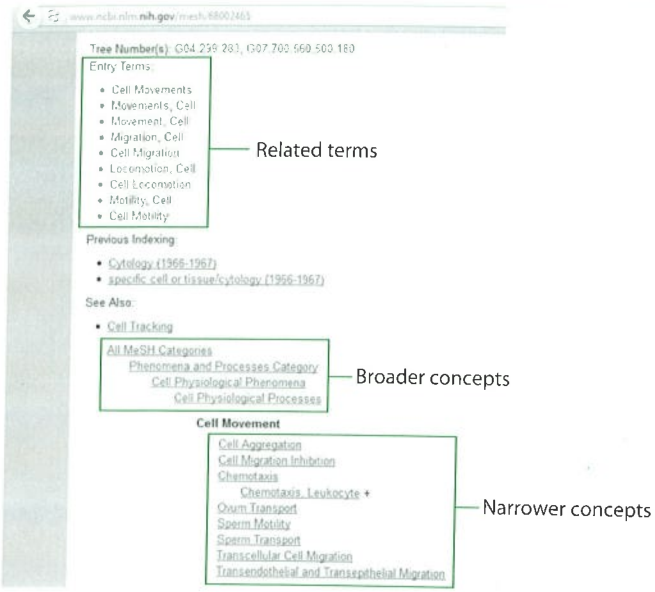

Figure 2.2 MeSH tree for the concept *cell movement*. The Entry Terms shown above the tree are automatically included in a search for the phrase *cell movement* in databases such as PubMed, which use MeSH.

Connect keywords with the operators and, or, *or* not

After you have generated a list of keywords, select two or more and combine them in a search string using operators such as *and*, *or*, or *not*.

- When the word *and* is used between keywords, the references must have both words present. This connector is a good way to limit your search.
- When the word *or* is used, the references must have at least one of the search terms. This connector is a good way to expand your search. For example, the search string *biuret or Bradford* turned up over 7,650 hits in PubMed, while *biuret and Bradford* resulted in only 15 (another search may not result in the same numbers, but the difference would likely be of the same magnitude).
- When the word *not* is used, then the references should not contain that particular keyword. This connector is another way to limit your search.

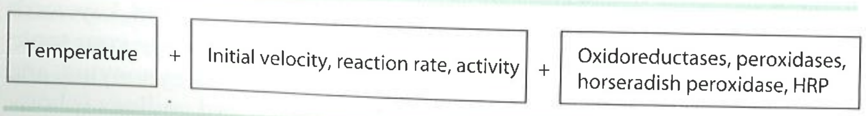

Figure 2.3 Possible keywords generated from concepts related to the topic "How temperature affects the initial velocity of peroxidase, an enzyme isolated from horseradish."

Use truncation symbols for multiple word endings

Truncation is a method for expanding your search when keywords have multiple endings. For example, many words related to the concept of temperature begin with *therm*, such as thermoregulation, thermoregulatory, thermy, and thermal. Rather than writing a lengthy search string containing all of these terms, simply type *therm* followed by a wildcard symbol like *, ?, or #. The appropriate truncation symbol can be found in the Help menu of the database you are searching. Google Scholar uses stemming technology instead of truncation, whereby it automatically searches for variations in word endings for the given keyword.

Search exact phrase

When the keyword is a phrase, the search engine typically searches for adjacent words in order. Unfortunately, the search results may also include "false hits" in which the words are separated. When it's important to search an exact phrase, use quotation marks. For example, type *"RNA polymerase"* instead of *RNA polymerase*.

Use the same keywords in a different database or search engine

If you are not having any success with different keyword combinations in one search engine or database, try a different one. Google Scholar and Scirus search the entire Web and may find links to published journal articles on scientists' homepages or course websites. These media are not included in PubMed or Web of Science database searches. Take advantage of the resources at your disposal. Remember that once you find that one good journal article, it will be much easier to find others (see the section "Finding related articles").

