ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΥΠΡΟΥ
ΚΕΝΤΡΟ ΔΙΔΑΣΚΑΛΙΑΣ ΚΑΙ ΜΑΘΗΣΗΣ
ΤΑΧΥΡΡΥΘΜΑ ΜΑΘΗΜΑΤΑ ΑΝΑΠΤΥΞΗΣ ΔΕΞΙΟΤΗΤΩΝ ΓΙΑ ΦΟΙΤΗΤΕΣ

Ανασκόπηση Επιστημονικής Βιβλιογραφίας σε Βάσεις Δεδομένων και στο Διαδίκτυο

Η επιστημονική έρευνα είναι μια εξελικτική διαδικασία η οποία χτίζει πάνω στις βάσεις που έχουν θέσει προηγούμενες προσπάθειες και έχουν καταγραφεί στη βιβλιογραφία. Υπάρχουν πολλοί λόγοι για τους οποίους μπορεί κανείς να χρειαστεί να αναζητήσει, αξιολογήσει και χρησιμοποιήσει αυτή την επιστημονική βιβλιογραφία: για να ενημερωθεί για τις τελευταίες εξελίξεις σε μια περιοχή ενδιαφέροντος, για να βρει συγκεκριμένες πληροφορίες που απαιτούνται είτε για πειραματική εργασία είτε για την κατανόηση ενός επιστημονικού αντικειμένου, ή ακόμα γιατί υπάρχει ανάγκη εντοπισμού και ανασκόπησης "όλων" των σχετικών πληροφοριών για ένα συγκεκριμένο θέμα. Αυτό το σύντομο μάθημα αποτελεί μια εισαγωγή στις δεξιότητες και στρατηγικές που απατούνται για μια αποτελεσματική αναζήτηση και ανασκόπηση επιστημονικής βιβλιογραφίας. Μην αφήσετε την πρόκληση της διερεύνησης επιστημονικών θεμάτων να σας καταβάλει, χρειάζονται μόνο λίγες βασικές δεξιότητες και εμπειρία!

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SIX STEPS TO SUCCESS

The Literature Review

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logical arguments expressed in clear, understandable language. She has taught high school English and history for the past thirty years. Research skills are always part of her curriculum.

For eight years, she worked for the California State Department of Education leading groups of educators in improving their ability to edit and assess student writing. Also for the state, she was a mentor for beginning English and history teachers. Participation in the California Writing Project extended her knowledge of writing and the difficulties that students at all levels face when producing a major assignment. She has worked as an editor and a proofreader for the books of several associates. She is currently doing research on health insurance coverage for two teachers' associations. Her depth of experience as a practitioner teaching writing and researching at many levels has shown her the many pitfalls that can bedevil student researchers. Her major interest has always been to help writers create work that is clear and logical. This continuing professional focus coupled with experience is a natural fit for creating a book that guides student researchers toward producing literature reviews that are well researched, well argued, and well written.

Introduction

The Literature Review Process

Getting Started

Chi ha fretta vada piano.
In order to go fast, you must go slow.

So you need to produce a **literature review**. Perhaps this is a class assignment, a thesis for a master's degree, or the foundation for your doctoral dissertation. Whether you are approaching this task as a first-time or experienced researcher, you are doing it for the same reason: to increase your skills and knowledge. You want to learn, and you also want the satisfaction of completing a job well. To succeed, you will want to avoid the problem mentioned by one of our colleagues: "Some do not have the patience and foresight to do it right the first time, but have the infinite patience and capacity to do it over, and over, and over again."

The good news is that you do not need to "reinvent" the literature review process. You do not have to use trial and error. There are known procedures and skills you can use to make your task easier and more efficient. This book provides a road map to guide you in producing a literature review that will contribute to your field. If you use this text conscientiously, it will help you arrive successfully at your destination. It offers tips and tools from many sources, including from the authors' experience. Using this information should enable you to plan your literature review journey to your own satisfaction, without losing time and effort with wrong turns and detours.

This introductory chapter begins with the selection of your destination—that is, with the selection of your literature review's purpose. As you begin, ask yourself, "Am I trying to present a thesis that defines the current state of knowledge about a **topic**, or am I arguing a thesis that defines a research problem for further study?"

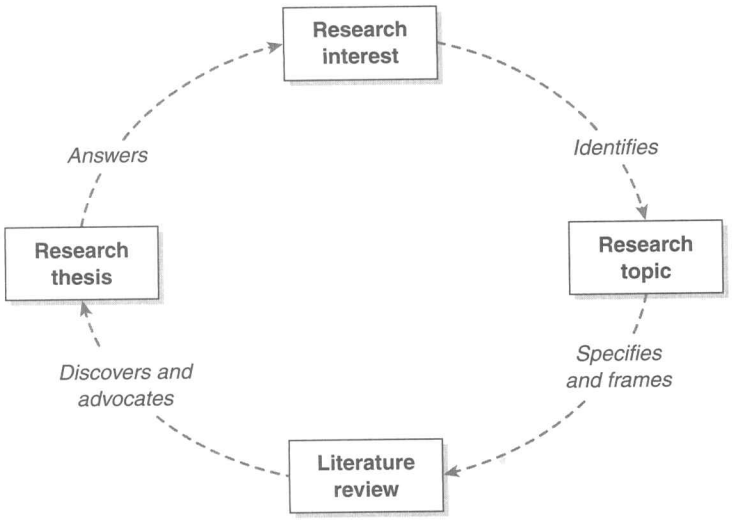
The Purpose of a Literature Review

Literature reviews have different purposes depending on the nature of the inquiry. If the purpose of the inquiry is to advance a position about the current state of knowledge on a topic, then you are doing a basic literature review. If the purpose of the inquiry is to uncover a research problem for further study, then you are doing an advanced literature review.

The basic literature review (Figure I.1) summarizes and evaluates the existing knowledge on a particular topic. Its purpose is to produce a position on the state of that knowledge; this is the thesis.

The basic literature review begins when you select and identify a research **interest** or issue for inquiry; this is the study question.

Figure I.1 The Basic Literature Review

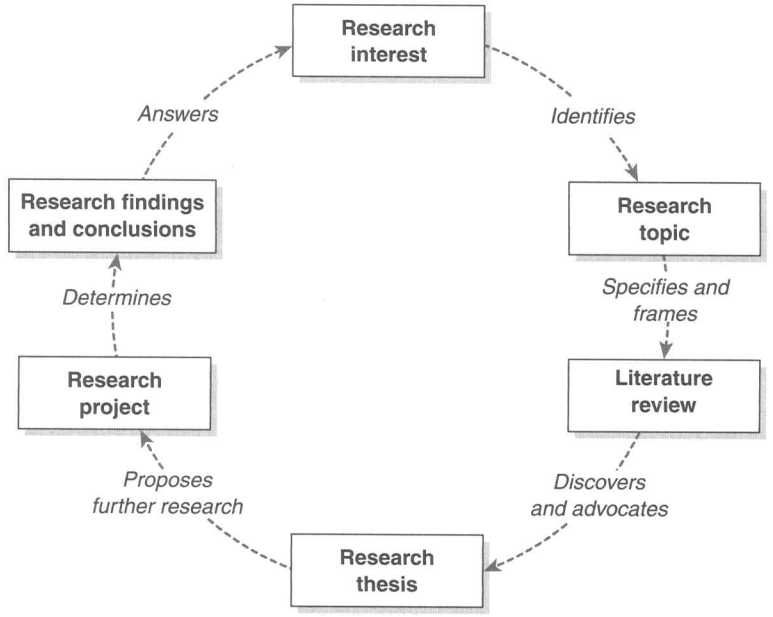


As you proceed, you will narrow and clarify this question into a research topic. The research topic specifies and frames the literature review. The outcome of the literature review will be the discovery and advocacy of a research thesis, which answers the study question. For instance, a class assignment or master's degree thesis would require a basic literature review.

The advanced literature review (Figure I.2) takes the inquiry one step further. It, too, selects a research interest and research topic; then it reviews the literature, leading to a research thesis. At that point, it proposes further research, which leads to identifying a research project, the determination of which leads to research findings and conclusions. The advanced literature review is the foundation for identifying a problem that demands original research, and is the basis for the study of a research problem.

In the advanced literature review, the researcher first addresses the current state of knowledge about the study question. Then, based on these findings, the researcher proposes a thesis that defines an

Figure I.2 The Advanced Literature Review



issue for further study. Advanced master's theses and all doctoral dissertations use the advanced literature review as a stepping-stone for discovering what is not yet known about the topic.

While basic reviews and advanced reviews seek different outcomes, the manner by which they uncover knowledge and produce a thesis are similar and parallel.

The Literature Review Defined

A literature review is a written **argument** that promotes a thesis position by building a case from credible **evidence** based on previous research. It provides the context and the background about the current knowledge of the topic and lays out a logical case to defend the thesis position taken. Here is our definition of a literature review:

> *A literature review is a written document that presents a logically argued case founded on a comprehensive understanding of the current state of knowledge about a topic of study. This case establishes a convincing thesis to answer the study's question.*

The Literature Review Process

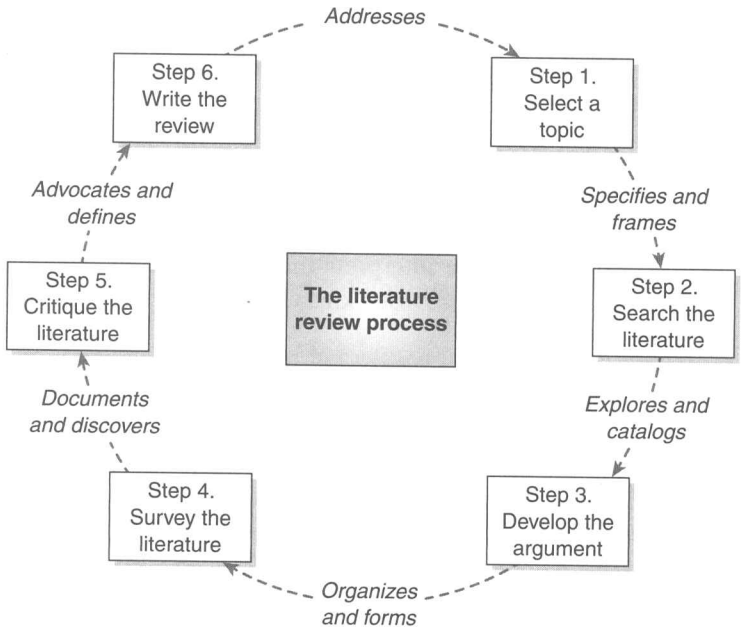
A literature review is an organized way to research the chosen topic. Figure I.3 shows the steps for conducting a literature review.

Writing a literature review is developmental, with each of the six steps leading to the next (Figure I.3). The following is a brief explanation of the six steps:

Step 1. Select a Topic

A successful research topic is usually the result of an interest in a practical problem. That interest must move from everyday language into ideas that form a researchable topic. This topic must be stated as a well-defined question accessible to a specific academic discipline. Specifying the language, refining the focus of the interest, and selecting the academic vantage point are the tasks necessary to create a research topic. The result is a defined topic that provides the direction for Step 2.

Figure I.3 The Literature Review Model



Step 2. Search the Literature

A **literature search** determines what information will be in the review. It does this by winnowing the information to only the **data** that provide the strongest evidence to support the thesis. When searching the literature, you must preview, select, and organize the data for study by using the skills of **skimming**, **scanning**, and **mapping** the data. At this point, you catalog and document the relevant data.

Step 3. Develop the Argument

To argue your thesis successfully, you need to form and then present your case. To form your case, you need to arrange your **claims** logically. To present your case, you need to organize the relevant data into a body of evidence that explains what is known about the topic.

Step 4. Survey the Literature

The **literature survey** assembles, synthesizes, and analyzes the data to form the argument about the current knowledge on the topic. The evidence creates a logical and defensible set of conclusions or claims. These conclusions provide the basis for addressing the research question.

Step 5. Critique the Literature

The **literature critique** interprets the current understanding of the topic. It analyzes how previous knowledge answers the research question.

Step 6. Write the Review

Thesis writing transforms the research project into a document for others. Through composing, molding, and refining, the written literature review becomes a work that accurately conveys the research and that can be understood by the intended audience. Thesis writing requires writing, **auditing**, and editing to produce a polished final composition.

The above discussion of the literature review, although condensed, provides a preliminary understanding of what you already know and what you still need to learn about the literature review. The succeeding chapters will describe the specifics for each step and help you to complete each of the tasks necessary for building a strong thesis position and conducting a good review. We turn now to a discussion of fundamentals—inquiry, researcher mind-set, and planning.

Inquiry: The Necessary Precondition

All successful research begins with inquiry. The researcher must have an inquiring mind, natural curiosity, and a fundamental need to learn and discover. The researcher must have an innate awareness of when present knowledge is insufficient and must have an intuitive sense of when something is missing.

- Curiosity creates the sparks that ignite a need to explore what lies beyond the currently known. This fire, in turn, sprouts the seeds that are the fragile beginnings of the research itself. Inquiring researchers begin their work with questions: "Why? What if . . . ? Is it true?" These questions and others like them are the bedrock of research; without them there is no good research.
- The inquiring researcher knows that each person has biases, opinions, beliefs, values, and experiences that come together to create a unique perspective. While these are fundamental human traits, researchers set them aside during the research process. Ideally, personal perspective should have no influence on the researcher's thinking and no place in the conduct of the research.
- The inquiring researcher comes to the research with an open mind. This researcher is objective, champions no favorites, and has no predetermined conclusions. This researcher is open to seeing all results of the inquiry, has no agenda, and weighs the value of each piece of evidence.
- The inquiring researcher looks at the evidence with a keen eye. This researcher looks for nuances when noting data, constantly looking for connections and patterns in the data. The researcher sees both the trees and the forest.
- The inquiring researcher thinks critically and weighs all data for veracity and value. This researcher seeks evidence, examines the pros and cons of any questions, and makes thesis claims based on strong evidence-based arguments.
- The inquiring researcher proceeds with diligence. This inquirer knows that any solid research need many hours of painstaking work. Data identification, collection, cataloging, and documenting need large blocks of time. There are no shortcuts. All good research builds on a thorough investigation of the facts. As any detective knows, successful investigations call for wearing through large quantities of shoe leather.
- The inquiring researcher is deliberate. This researcher acts on a calculated purpose with careful consideration and thoughtful intent. Good research builds on solid thinking and careful execution.
- The inquiring researcher reflects continually. This inquirer advances with skepticism, and questions everything. The research and the researcher are under constant self-scrutiny: "What did I do? What does it mean? How did it work? What

should I do next?" The inquiring researcher is constantly learning, reflecting on the past in order to navigate the present while examining the here and now to select the best course forward.

- The inquiring researcher works ethically. Plagiarism of ideas and words is unthinkable. The ethical inquirer acknowledges all who have come before, and understands what Newton meant when he wrote, "If I have seen farther it is by standing on the shoulders of giants."

These behaviors are the building blocks of academic rigor and discipline. Researchers must have rigor and discipline to conduct their tasks successfully. Rigorous and disciplined research, by its nature, must be deliberate and reflective. Researchers must strive to turn over all stones, scrupulously examine everything in their path, and conscientiously report all they find. These behaviors are tools for producing high-quality work, ethical research, and good science. Remember, "In order to go fast, you must go slow."

Pack Wisely Before You Begin

The secret for any successful journey—and a literature review is a kind of journey—is planning and preparation. The successful researcher must be physically and emotionally ready, and must have a plan of action. Doing a literature review well demands a commitment of focused time and effort, which will probably require a fundamental reorganization of daily life. A project such as a literature review cannot take place "when time allows," because time would probably never allow. Rather than trying to integrate this new work into the already-busy day, you should seek creative scheduling solutions.

First, you should organize a workspace free from distractions. Make sure the space has good lighting and that all necessary tools are conveniently placed. You will need a computer with an Internet connection, copying and printing capability, notepads, writing instruments, and filing space. You will also need, minimally, at least one high-quality dictionary and thesaurus. Reference works on research methods and writing skills can also be useful. Plan the space, and arrange it before you begin.

As with any complex project, the literature review demands concentrated mental focus. Mental discipline demands emotional balance. You must be actively present in mind and in spirit when conducting your work. If pressures invade your mental space, then concentration and focus decrease or disappear. Being contemplative is a strong aid to keeping emotional balance. When beginning a new day's research, start by putting the emotions and the pressures of the day aside; they can return later. Say to yourself that you are present and ready to work, and only then begin. Concentration is everything.

Having a plan increases productivity. Develop a three-level plan. First, create an overall project plan and time line. Second, subdivide the overall plan into sections that act as intermediate goals for the project. Finally, build daily plans from the subsections to schedule the work for each daily session. Remember, a plan implies a goal. Give yourself permission to modify your plan, but never proceed without one. Plans provide direction and organization. They build a structure to address the ambiguous and complex world of the literature review. These are our suggestions for planning:

1. Build an overall plan. Use the literature review model, Figure I.3, to form the overall plan. First, estimate the available monthly research time that you have for the project. Calculate this in hours, then estimate the number of hours it will take to complete the tasks for each step of the literature review. If you are not comfortable assigning task times, consult with colleagues or faculty who are experienced in literature research. Next, build an overall plan and time line for the research. Be sure to include extra time for unplanned eventualities.

2. Subdivide the plan by benchmarks that will serve as intermediate goals for the research. These benchmarks can be time or task driven. A monthly design is one choice if time is the measurement for progress. Use the steps of the literature review model when you use task completion as the measure of progress. Put the benchmarks on a time line, and readjust the overall plan as necessary. The benchmark division drives the work. It provides you with a solid schedule that addresses the tasks. At this point, the work becomes tangible.

3. Build daily plans for action. Each work session must have its goals. Ask yourself each day, "What do I have to do today?" If possible, schedule at least a two-hour block of time for each session. Early morning works best for many, when the house or library is quiet, allowing you to focus and concentrate more easily. Other times of the day may be more suitable in your case. Schedule a time with no interruptions and quiet surroundings. Give yourself enough time to complete a significant amount of work in each session. We recommend daily sessions. While two-hour sessions each day may be impractical, daily work on the project is not. Allowing extended time between work sessions will blur your focus. The literature review is a serious undertaking that builds one day at a time. You cannot succeed by leaving the work for the last minute. Of course, as you use the daily schedule, your benchmarks and the overall plan may need to change.

TIPS

- Study carefully the literature review model (Figure I.3). Memorize it if possible. Use this figure to keep yourself on track.
- Select a topic that is important to you. A subject of true concern or curiosity will produce better work than a topic chosen for expediency.
- Plan every step. Going back to pick up missed steps takes far more time than completing the work diligently.

Summary

The purpose of this chapter is to provide you with a general introduction to both the conduct and the product of a literature review. The chapter provides a discussion of what it means to be an inquirer, and gives a description of the traits of a good researcher. This chapter ends with preparation tips to help you launch a successful literature review. With a preliminary understanding of the project, a thoughtful mind-set, and a plan, you are ready to tackle developing the research topic, which is the subject of Chapter 1.

Checklist

Task	Completed
1. Are you clear on the definition and purpose of a literature review?	☐
2. Do you have a general interest to begin exploring?	☐
3. Have you internalized the six steps needed to create a successful literature review?	☐
4. Are you physically and emotionally ready to be an inquiring researcher?	☐
5. Do you have a suitable workspace, with necessary tools?	☐
6. Have you built an overall plan?	☐

Step Two

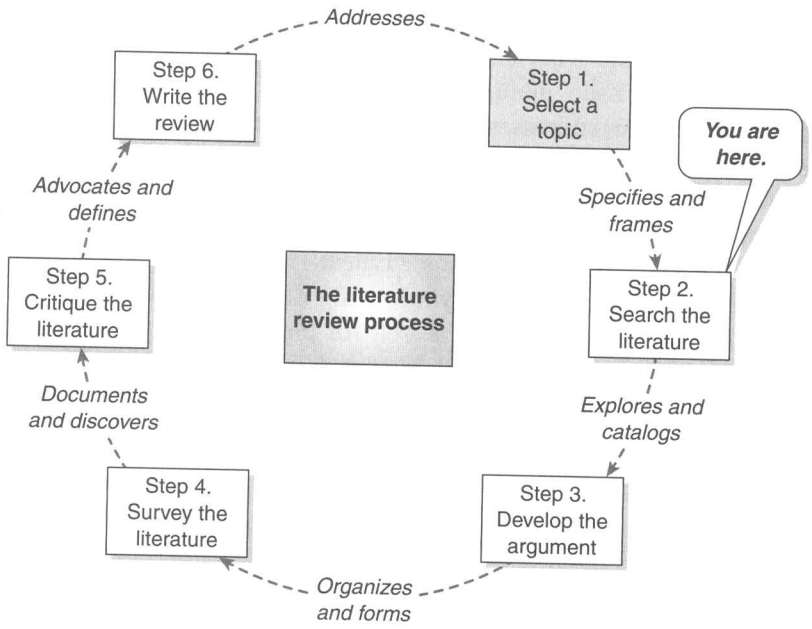
Search the Literature

Search Tasks and Tools

Veni, vidi, vici.
I came, I saw, I conquered.