Evaluating Search Results

After you type a keyword string into the search box, the search engine goes to work. The result is a page that lists the records by publication date (most

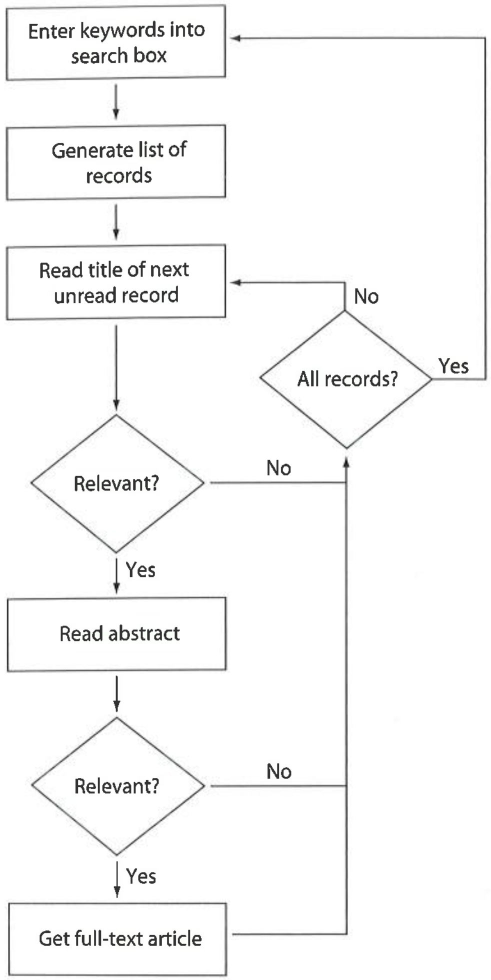

Figure 2.4 Evaluating database or search engine results is an iterative process.

recent first), relevance, or another criterion. Each journal article record contains the article title, the authors' names, the name of the journal, the volume and issue numbers, the pages, and the publication date. Based on the title, decide if you want to read the abstract. After having read the abstract, decide whether you want to read the entire paper. This iterative process is summarized in Figure 2.4.

The results pages for Web of Science and PubMed are formatted slightly differently, but both contain the same basic information about the journal

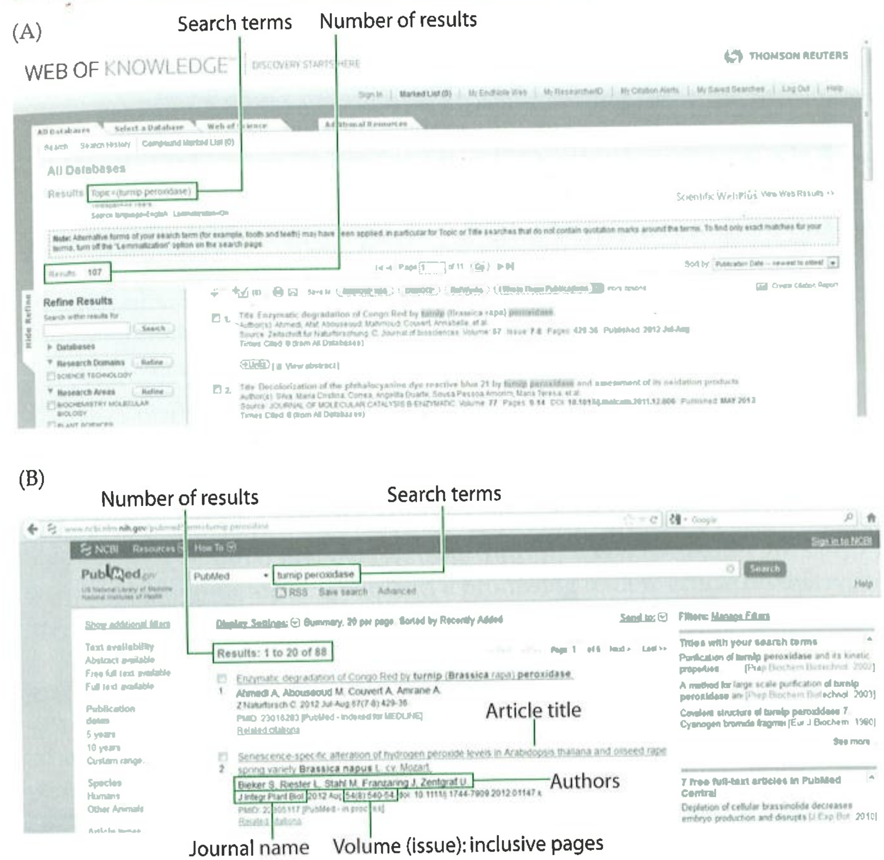

Figure 2.5 The results page from (A) Web of Science and (B) PubMed for the keyword phrase *turnip peroxidase*.

articles (Figure 2.5). You will need this information when you cite the article in your lab report or research paper (see the section "Documenting Sources" in Chapter 4).