—*Julius Caesar*

The Literature Review Model



You have successfully completed Step 1 of the literature review and are ready for Step 2, to review possible data for your topic. Some researchers make a serious error at this point. With paper and pencil or computer, they take the citations acquired from their subject and author query, go to the stacks or the Internet, grab books and journals, and begin writing furiously. They fall prey to the misguided notion that now is the time to write up the review of the literature. Remember, though: you cannot write about what you do not know. There are no shortcuts through this process. Before you can write the literature review you need to assemble the information on the topic and study it, thus gaining a thorough understanding of the subject matter. There is much examining, analyzing, and synthesizing to do before the formal writing can begin. By doing a quality search of the literature, which means reading and absorbing the information, you will be able to select the literature that needs reviewing, and then refine your topic based on the literature you select.

Stage 1. Discover the Literature to Review

At this point in the literature review, you must select the material you will review and the material you will not review. Several considerations decide what material is suitable to your particular literature search: Your main consideration must be gathering the information that addresses the key ideas contained in your topic statement. Other considerations might apply as well. For example, if your topic is time sensitive, you will need to look carefully at dates of publication before using information. A 1940s text is probably no help if your topic title begins, "Latest Theories on . . ." Perhaps, instead, your topic involves synthesizing the major works addressing a subject. If so, you will search for the important authors and theories about the topic, regardless of date. Your topic statement provides the direction and boundaries of your search. Using the topic statement as your pathfinder, continually ask yourself the following questions:

1. What is the subject of your inquiry?
2. What literature must you include that will tell you about the subject?

A second and equally important task should also take place now: you should refine your preliminary topic. The topic is fluid and subject to change early in the literature review. Your topic understanding is not yet influenced by knowledge of any literature. The data gathered while completing a search of the literature will impact your topic knowledge. This research of your topic interests will change as you gain a deeper understanding of the subject matter. The literature that you select in the search will qualify and refine your topic statement, thus causing your topic statement to narrow and become more concrete. As you research, reflect on how the topic is influenced and molded by the relevant literature you gather. For example, you may discover that your original topic is too broad and that it would be unrealistic to attempt covering all the information on the subject. Equally, you might find that your first topic choice is too narrow and that it fails to provide the substantial information necessary to answer your thesis question or statement.

Examine and reflect on the impact of the search data on your topic understanding. These deliberations will lead to creating a more concise topic statement. Be mindful and deliberate while conducting the search. Become aware of how the literature is influencing your topic interests. Keep these three questions in the forefront of your thinking when reflecting on your topic:

1. What is the literature telling you about your topic?
2. How is your understanding of your research topic changing?
3. What should your topic statement be now?

Stage 2. Conduct a Literature Search

A methodical approach to searching the literature and reflective deliberation on the impact of the literature on your topic will provide a sound foundation for your literature review. You will know what you are looking for and why you are looking for it. How do you methodically search the literature?

The second stage of Step 2 requires collecting and selecting data. This stage has three separate tasks: previewing, selecting, and organizing (Figure 2.1). Begin the search by previewing the potential works for inclusion in the study. Then select the final works to

Figure 2.1 Literature Search Tasks and Tools

Search Task	*Search Tools*
Literature Preview	Scan
Content selection	Skim
Data organization	Map

include, deciding on their specific contribution to the research, their timeliness, and their accuracy. Finally, organize the specific ideas from each work selected for review.

Three tools will help you complete these tasks. These tools are your abilities to (1) scan the literature, (2) skim potential works for content, and (3) map the suitable works for inclusion in the study. While these are three separate techniques, you may use them in various ways depending on your ability and your topic selection.

Think of searching the literature as assembling a well-used jigsaw puzzle. There are always parts missing, and often pieces of other puzzles have become intermixed. Developing a strategy for assembling a jigsaw puzzle is simple. Find a table with room to spread out the puzzle. Ensure that you have enough room to sort pieces and to organize them. Make sure there is good lighting. Consider what the puzzle should look like when completed by looking at the picture on the box. Spread the puzzle pieces out on the table. Look for pieces that obviously do not belong, and set them aside. Look for the puzzle pieces that make up the outer edge. Assemble them, and sort the remaining pieces by like pattern. Look for matching color patterns and the specific shape of each piece. Finally, put the puzzle together one piece at a time.

Searching the literature is similar to assembling a jigsaw puzzle. Open the box, and spread the puzzle pieces on the table by consulting subject and author indices for potential texts and materials you might review. The key terms and core ideas of the preliminary topic statement define the search. They represent the boundaries of your research puzzle. Scan the library materials, collecting the pieces that are part of the research puzzle. Catalog the materials found to make them available for the next stage of the search—skimming.

Skimming resembles a first sorting of the jigsaw puzzle pieces. As with the jigsaw puzzle, data mined from the scan of the literature will be studied for usefulness. What should you include? What should you discard? Skim the materials collected in the scan to decide their appropriateness for inclusion in the study. Does this work address the topic? If so, how? The preliminary topic statement provides the frame for deciding what to include. Some puzzle pieces are not part of this jigsaw puzzle. Remove these first. Arrange those that remain into an orderly pattern. After deciding what works will be useful in the study, you then address the final task of the search, mapping.

As with the jigsaw puzzle, examine the material to decide its potential place in the literature review. How do these data explain a core idea? How do these data further define the key words of the topic statement? Organize the literature review puzzle by documenting the place each of the included works has in developing the topic statement. After completing the literature search, you amass the information for inclusion in the review. You first weed out data that do not directly address the topic, and then organize the selected works by key idea, noting the specific contribution that each work will make when explaining the topic. Remember the two questions that guide your literature search:

1. What is the subject of your inquiry?
2. What literature must you include that will tell you about the subject?

Stage 3. Scan the Literature

Begin the literature search by scanning the literature. A literature scan is a systematic canvassing of library and online catalogs, subject encyclopedias, periodical indexes, and abstracts. The scan's purpose is to identify potentially useful works, which could be books, articles, theses, dissertations, reports, and conference proceedings. When scanning, you should quickly examine each of the reference catalogs or guides, identifying the works you might want to include. Typically, you will engage in multiple scanning sessions, each designed to cover a particular view of the study. Each scan carefully identifies literature references based on their usefulness in building the topic's story. Design your scans to seek out various types of topic

content, theoretical foundations and definitions, discussion and debate, current issues, field problems, and functional applications. Literature sources are usually categorized by these content types and are in chronological order of publication. You can place content types on a sequence based on specific content, publication type, and publication time frame (Figure 2.2).

As you can see, different reference types contain different categories of information. You would not look at trade magazines to search for the theoretical foundations of a topic, nor would you search definitive texts for recent issues or practices. Your strategy for each scanning session should consider the information category needed and the suitable research database that contains that literature type.

An academic literature review for practitioners most often demands that you seek both theoretical and field-based knowledge. Use current field-based literature to decide the issues, significance, and relevance of the study. The theoretical literature clearly defines the topic and provides the knowledge base for understanding the topic's depth and breadth. A search for the most recent data (see Figure 2.2) can help you gather information dealing with topic significance and relevance to the academic body of knowledge or professional practice. Specific databases contain different literature

Figure 2.2 Literature References

Recency	*Years*	*Months*	*Weeks*	*Days*	*Current*
Resource type	Books, monographs, and reference works	Journals and periodicals	Popular and trade magazines	Newspapers	Web sites and blogs
Content type	Theoretical foundations, definitions, research, key concepts, and constructs	Recent research, theoretical discussion, and debate	Current issues, debates, applications, practices, and field problems	Current issues, debates, and field problems	Up to date issues, debates, practices, and applications

types. Figure 2.3 provides a categorical listing of databases by literature type. For an up-to-date listing of databases that directly address the specific academic discipline of the study, confer with the research librarian, or consult the library's online database directory.

Begin the scan by doing a query of the reference databases that match the focus, vantage point, and content of the literature you are studying. For example, let's assume that you have identified your topic interest as theories of intelligence and that your selected vantage point is cognitive psychology. You might begin the search by querying online public access categories. This would provide a starting point, which might well lead to searches of each research database type as listed in Figure 2.3. Search directories are databases that use a query to obtain information. The most common query uses a Boolean logic to frame the database search. A **Boolean query** uses key words connected by the logical operators "and," "or," and "not" to define the search of the database. Using a combination of key words and one or more of the Boolean operators, you can focus the query and narrow the search to a specific area of interest.

Here is how it works. Select a key idea from your preliminary topic statement, and break it down by its key terms. Using the key terms as descriptors, combine the descriptors with the Boolean operators (and, or, not) to frame your search question. Use the operator "and" between two key terms to narrow the search selection. For example, say you are conducting a search about the key idea, "What is the nature of human intelligence?" Using three key terms—theories, human, and intelligence—a Boolean search might be as follows,

Figure 2.3 Reference Databases

Literature type	*Books, subjects, authors*	*Refereed journals, subject periodicals*	*Theses and dissertations*	*Trade and popular magazines, newspapers*	*Web sites and blogs*
Database	Library catalogs Online public assess catalogs	Library based and online subject indices and abstracts	Dissertation abstracts	Online indices Web query	Online search engines

"theories and human and intelligence." Notice that you can narrow the query by linking the two descriptors together to match the key idea. You can also narrow the search by author and subject: "Gardner and Wexler and Terman and intelligence." In this case, you are designing a query to find what these three theorists have to say about intelligence.

The Boolean operator "not" excludes terms from the search. Using the previous key idea, theories of intelligence, you query the database as follows: "theories and intelligence not emotional." This query will search for theories of intelligence and exclude any works that reference the word emotional in the text. When possible, avoid using the operator "not" since it tends to exclude documents you could actually use.

Using the Boolean operator "or" expands or broadens the query. The principal use here is to include similar ideas. For example, suppose you are exploring the key idea of the cultural bias of standardized tests. Frame the query in the following manner: "cultural bias and standardized tests or assessments or testing." Here you expand the query to include more descriptors that could well provide important banks of information about the key idea. Mix and match the Boolean operators to best fit the key idea of the search. You may need to use a trial- and- error method of framing the descriptors and operators into a statement in order to produce the needed result. Figure 2.4 summarizes the use of Boolean operators.

Figure 2.4 Boolean Operators

Operator	*Topic search*	*Descriptor use*
and	Narrows	Links descriptors
not	Excludes	Qualifies descriptors
or	Broadens	Adds descriptors

Stage 4. Use the Internet

You will probably be using the Internet for data gathering as part of your literature search. The Internet has quickly become a necessary

storehouse for information and is in fact a virtual library. As with any library, the Internet supplies information from seemingly infinite sources. Be careful, though: Internet data sources vary in their credibility, accuracy, and soundness. Two major problems with the Internet are (1) it has no quality control, and (2) it has no librarian. In your university library, the librarian will help you find the data you need and will provide expertise in judging the quality of the material you seek. On the Internet, you must be your own librarian. You must judge data quality, authority, and applicability. Remember, anybody can put inaccurate information online. You don't want to quote from a paper written by a third-grade student, but such papers will be mixed in with scholarly works by experts in the field. Take extra pains to ensure that data you find on the Internet are high quality, authentic, and correctly cited.