Peruse the titles of the first 20 records. If the titles seem to be unrelated to your topic, start a new search with different keywords using the strategies described previously (see the section "Choose effective keywords"). If a title seems promising, click it to open a page that contains the abstract (Figure 2.6). Based on the title and the abstract, decide whether or not you want to read the entire article.

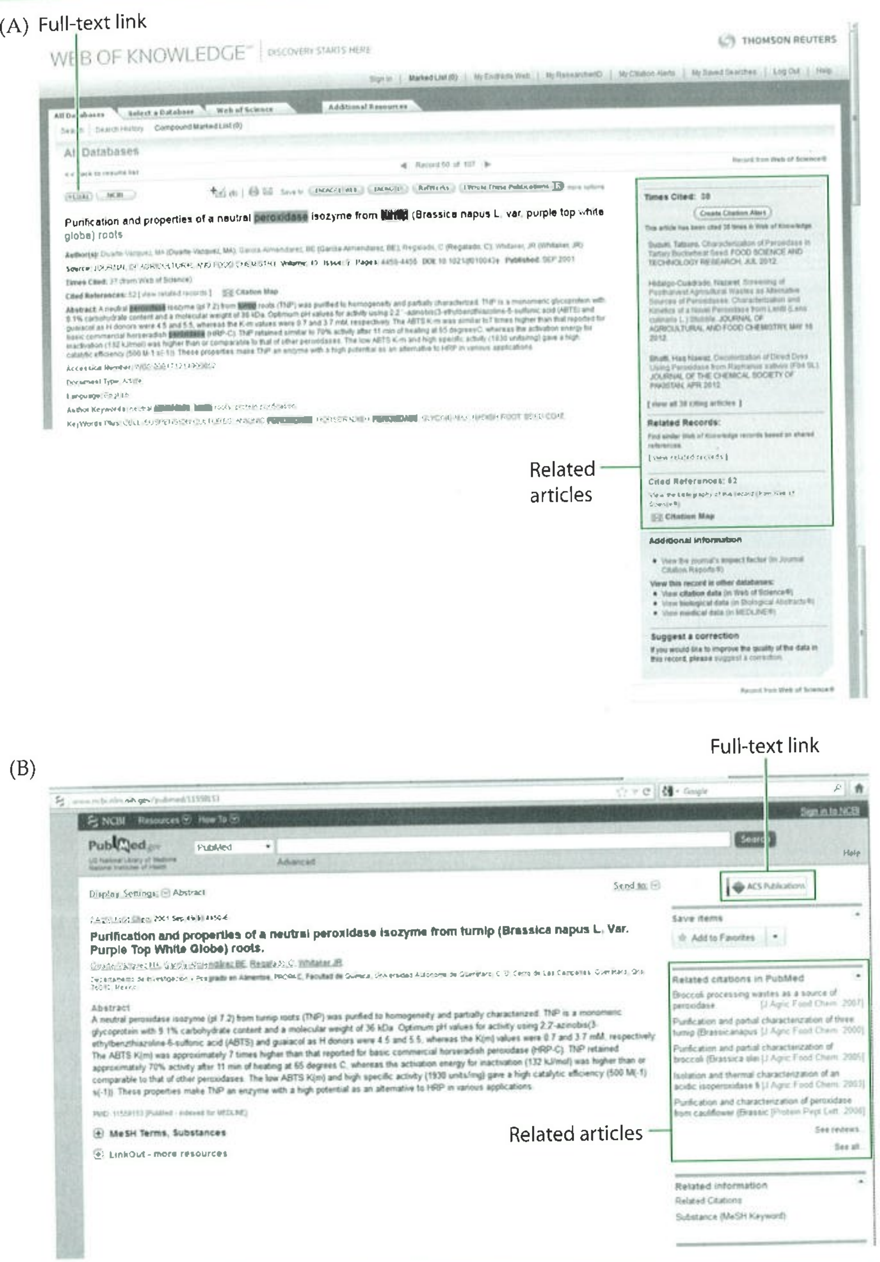

Figure 2.6 Detailed record from (A) Web of Science and (B) PubMed showing the abstract, a link to the full-text article, and links to related articles.