We recommend that you use electronic databases provided through your academic institution. University libraries have developed a comprehensive collection of electronic databases to help you with your research. These databases have been checked by librarians and are at your disposal for doing research. Your library research staff can coach you through the use and applicability of the electronic references. These references can include online connectivity to virtual research librarians, access to the major journals and reports for your field of study, availability of virtual texts, connectivity to university library networks, and many other services. As you prepare to do your literature search, consult with your research librarian for coaching on the use of the electronic resources provided by your university. You should also check with a librarian on the best use of general Internet references.

One note of caution before leaving this topic: many of the journals provided through university electronic databases connect directly with your personal research databases (such as *EndNote, Citation,* and *Ref Works*). This means that you can cite a journal, transfer its abstract, and catalog its contents with one click of your mouse. The good news is that you can document and catalog this information quickly. The bad news is that little, if any, of this knowledge transfers to your consciousness. Make use of the great improvements electronic databases provide to the task of searching, but take the time to understand and internalize the meaning of your information as you collect your data.

EXERCISE 2.1

Beginning Your Search

1. Check your understanding about literature searching by applying what you have learned to your own project.
2. Write your topic as you currently understand it.
3. List the literature types that address the core ideas of your topic (see Figure 2.2).
4. List the databases you plan to use for your first scan of the literature (see Figure 2.3).

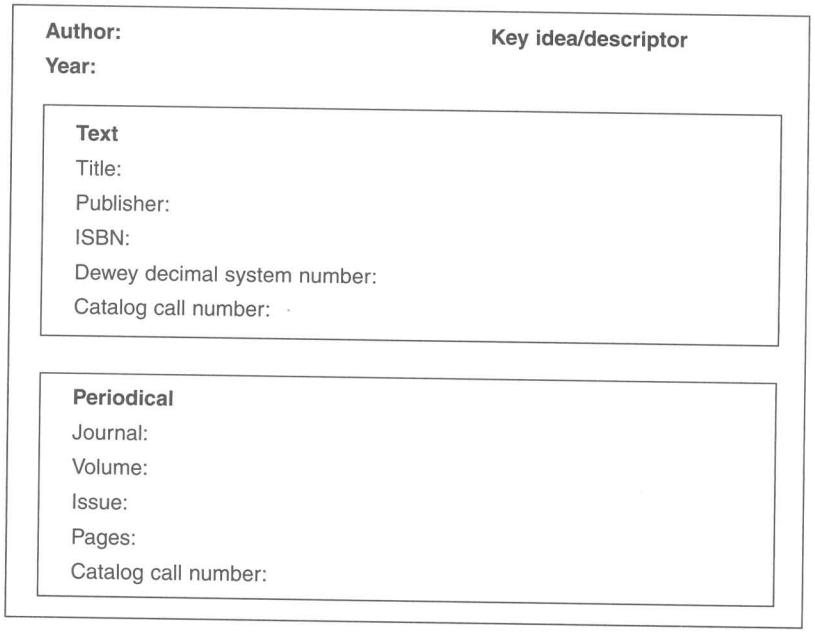
Stage 5. Manage Your Data

Before scanning, you must address how you will catalog and document the scan information. Be aware that, without careful management, your data can overwhelm you. At this point in the literature search, you only need to log two types of information: bibliographic information and scan progress.

Bibliographic Documentation

For each entry, bibliographic documentation includes author, title, data, publisher, ISB number, pages referenced, and the call number. List each entry by idea or descriptor. You can do this simply by using the old standby of building a three-by-five card stack. However, we recommend that you use integrated cataloging and documentation software, such as *EndNote* or *Citation,* which is available at college bookstores and on the Internet. Use of software simplifies the process and allows you to integrate information as you go along. Basic bibliographic information serves as the reference point for succeeding search tasks. Documentation and cataloging are cumulative. With each new stage of the search you will have more information. Use a bibliographic entry card (Figure 2.5) to document your data.

Figure 2.5 Bibliographic Entry Card (front)



Employing the techniques and tools presented in this section, you can now perform the following:

1. Successfully develop a specific scanning strategy that connects the preliminary topic statement, its focus and vantage point to key ideas;
2. Frame key ideas as descriptors for the search;
3. Build Boolean frameworks to query the appropriate databases;
4. Develop cataloging tools to document the works you plan to review for potential inclusion in the study;
5. Define the sequence and purpose for each scan, and identify appropriate search databases and their accessibility.

Scan Progress

Keep a log that catalogs the material that your scanning has determined may be useful for inclusion in your research. Logging

can be done in two ways: First, you can work directly from your Boolean query lists. As you scan, cross out items that will be excluded from your study. Use those items that remain from the list in the next stage of your research work. Date all of your work. This procedure ensures that you do not miss any potential resources. Second, following the same idea, complete the cataloging procedure using a database documentation program such as *EndNote.*

Stage 6. Skim the Literature

Now that you have scanned the literature to identify potential works for inclusion in your literature review, the next stage is to skim the identified works to decide what materials you will use. Skimming quickly identifies the important ideas contained in a text. While scanning identifies potential information to include in your study, skimming selects the best of all potential information. Here, you decide what to include and what to omit. Two standards guide you in conducting the literature skim.

1. Will this work be included or excluded from the study?
2. If included, what in this work is useful?

Use two techniques when skimming. First, examine and review the table of contents or index to locate specific material applicable to your topic. Second, do a quick read of those sections, chapters, or subchapters to decide whether (and if so, where) that information fits with the topic statement. Skimming identifies, organizes, and catalogs the specific material for review. Document the skimming results on the back of your bibliographic entry card. Figure 2.6 is an example of how this might look.

1. Begin skimming by reviewing the abstract or the text's introduction.
2. Does this material address the topic statement of the literature review? If so, how?
3. Continue by examining the table of contents of the text or major subject headings of a periodical. Note those chapters or sections that address the key terms or core ideas in the topic statement of the literature review.

Figure 2.6 Bibliographic Entry Card (back)

Author:	**Key idea/descriptor**
Selection review:	
Abstract:	
Notes:	

4. Document the results in the selection review section of the bibliographic entry card. Make sure that each entry documents the specific ideas and identifies the document, including page numbers, that you plan to use.
5. Once you have selected the specific areas of the text or periodical, do a quick read of that section to find the relevant information. Conduct a quick read by reading the first (introduction) and the last (conclusion) paragraphs of the section to identify the main ideas.
6. Skim read the section at three to four times your normal rate to quickly gather the main ideas.
7. Note the main ideas in the abstract section of the bibliographic entry card. Again, be sure to include page references for each major idea. Also, be sure to check all glossaries, appendixes, and other information in the end matter of the book. If there is a glossary, skim it for definitions connected to the topic's core ideas or key terms. Document these as well.

To continue the example from above, suppose the research topic is, "What is the nature of individual human intelligence?" The results of the literature scan identified several potential sources, which you have cataloged. You are ready to skim. One of the texts sited is *Intelligence Reframed*, by Howard Gardner. After reading the introduction, you decide that this text will make a major contribution to your literature review. In reviewing the table of contents, you find that Chapters 1 to 7 deal directly with your core idea, psychological theories of intelligences, so you note each chapter title

and page number in the selection review section on the bibliographic entry card. You then read the opening and closing paragraphs, and skim the body of each chapter. You document the main ideas of each chapter in the abstract section of the bibliographic entry card. You also document, in the notes section of the bibliographic entry card, that Appendix D of the text contains the contact list for theorists in multiple intelligence theory. You then proceed to use this skimming technique for each of the texts selected.

Stage 7. Map Your Materials

Now that you have scanned the literature and skimmed identified works to decide what materials you will use, you are ready to begin using mapping to form data patterns. Mapping is a technique for organizing the works that will be included in your literature review. Analyze each work for its contribution to the topic statement. Remember, the topic statement consists of core ideas and key terms. These core ideas and key terms are the descriptors on the bibliographic entry card. The content relevant to the descriptors should be noted and cataloged. In this phase of the search, you discover where each piece of the material gathered fits in with understanding the topic. Mapping allows you to organize the data collected into a pattern from which further analysis can emerge.

Use the descriptors created when you developed the preliminary topic statement as the central themes of your content maps. You might also create outlines that use the key terms and descriptors as major headings to map your data. Either of these methods can be effective for patterning your information.

Map and outline during the literature search to picture how material collected from the scan and skim addresses your topic statement; then develop content and author maps to pattern your information. Map the literature as follows:

1. Use your literature search key descriptors as central themes to create core idea maps. Map your data by each theme.
2. Compare your topic statement to your core maps to ensure the completeness of the information gathered by your scan and skim of the literature. If you find gaps or omissions, scan and skim the literature again.

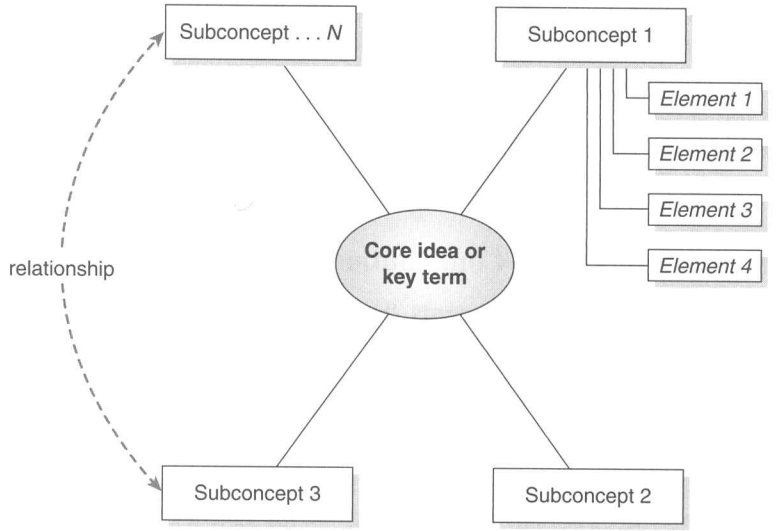
3. Reorganize your data by author to document theory knowledge and citations. Expand your data detail when creating author maps.
4. Review your maps. Now that you have a general idea about the basic information addressing your topic, do you need to revise your topic interest? If so, rewrite your topic statement to reflect your new topic understanding.

Mapping by Core Idea

A core idea map isolates each of the core ideas of the preliminary topic as a central idea. These maps answer the question, "What is known about this subject?"

Review the model in Figure 2.7. Notice the core idea, or descriptor, is in the center and serves as the central idea or theme of the map. Each of the categories or parts that make up the core idea should be sketched as a subsidiary, or supporting, idea. These parts can be different theoretical positions, or they can be definitional or descriptive categories. Various arrangements are possible, such as

Figure 2.7 Core Idea Map



type, theme, or chronology, depending on what makes the most sense based on your particular research question. Break down each of the subsidiary ideas into individual categories, such as laws, theories, definitions, or examples. You may further break down individual parts as well. How you depict each of these maps will depend on the core idea and the parts that define it. The key to the successful development of a core idea map is the story it tells. As you develop the map, consider the following questions:

1. Is the depiction clear, inclusive, and comprehensive?
2. Does the map document the current state of knowledge about the core idea?