Finding related articles

Once you have found a good article, Web of Science makes it easy to find related articles. In the **Times Cited** section, there is a list of more recent papers that cite this article (see Figure 2.6A). Clicking on one of these titles opens a new page that displays the abstract of the more recent paper. In the **Related Records** section, papers are listed, which cite references that were also cited in the article. Common references indicate that the authors were pursuing a similar research topic. In the **Cited References** section, you can view the references listed in the article. Browsing the list allows you to find related papers with a slightly different focus. PubMed also offers a **Related Articles** option (see Figure 2.6B).

Finding **review articles** is the equivalent of hitting the mother lode. Review articles are secondary references that summarize the findings of all major journal articles on a specific topic since the last review. You can find background information, the state of current knowledge, and a list of the primary journal articles authored by scientists who are working on this topic. If you are unable to find a relevant review article in a database, go directly to the Annual Reviews website (http://www.annualreviews.org/) and search for your topic. If you find a promising review article on this website, you may be able to obtain a copy through your academic library.

Most of the article databases and search engines also have an **advanced search** option. Advanced search makes it possible for you to limit your search by specifying one or more authors, publication years, journals, and other criteria.

Obtaining full-text articles

If the title and the abstract of an article sound promising, you will want to obtain the full-text article. Both the Web of Science and PubMed abstract pages have links to full-text articles. To access the full-text article in Web of Science, click the **->Links** button on the left side above the article title; in PubMed, the link is found at the top right above the **Related Articles** section (see Figure 2.6).

Both databases lead you to the journal publisher's homepage, where you can download the full-text article as a PDF or HTML file (Figure 2.7). PDFs preserve formatting, while HTML files contain hyperlinks that make it easy to access other references. Save the full-text article to your computer or virtual storage space to read later. Copy the URL and write down the download date, because you may need this information when citing the source.

While the abstract is usually free, some publishers charge a fee to access the full-text article. Fortunately, academic libraries and institutions often purchase subscriptions so that faculty, staff, and students can obtain many

igure 2.7 Full-text articles are typically accessed through links to the journal ublisher's website. This article can be downloaded as a PDF or HTML file. The ull reference can also be downloaded to a citation manager.

lectronic journal articles for free. If your library does not have a subscrip-ion and you are not in a hurry to get the article, you may be able to use nterlibrary loan. **Interlibrary loan** is a way for a library to borrow or obtain naterials that it does not own from another library or organization.

lanaging References (Citations)

Reference management software makes it possible to

- Build your own collection of references from database searches
- Insert citations into a paper
- Format both the in-text citation and the end reference according to Council of Science Editors style. You can select other styles such as MLA or Chicago Style for papers you write in the humanities.

Some of these products are commercially available (e.g., ProCite, EndNote, nd Reference Manager) and others are free as long as you are affiliated with subscribing institution (e.g., RefWorks and EndNote Web).

Many scientists and other scholars rely heavily on reference management oftware to organize all of their references. Students will appreciate the con-venience and ease of use of these programs as well. The following instruc-

tions for RefWorks are intended simply to make you aware of the possibil-ities. If you like what you see, ask your librarian if you can access something similar at your school.

RefWorks

Create an account. Go to the RefWorks login page found at https://www.refworks.com/refworks2/?r=authentication::init. Enter your institution's Group Code to login. Then create an individual account by clicking **Sign up for an Individual Account** and entering your personal information. Back on the RefWorks Login Center page, log in.

Download citation from database. Using the citation in Figure 2.7 as an example:

1. Click the **Download Citation** link.
2. Click the desired content format: **Citation only**, **Citation and references**, or **Citation and abstract** (Figure 2.8). Click **Download Citation(s)**. The citation file may be downloaded to your computer in RIS format (see next step) or imported directly into the **Last Imported Folder** in RefWorks (skip to Step 4).