You should complete a core idea map for each of the ideas, key descriptors, or key terms outlined in your first subject map. One last word about core mapping: use this tool continually as you complete the remaining steps of the literature review. Core maps help navigate, survey, and analyze the literature. They serve as guideposts in refining the research topic. Finally, they are excellent reference tools for developing the composition outline of the literature review document.

Figure 2.8 is an example of a beginning core map on the history of the theory of human intelligence. The key descriptor, the main map topic, for this map is "The History of the Theory of Intelligence." Five themes were produced to address this descriptor, beginning with "Intelligence as an Abstraction." Notice that themes are arranged chronologically to show the evolution of intelligent thought. Each theme is further explained by subsidiary ideas, subtopics, which pattern the data you gathered by scanning and skimming. Each subtopic has author references to cross-reference the information.

Mapping by Author Contribution

The author map documents the literature review differently. It depicts the material assembled from the scan and skim of the literature from the vantage point of an authority. While the core idea map organized the material based on subject knowledge, the author map organizes the material by individual contributor. The core idea map answers the question, "What is known about this subject?" The author map responds to the question, "Who said it?" Figure 2.9 on page 52 shows an example of an author map.

Figure 2.8 Core Map Example: History of Intelligence

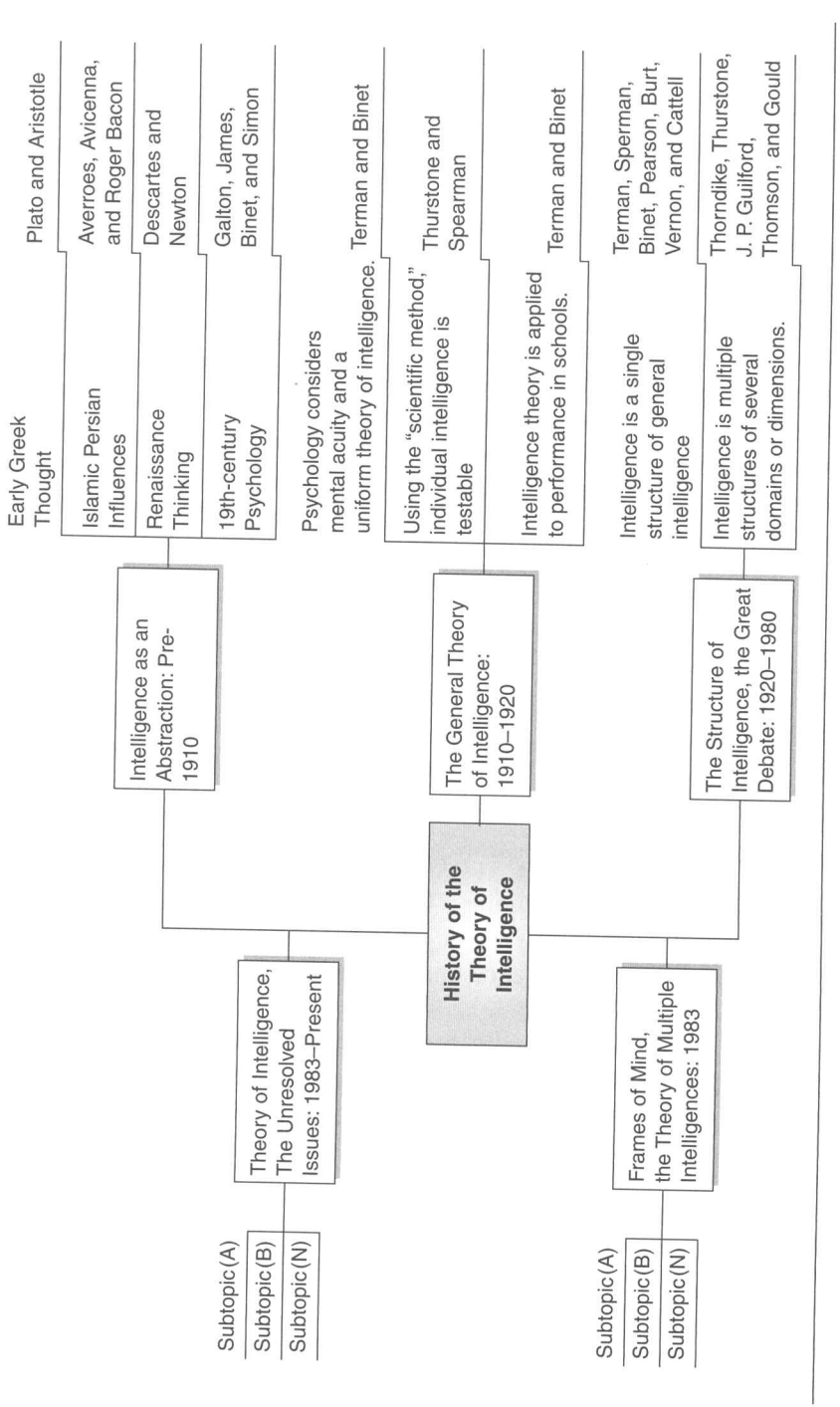
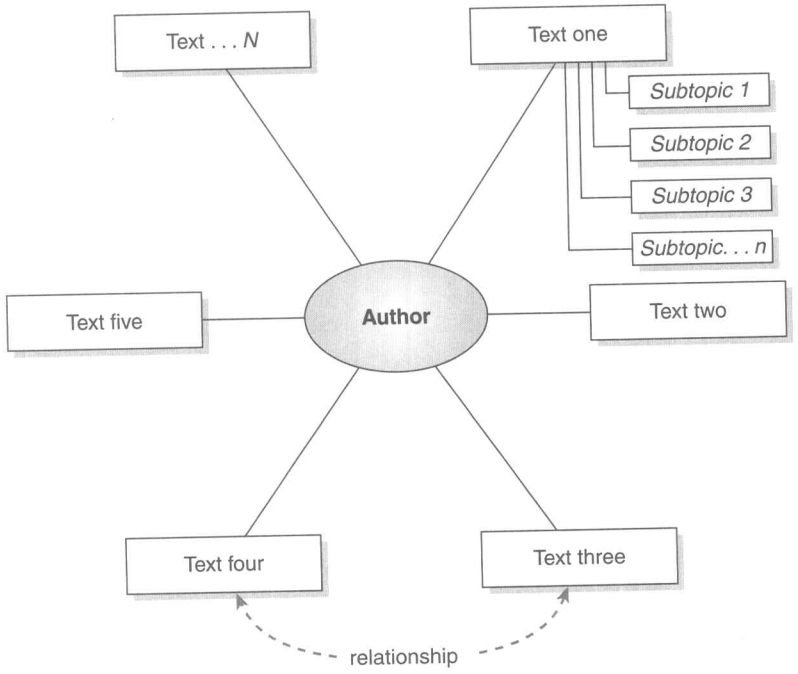


Figure 2.9 Author Map



Author mapping provides the depth and reference specificity to support core idea mapping. When author mapping, you develop maps that depict the work of each author you cite in the literature review and cross-reference this information to a core idea map.

1. Note each specific text. Obtain this information from the author and selection review sections of the bibliographic entry card.
2. Record on your map the relevant ideas and details from the text, organizing them by content, theory explanation, or chapter headings and subheadings. You can find this information in the abstract and notes sections of the bibliographic entry card.
3. Record the relationships among the texts depicted on the author map. These connections compare theories, cross-reference subject information, and develop chronological connections among texts. Place more information on these author maps, including page number references, notable quotes, and other authors or texts cited. As with the scanning and skimming techniques, adapt mapping skills and designs to your preferences and needs.

EXERCISE 2.2

Practicing Searching Skills

Practice what you have learned so far. Use the list you created in Exercise 2.1 to complete this exercise.

1. Select a method—three-by-five card, *Citation*, or *Endnotes*—for cataloging your data.
2. Enter the core ideas from your topic statement into your selected management tool.
3. Prepare your management tool for data entry.
4. Scan your references, and select one reference to work on.
5. Skim the selected reference for appropriate data to include in your review.
6. Enter the selected data into your management tool.
7. Develop a suitable core idea map.
8. Build a cross-referenced author map.

If you had difficulty completing this exercise, review this chapter. If you were able to complete this exercise successfully, continue entering other references into your management tool.

Stage 8. Refine Your Topic

Remember, the topic statement defines what is to be learned. It also forms the boundary of the study. This is an important notion. Not long ago we asked a colleague, a researcher from the University of

Chicago who holds a doctorate in his field, how he approached studying a topic. His answer surprised us: "For me, I spend less time thinking about what I am trying to study. Where I spend my time is in the hard thinking of what I am not going to study." The boundaries provided by the topic statement define the study from two perspectives: that which is to be studied and that which is not to be studied. This "hard thinking," deciding what is not to be studied, allows you to build a framed and focused topic of a study." How much is enough?" and "Do you have enough?" are the wrong questions to ask. The questions you should ask at this stage are the following:

1. Do you have a clear understanding of the core ideas in your topic statement?
2. Are these core ideas backed up adequately by your literature search?
3. Based on the literature search, how has your topic statement changed?
4. In reviewing your core idea and author maps, have you taken on too broad or too narrow a topic?

Completing a literature search gives you a great opportunity to refine the preliminary topic statement. You have done an in-depth study of your core ideas and key terms, and you know their main ideas. You may now revise the focus and vantage point taken in your topic statement for accuracy and clarity based on the information produced by the literature search (your scan and skim). After answering the four questions above, you may discover that your topic is too broad. The author maps contain hundreds of citations, and each individual core idea map could be a study in itself. What to do? The simple answer is to reframe the research topic statement by narrowing the focus. For example, your topic may be, "What are the negative connections that exist among members of a group?" When scanning the literature, you find an overwhelming amount of data addressing your topic, so you decide to narrow the focus. Your strongest interest is in the connections built among individuals in work groups. You refine your topic to now state, "What negative connections can exist in work-group dyads?"

Limiting the core ideas you plan to study and the specific theory areas you plan to include, or adopting a narrower point of view in the

academic field are all ways of refining the vantage point. Limiting can also refine the study topic. You might further qualify your interest by selecting a specific vantage point. For example, your original study focus might have been group psychology and psychodynamics. You now refine your topic statement to ask, "What are the psychodynamics present in negative relationships of dyads in work groups?" By limiting the focus to a subset (dyads in work groups) of the larger category (groups), and by specifying a specific discipline to study (psychodynamics), your topic area attenuates to a workable dimension.

You can further define the subject demographically. You can delimit the topic statement by gender, age, experience, geographical location, ethnic background, or other qualification. In addition, you can further narrow the previous topic example by asking, "What are the psychodynamics present in negative relationships of dyads comprising adult males in work groups with a membership of fewer than fifteen?"

There are many ways to narrow your topic of study. Ask yourself the following when you are trying to narrow the topic:

1. What are you actually trying to study?
2. What are you *not* going to study?

As your guide to narrowing the topic, you should refer to the original interest statement you used to define your topic. Refer to your work in Exercise 1.6, Refining Your Topic Statement, to further edit your research topic statement.

Stage 9. Expand Your Topic

You can also find yourself with the opposite problem: The results of your literature search may have produced scant information on the topic. In this case, you should review the key terms and core ideas developed in building your topic.

1. Have you defined your key terms and core ideas correctly?
2. Are there other definitions and academic vantage points that could produce better results?
3. Should the research become more inclusive by expanding either the focus or vantage point selected?

Examining the omissions and weaknesses found by the literature search is also a good way to expand the topic statement. When either narrowing or broadening the topic statement, you should keep in mind that quality is the critical standard of a research project. Narrowing or broadening the topic statement is not about how much work you need to do, but what work you must do to address the research interest.

TIPS

1. Be diligent. Slow down. Employing the many stages necessary for a high-quality literature search may seem time consuming. It is. However, the various tasks you perform correctly now will save time in the future. Careful, accurate research done once is much more efficient than hurried research that must repeated again and again.
2. Organize. Careful organization of information at the beginning will save you from the daunting task of trying to organize at the end when you have far too much material.

Summary

You now have developmental and incremental plans for searching the literature. You know that a literature search is strategic data collection. It involves the three stages of previewing, selecting, and organizing literature for possible inclusion in the literature review. Three tools are available to help you in conducting the search. They are the techniques of scanning, skimming, and mapping.

- *Scanning* is an organized search of the library and online catalogs, subject encyclopedias, periodical indexes, and abstracts. The scan's purpose is to identify the works for possible inclusion in the study.
- *Skimming* is a rapid perusal of possible works to identify important ideas and their specific contribution to the research study, and to determine whether or not to use the work.
- *Mapping* is a technique that organizes the results of skimming to put the topic story together. Build core idea and author maps, and cross-reference them.

Use the information you now have to analyze the breadth and depth of your topic. After the search, you can select the works to include for review and, with careful reflection, can further define and refine the topic of study.

CHECKLIST

Task	Completed
Previewing the Data	
1. Conduct scans of potential works by topic ideas and key terms.	☐
2. Conduct scans of potential works to build the case for study significance and relevance.	☐
Managing the Data	
1. Catalog bibliographic information.	☐
2. Create historical log of scan process.	☐
3. Create a database structure.	☐
Reviewing the Data	
1. Examine major parts of potential works for inclusion.	☐
2. Quick-read selected work for pertinent data.	☐
Mapping the Data	
1. Build initial core maps by key idea and key terms.	☐
2. Build maps by major contributing author.	☐
Refining Your Research Topic	
1. Refine topic statement for accuracy and clarity.	☐
2. Revise topic statement as necessary.	☐

Tips from the Experts

Research Methods for Comprehensive Science Literature Reviews

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Abstract

Finding some information on most topics is easy. There are abundant sources of information readily available. However, completing a comprehensive literature review on a particular topic is often difficult, laborious, and time intensive; the project requires organization, persistence, and an understanding of the scholarly communication and publishing process. This paper briefly outlines methods of conducting a comprehensive literature review for science topics.

Define and Refine Your Topic

Identifying potential topics of interest is typically the beginning of a literature review. A topic may be selected for you or you may need to choose one. Browsing textbooks, encyclopedias, review journals (e.g., the Annual Reviews series) or web sites that best fit the general category of your topic may help initially with selecting a topic and further refining it. You will want to begin by discovering general information about your topic and where the information fits within broader and narrower subject categories. You will want to identify major ideas, issues, controversies, and prominent researchers. The process of identifying a topic and outlining aspects of it moves ideally back and forth between finding and analyzing information and thinking critically about the topic (see Outline for Comprehensive Science Literature Reviews handout). Formulating a draft working title is a good first step for framing the topic for a particular publication or presentation with a specific audience in mind.

Before beginning to search for information resources, it is useful to write out concepts or facets of a topic on a search planner worksheet (see Search Planner -- Science Literature Databases handout). Each concept can serve as initial keywords and lead to additional related or synonymous keywords. A decision concerning the time period to cover for your topic should be made based on the importance of older research to the discipline and sometimes on the amount or type of literature found. In some disciplines, and at some institutions, this time frame will require going beyond electronic indexes into paper indexes. The interface and features of each electronic resource or database searched will structure the way search statements are entered and the ability to utilize Boolean search operators, truncation symbols, proximity operators, phrase searching, and limiters. Successful search strategies must be adapted for use in each new database. Recording precise methods of searching particular resources is as important as keeping accurate laboratory or field notes so that a particular search can later be replicated or revised.

The first results of searching an information resource are rarely the best results. It is worth reviewing the first page or two of results and examining how many of them are relevant or of interest to your topic. This assessment can be accomplished by title, by abstract, by other information in the full record display, and by obtaining the full article or source. Focusing on the full record display of one or two results that initially appear to be of most

interest and closely analyzing all the words in the full records will often lead to a better reformulation of a search statement with keywords or subject headings scavenged from those records. Some databases have thesauri, which can also help with this process. Modifying and revising search statement words and operators should be an iterative process and may require several attempts in each new information resource.

When beginning a search, it is often helpful to try broadening and narrowing search statements. Use the Boolean operators to retrieve between 10 and 100 results with over half the records displayed on each page relevant to the topic. There are various suggestions for improving bibliographic database search results depending on whether you are finding no citations (i.e., are you in the right database; do you have misspelled terms; are your terms too specific?). Perhaps you have found too few citations (i.e., don't use multi-word phrases; decrease the number of concepts combined with "and"), or too many citations (i.e., decrease the number of related terms combined with "or"; increase the number of concepts combined with "and"; add some limits to your search). See Improving Bibliographic Database Search Results handout. This search challenge can help with thinking through the narrowing and broadening of the topic itself.

Search All Relevant Sources Comprehensively and Efficiently

Journal articles are the primary vehicle of communication in most science disciplines and, therefore, journal indexes and e-journal packages are critical information resources. To identify and remain knowledgeable about the main indexes to the science literature and many other specific resources for each science discipline, there are science librarians, library database lists and guides arranged by subject, and specific literature guide books to assist you. Journal and bibliographic indexes typically allow keyword searching of article titles, abstracts, and subject headings or descriptors. E-journal packages (e.g., JSTOR; ScienceDirect; SpringerLink; Wiley Interscience) often allow keyword searching of the full text of articles as well. The ability to keyword search full text enables a new level of searching. While producing many irrelevant results, full-text searches can also find information not previously discoverable by searching indexes. Multidisciplinary indexes, such as Google Scholar, Scopus, and Web of Science, which analyze article bibliographies and track citations (i.e., who is citing who) are valuable tools for identifying the most cited and presumably important papers on particular topics. Once a relevant article is found, by examining its bibliography additional older results can often be identified for your topic. Conversely, once a relevant article is found, by examining who has cited it additional newer results can often be identified for your topic. A caveat is that more recent articles will not have had the time to build up the numbers of citing articles that older articles have.

After searching several indexes or e-journal packages and identifying the best articles for your topic, it may become apparent that the best articles are consistently found in a handful of journals. Once you have identified the best journals for your topic, then you should directly browse the table of contents of those journals for the last few years, or longer depending on the scope of your topic. No search strategy is perfect and many indexes have selective indexing of journal contents or have lag times before recent citations appear. Only by directly browsing the most important journals can you be assured of finding all the current, relevant articles on your topic from them. Many journals allow setting up e-mail alerts or RSS feeds with automatic notification of table of contents information from new issues. Similarly, many databases allow setting up automatic searches on a weekly or monthly basis. And many web sites have RSS feeds for notification of new content added.

Before a research project leads to a published or discoverable presentation or publication, you may find out about it by searching grant databases. Major research granting agencies for the United States, such as the National Science Foundation, and the National Institutes of Health have searchable grants databases that can identify ongoing research projects. These records often have abstracts and describe the project and identify the individuals and institutions involved. Other current awareness resources are newspaper indexes, blogs, and internet discussion groups. Identifying a leading researcher or expert on a topic and then contacting them for a brief discussion or to answer a focused question can be another excellent way to find out about new developments. And web search engines can also uncover all sorts of current, miscellaneous information. To find information on web sites there are a variety of general web search engines, meta-search engines, and specialized

search engines. Some specialized search engines for science topics currently include: Science.gov, Scirus, Scitopia.org, and WorldWideScience.org.

Many bibliographic indexes include records for books, government documents, theses and dissertations, media materials, and other gray literature. However, some indexes only include journal articles and even those which do include other types of information sources usually are very selective about what they include. The most comprehensive information resource for books, government documents, theses and dissertations, media materials, and gray literature is WorldCat, the global union catalog of over 70,000 libraries. Additionally, most individual libraries have their catalogs publicly available for searching online. The key to a comprehensive search of library catalogs is utilizing subject headings as part of a search strategy. A new level of searching for books beyond catalog records is now available from Google Books, which allows keyword searching of the full text of an unknown number (but currently believed to be over 7 million) of books.

There is no single, all encompassing, comprehensive database for the sciences or for most individual science disciplines. There is overlap between many bibliographic indexes, but to search the literature comprehensively for a specific topic typically requires the use of multiple information resources (see Main Indexes to the Science Literature handout). A good strategy for many science topics is to search the following: Scopus or Web of Science; Google Scholar; one or two specialized databases for a particular science discipline; Google Books; and WorldCat. That combination plus scouring bibliographies, browsing the table of contents of the most relevant journals, searching web sites using general and science web search engines, and talking to experts is likely to comprehensively uncover all types of relevant information sources. Note that many libraries offer federated, simultaneous searching of many databases at once. Those searches can be efficient ways to initially test the relevance of particular databases for specific topics; however, once the best databases are identified, it is optimal to individually search them, using the advanced search option, to take advantage of their unique, powerful search features.

Find and Evaluate and Manage the Information

As you search databases and analyze search results, you should continually review your search statement and modify it to provide better results. There is a trade off between comprehensiveness (retrieving all the relevant results mixed with lots of other irrelevant results) and precision (retrieving only relevant results, but missing lots of other relevant results). You will want to craft a search statement for each database that strikes a balance between comprehensiveness and precision. This strategy is often accomplished by utilizing various limiters and subject headings. Depending on your topic, you may wish to limit your results to scholarly sources and peer-reviewed or refereed articles. Scholarly sources are not necessarily better than popular sources; the appropriateness of the source depends on the topic and the audience.

Evaluating the results of your searches can be done based on many different criteria including these important concepts: relevance to your topic, objectivity, accuracy and credibility of the information source, significance of the research, authority of the author, date published, the type of information source, etc. A skeptical researcher is a better researcher. On the other hand, there is some evidence that individuals performing literature searches often only see those studies confirming their pre-existing beliefs or biases. So the ability to really look objectively at all results and weigh the evidence on a topic is important. There are specific methods, typically from medical disciplines, for overcoming researcher bias and performing systematic literature reviews.