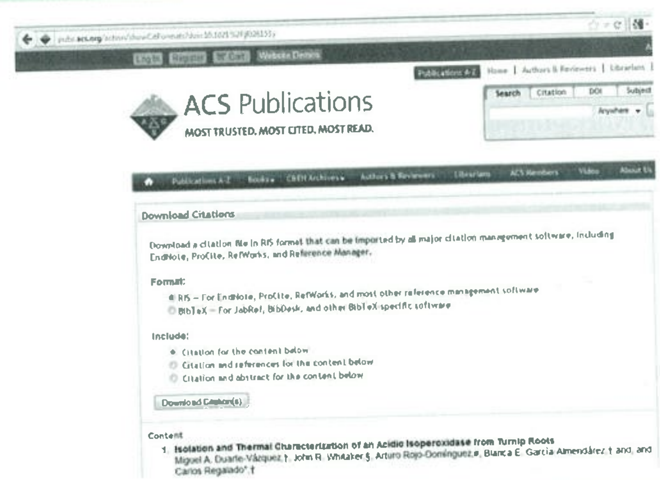

Figure 2.8 The **Download Citations** dialog box is used to specify the type of download and the name of the reference management software.

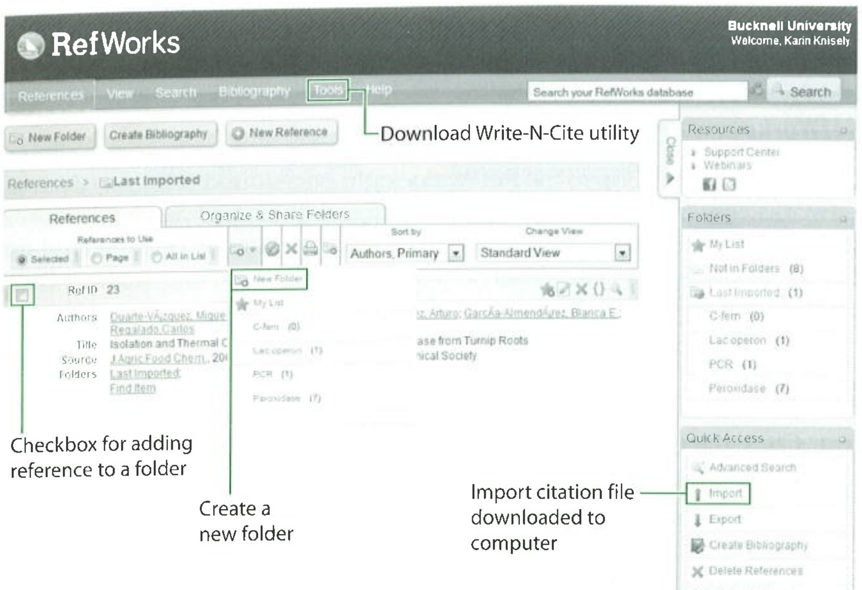

Figure 2.9 Downloaded references can be added to folders to facilitate reference management.

3. In RefWorks, click **Import** and browse your computer for the downloaded citation file. Unless you specify a different folder, the citation will be imported into the **Last Imported Folder**.
4. The RefWorks **Import References** dialog box will notify you that 1 reference was imported. Click **View Last Imported Folder** to see the details of the reference.
5. Click the checkbox for the imported reference (Figure 2.9). Click **New Folder** and type a name or add the reference to an existing folder. References will be easier to find when they are assigned to folders.

Download Write-N-Cite. Write-N-Cite is a utility that allows you to cite sources saved in RefWorks. To download Write-N-Cite, click **Tools | Write-N-Cite** in RefWorks (see Figure 2.9) and follow the installation instructions. Make sure no MS Word documents are open during the installation. Once Write-N-Cite has been installed, open Word and you will notice that a new tab, **RefWorks**, has been added to the Ribbon, as shown in Figure 2.10.

Create an in-text citation and end reference list. When you write lab reports and research articles, you will cite the work of others and then, at the end of your paper, list the full references. Scientists follow the Council of Science Editors (CSE) style, which is quite different from the MLA or Chicago Style you may be accustomed to using in the humanities. The CSE recommends the following three systems:

- Citation-Sequence
- Name-Year
- Citation-Name

The Citation-Name system is a hybrid of the other two and will be discussed briefly in Chapter 4.