Retrieving the information source from the citation via the open web or through a library site or requesting document delivery can be challenging some times. Librarians are always eager to assist with that process. There are books and courses devoted to techniques for critically reading and reviewing research articles and then organizing and synthesizing many information sources into a new review.
Nevertheless, understanding technical, research articles can prove quite challenging for those lacking a PhD in the discipline. There may only be parts of some primary articles and sources that are useful. Secondary and tertiary information sources may have to be relied on sometimes.

It is critical to carefully store citations and papers and annotations of them. With a large literature review, it is easy to lose the connection between notes and sources. There are a number of commercial and open source bibliographic management tools and social bookmarking sites available to assist with this process including: 2collab, CiteULike, Connotea, EndNote, EndNote Web, Mendeley, Refworks, and Zotero. Keeping track of irrelevant citations that initially look relevant but aren't, in addition to relevant citations, can avoid wasted time spent repeatedly evaluating some of the same results from multiple database searches.

Synthesize the Literature and Integrate it Into Your Writing or Presenting

Ideally, there is continual movement back and forth between searching for information on a topic, evaluating results, adapting search strategies, narrowing and broadening topics, reviewing and synthesizing the literature and integrating it into a publication or presentation which then triggers new questions leading to further searches for additional information. Knowing when to stop searching is sometimes as hard or harder than knowing where to begin searching, particularly when information is not found on a specific question or subtopic. Finding the best sources repeatedly in different databases, with a variety of search strategies, often leads to confidence that the topic has been well searched.

Choosing the appropriate type and venue of publication or presentation is important for the impact of a literature review and typically dictates the bibliographic style required. The Council of Science Editors (CSE) style is a good choice if there is no discipline or publication specific requirement. There are many books and guides to assist with style questions. Having a good model to emulate and tailoring your writing or presentation to your audience is one of the keys to its effectiveness.

Outline for Comprehensive Science Literature Reviews

Define and Refine Your Topic

- Choose a Research Topic of Interest; Think Critically About It; Formulate a Title
- Start a General Review (browse textbooks, encyclopedias, review journals, web pages)
- Identify the Major Ideas & Issues & Researchers
- Define the Time Period (i.e. how far back do you need to search the literature)
- Formulate Keywords = Main Concepts & Related Terms (use thesauri, subject headings, etc.)
- Craft Search Statements for Indexes/Databases/Catalogs (utilize Boolean operators, truncation, parentheses, proximity operators, phrase searching); Record your methods
- Narrow or Broaden your Topic as appropriate based on literature search results

Search All Relevant Sources Comprehensively & Efficiently

- Journal Indexes/ Databases & Ejournal Packages - find citations of articles and full articles
- Bibliographies - from relevant journal articles, books, etc. (cycle backwards in time)
- Citation Indexes – e.g. Web of Science/ Scopus; Google Scholar (cycle forwards in time by identifying citing articles; find the most cited articles on your topic)
- Specialized Data (e.g. chemical/ molecular name & structure; genetic sequence; etc.)
- Current Awareness Sources
  - Identify & Browse Current Issues of the Most Relevant Journals for your topic
  - Setup Alerts (Email; RSS) - Journal Table of Contents; Indexes; Web Pages
  - Grant Databases (e.g. NSF; NIH; CRIS)
  - Newspaper Indexes (e.g. Lexis Nexis Academic; Newsbank; individual newspapers)
  - Internet Discussion Groups, Listservs, Blogs, etc.
- Book Catalogs (find books, government docs, media materials, theses/dissertations, etc.)
  - Your Local Library Catalog; Other Libraries – i.e. WorldCat; Google Books
  - Individual Specialized Library Catalogs via the Internet
- Web Search Engines (e.g. Google, Yahoo, Dogpile, FirstGov, Scirus, etc.)
  - Directories (e.g. BUBL, Intute, Librarians Index to the Internet)
- Experts (Scientists; Scholars; Librarians, etc.) @ Institutions/ Organizations/ Agencies/
- Literature Guides (Books; Online Library Database Lists/ Guides/ Pathfinders)

Find & Evaluate & Manage the Information

- Analyze Your Database Search Results (citations) & Revise/Improve Your Search Statement (find the best balance/tradeoff between comprehensiveness and precision)
- Understand the Scholarly/Scientific Research & Peer Review Publication Process
- Evaluate the Type of Information Found and its Relevance to your Topic (Determine the Source; Credentials of the Author; Objectivity, Accuracy, Currency, etc.)
- Retrieve the Information Source from the Database or Library or ILL/Document Delivery
- Critically Read and Analyze Articles; Review Methods, Data, Statistics, etc.
- Gather, Store, and Annotate relevant Citations (e.g. Refworks, Endnote, Zotero)

Synthesize the Literature and Integrate it Into Your Writing

- Choose the Appropriate Type and Style of Publication/Presentation
- Move Back and Forth between Writing and further Literature Research

SEARCH PLANNER – SCIENCE LITERATURE DATABASES

This worksheet is designed to help you develop a search strategy for a bibliographic database.

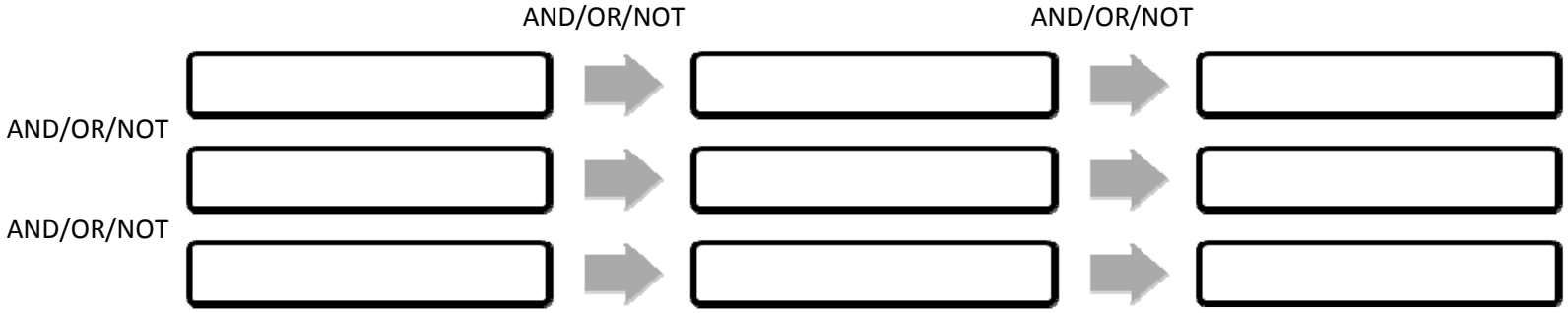
State your topic as completely as you can (in the form of a sentence or title):

_____

1) Think about your topic.
2) Circle the two or three most important concepts in the topic statement above.
3) Write each concept you circled in the first space of each line below.
4) List synonymous or related terms next to it on the same line, if applicable.

   To find related terms use: your knowledge of the subject, and/or a thesaurus (e.g. Biosis Previews Search Guide, Medical Subject Headings, CAB Thesaurus, Thesaurus of Psychological Terms, etc.), and/ or scavenge terms from relevant citations that you have already found. Use truncation whenever appropriate and allowed, e.g. "ecolog*" retrieves ecology or ecological. Select the appropriate field if the default is not the best choice.

5) Insert an operator (AND/OR/NOT) between the concepts to combine them into a search statement



6) Indicate which limits are helpful with your search and list them here:

   ☐ Limit by date:

   ☐ Limit by field (e.g. title; subject headings; etc.):

   ☐ Other limits:

7) List the best indexes/databases for your topic:

Improving Bibliographic Database Search Results

Note: reading the help screens within a database can be very instructive and can provide specific details for search options that may improve your search results. There are many advanced and/ or specialized ways of searching each particular database.

If your database search produces:

No Citations

- Check for misspellings
- Check for terms that are unlikely to be used by an author
- Check for terms that are too specific
- Check for incorrect or missing field terms/ limiters
- Ask yourself, if you can expect to find articles with these terms or these combination of terms in the title, abstract, or subject headings
- Check your assumptions (e.g. are you in the right database)
- Also try techniques listed under "too few records"

Too Few Citations

- Drop the use of multi-word phrases and use AND between words instead
- Decrease the use of the AND operator or the number of concepts searched
- Increase the number of synonyms or alternatives for a term (combined with OR)
- Use the scientific name and the common name (e.g. “wolves or canis lupus”; “prozac or fluoxetine”)
- Use variant spellings (i.e. British variants - e.g. "color or colour"; “behavior or behaviour”, etc.)
- Use truncation (*) at the appropriate place in terms to pick up variant endings (e.g. ecolog*)
- Use a search term appropriate to the database you're searching (subject headings/ descriptors)
- Use a broader search term; use a thesaurus for the database or subject
- Search earlier or more years of the database
- Try searching a different database

Too Many Citations

- Decrease the number of synonyms by choosing the most specific subject headings or the most significant/relevant keyword
- Increase the number of search concepts (with AND)
- Do not search by full text (i.e. change the field limiter to keyword)
- Limit your search by field, e.g. restrict your search to terms found only in the title of the article
- Limit your search (to peer reviewed/ refereed articles, or to articles in english, etc.)
- Limit your search by time period to the last five years
- Exclude less relevant concepts with NOT

Main Indexes to the Science Literature

All Topics	
➢ Web of Science and/or Scopus	➢ WorldCat (OCLC)
➢ Google Scholar	➢ Google Books

Agriculture & Forestry
Agricola
CAB Abstracts

Astronomy
arXiv
Astrophysics Data System

Biosciences
Biological Sciences (CSA)
Biosis Previews or Biological Abstracts
PubMed

Chemistry
PubMed
SciFinder

Computer Science
ACM Digital Library
IEEE Xplore or IEEE CS Digital Library

Environmental Sciences
Environment Complete (Ebsco)
Environmental Sciences and Pollution Management (CSA)