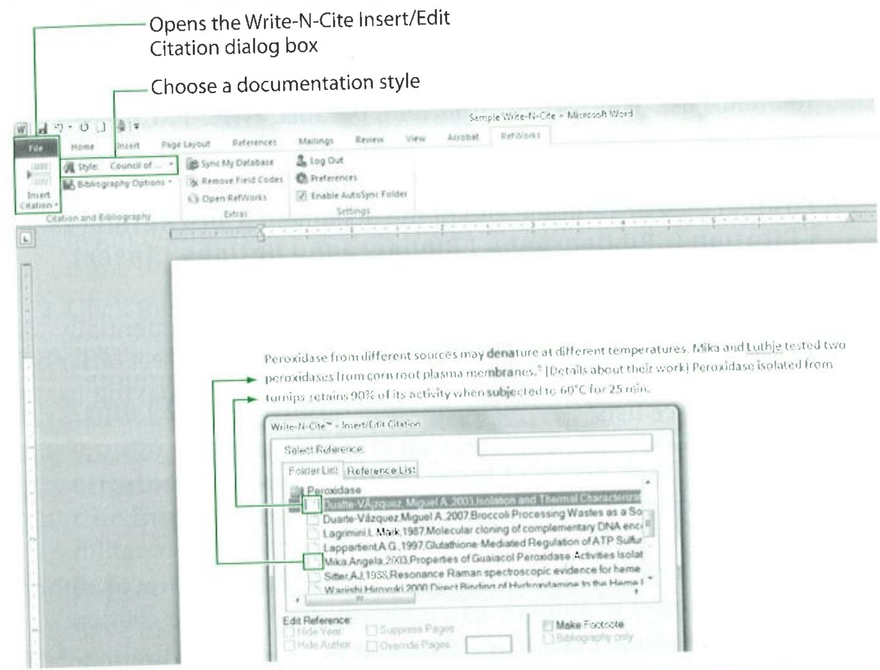

Figure 2.10 To insert a citation in C-S style, position the cursor in the Word document after the period. Click **Insert Citation** and navigate to the folder that contains the reference. After clicking the desired reference and then **OK**, Write-N-Cite inserts a superscripted number.

CITATION-SEQUENCE (C-S)

In the Citation-Sequence system, in-text citations are numbered sequentially and the corresponding full reference is given in a numbered list at the end of the paper.

1. Begin typing your paper in Word. Save the document after you come to a sentence in which you want to cite a reference.
2. Click the **RefWorks** tab and log in.
3. Select the **Council of Science Editors – CSE 7th, Citation-Sequence** style from **RefWorks | Citation & Bibliography | Style | Select Other Style** (Figure 2.10).
4. Position the cursor *after the period* and click **RefWorks | Citation & Bibliography | Insert Citation**. In the **Write-N-Cite Insert/Edit Citation** dialog box, navigate to the relevant folder and click the reference that is to be cited. A superscripted number will appear in the Word document.
5. Repeat this process for each reference to be cited.
6. Save the document just before you are ready to generate the end reference list. This step is important, because Write-N-Cite will not properly format the in-text citation and the end references list if the document has not been saved.
7. Position the cursor at the end of the document. Click **RefWorks | Citation & Bibliography | Bibliography Options | Insert Bibliography** (Figure 2.11).
8. In your Word document, in-text citations are listed sequentially and the information in the end references is in the correct order (see Figure 2.11). Think of the time you'll save by not having to type reference lists!

NAME-YEAR (N-Y)

In the Name-Year system, the in-text citation is given in the form of author and year. The number of authors determines the format of the citation:

- 1 author: Author's last name followed by year of publication
- 2 authors: First author's last name and second author's last name followed by year of publication
- 3 or more authors: First author's last name followed by the words *and others* (or *et al.*) and year of publication

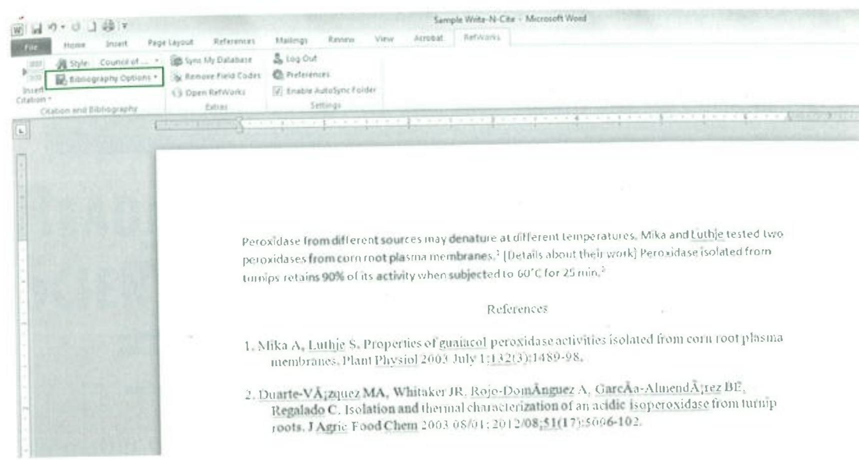

Figure 2.11 Final appearance of a sample lab report formatted using the Citation-Sequence system. After clicking **Bibliography Options | Insert Bibliography**, Write-N-Cite generates the end reference list based on the style selected.

The corresponding full references are listed alphabetically at the end of the paper.

1. Begin typing your paper in Word. Save the document after you come to a sentence in which you want to cite a reference.
2. Click the **RefWorks** tab and log in.
3. Select the **Council of Science Editors - CSE 7th, Name-Year Sequence** style from **RefWorks | Citation & Bibliography | Style | Select Other Style** (see Figure 2.10).
4. Position the cursor *ahead of the period* and click **RefWorks | Citation & Bibliography | Insert Citation**. In the **Write-N-Cite Insert/Edit Citation** dialog box, navigate to the relevant folder and click the reference that is to be cited.
5. Repeat this process for each reference to be cited.
6. Save the document just before you are ready to generate the end reference list. This step is important, because Write-N-Cite will not properly format the in-text citation and the end references list if the document has not been saved.
7. Position the cursor at the end of the document. Click **RefWorks | Citation & Bibliography | Bibliography Options | Insert Bibliography**.

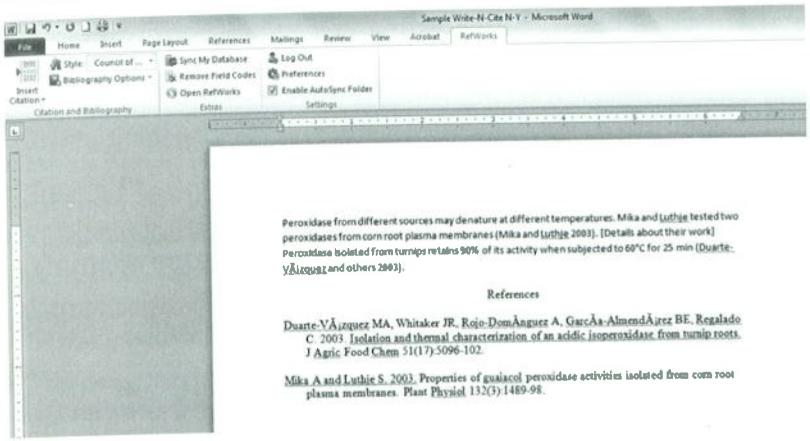

Figure 2.12 Final appearance of a sample lab report formatted using the Name-Year system. After clicking **Bibliography Options | Insert Bibliography**, Write-N-Cite generates the end reference list based on the style selected.

8. In your Word document, in-text citations are listed sequentially and the information in the end references is in the correct order (Figure 2.12). Think of the time you'll save by not having to type reference lists!

Chapter 3

Reading and Writing Scientific Papers

No matter whether you are a student or are already engaged in a profession, writing is a fact of life. There are many reasons for writing: to express your feelings, to entertain, to communicate information, and to persuade. When you write scientific papers, your primary reasons for writing are to communicate information and to persuade others of the validity of your methods, findings, and conclusions.

Types of Scientific Writing

Scientific writing takes many forms. As an undergraduate biology major, you will be asked to write laboratory reports, answer essay questions on exams, write summaries of journal articles, and do literature surveys on topics of interest. Upperclass students may write a research proposal for honors work, and then complete their project by submitting an honors thesis. Graduate students typically write master's theses and doctoral dissertations and defend their written work with oral presentations. Professors write lectures, letters of recommendation for students, grant proposals, reviews of articles submitted for publication to scientific journals by their colleagues, and evaluations of grant proposals. In business and industry, scientific writing may take the form of progress reports, product descriptions, operating manuals, and sales and marketing material.