Geosciences
GeoRef
SciFinder

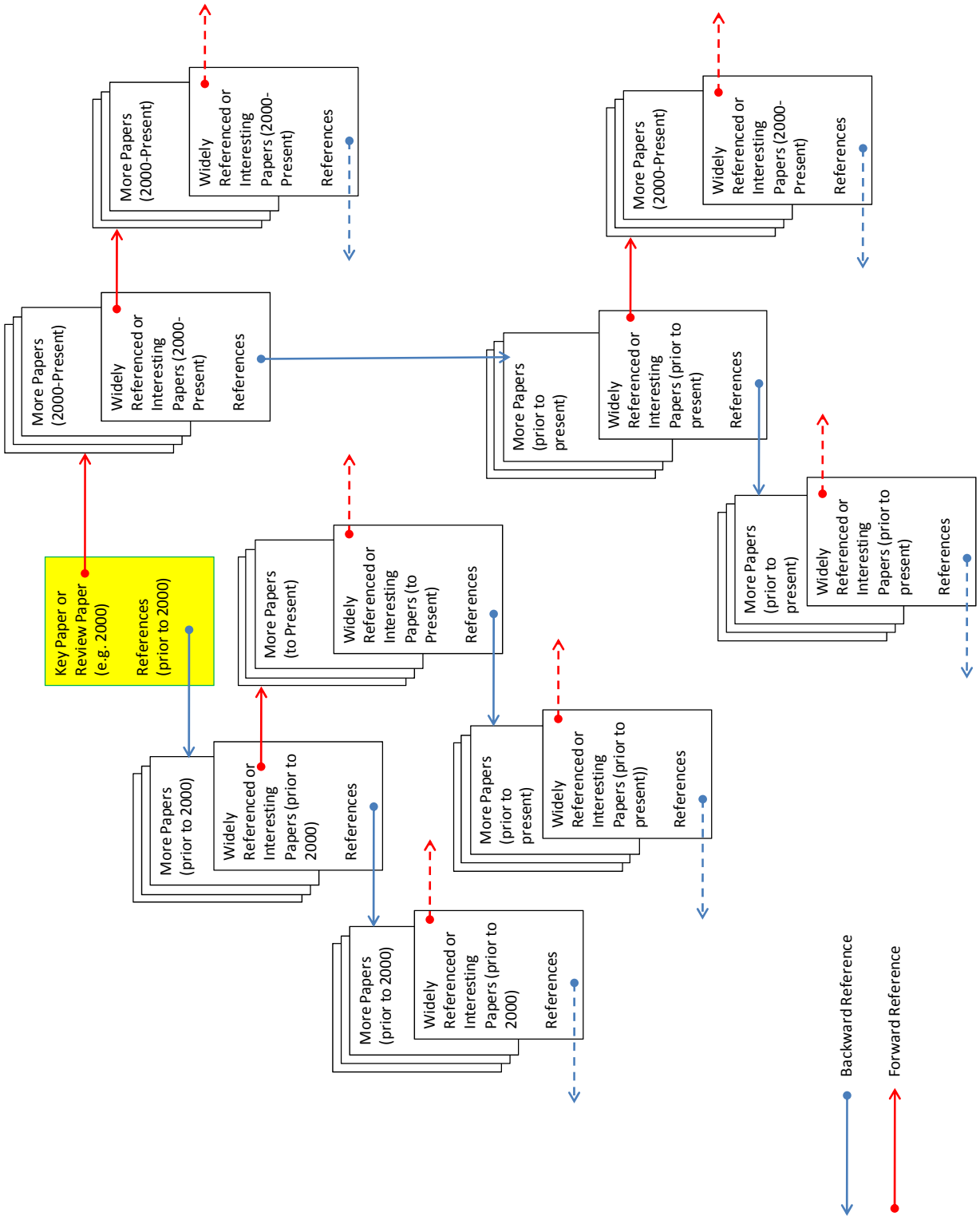
Health Sciences and Medicine
Embase
PubMed

Mathematical Sciences
AMS Directory of Mathematics Preprint and ePrint Servers
MathSciNet
Zentralblatt MATH

Physics
arXiv
Inspec
Scitation and SPIN

Wildlife & Fisheries
Biological Sciences (CSA)
Biosis Previews or Biological Abstracts
Wildlife and Ecology Studies Worldwide
Zoological Record

Backward/Forward Search Scheme



WEB OF SCIENCE® Quick Reference Card

Search over 9,200 journals from over 45 different languages across the sciences, social sciences, and arts and humanities to find the high quality research most relevant to your area of interest. Link between relevant records using the cited references and exploit the subject connections between articles that are established by the expert researchers working in your field.

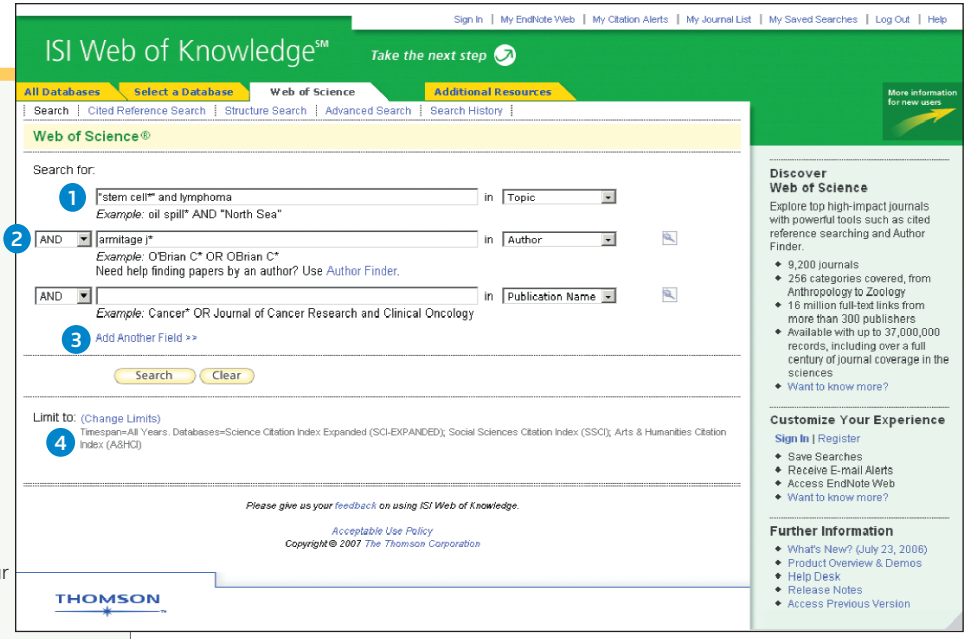
1 Search

Search by Topic, Author, Group Author, Source Title, Publication Year, and Address. Use the drop down menu for each search box to choose the area of your search.
You can limit your search by original language of publication or document type.

2 Use the drop down menu to change the relationship between each search field to AND, OR, or NOT.

3 Add additional fields for a more complex search.

4 Change the time frame and data limits of your search.



Cited Reference Search

All cited references from each article are indexed and searchable. Search by Cited Author, Cited Work, and Cited Year. Remember: Secondary Cited Authors are automatically searched in Web of Science source records within your subscription.

SEARCH OPERATORS

Search using AND, OR, NOT, and SAME (same sentence) to create logical search statements. Nest search operators inside parentheses. Search exact or truncated phrases inside quotations marks.

TRUNCATION SYMBOLS

Use truncation to retrieve plurals and variant spellings.

* = zero to many characters
? = one character
$ = zero or one character

SCIENTIFIC

THOMSON REUTERS

FULL RECORD

1 Titles

The full title is indexed and searched in a Topic search. Foreign language titles are translated into English.

2 Authors

All authors are indexed. Search using last name and up to five initials. Click an author's name to find all the articles by that author name.

3 Source

Source titles are searchable. Search using the full title or use the Search Aid on the General Search page to select a title.

4 Abstract

All author abstracts are indexed and searched in a Topic search.

5 Author Keywords

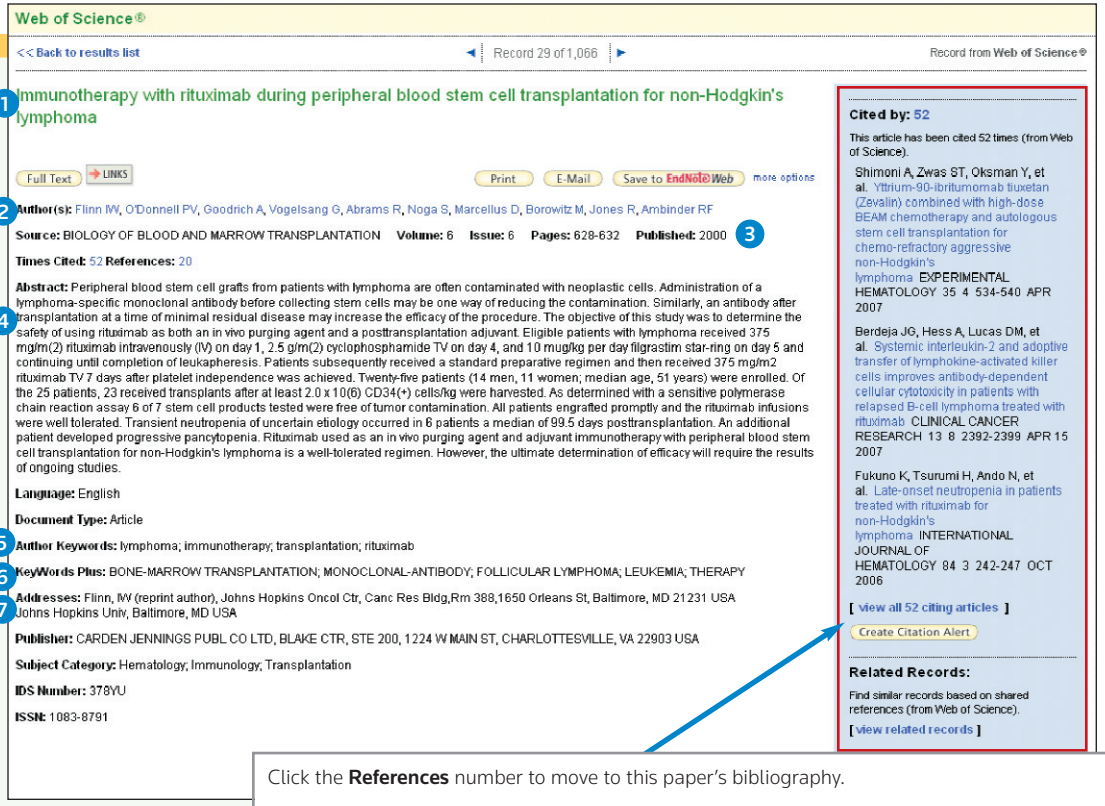
All author keywords are indexed and searched in a Topic search.

6 KeyWords Plus

KeyWords Plus® are unique to Web of Science and consist of words and phrases harvested from the titles of the cited articles. KeyWords Plus are searched in a Topic search.

7 Addresses

All author addresses are indexed and searchable. Reprint authors are identified and their e-mail addresses are provided when available.



Click the **References** number to move to this paper's bibliography.

Click the **Cited By** number to move to the articles that have cited this article in Web of Science. The bibliographic information for the three latest articles to cite this article will automatically display with the full record.

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Click **Create Citation Alert** to be notified when the article is cited by any new Web of Science record. Citation Alerts will remain active for one year, but can be renewed at any time.

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All cited references are searchable via the Cited Reference Search interface. References that appear in blue serve as links to other *Web of Science* source records. These links are limited by your subscription. References appearing in plain black text may be:

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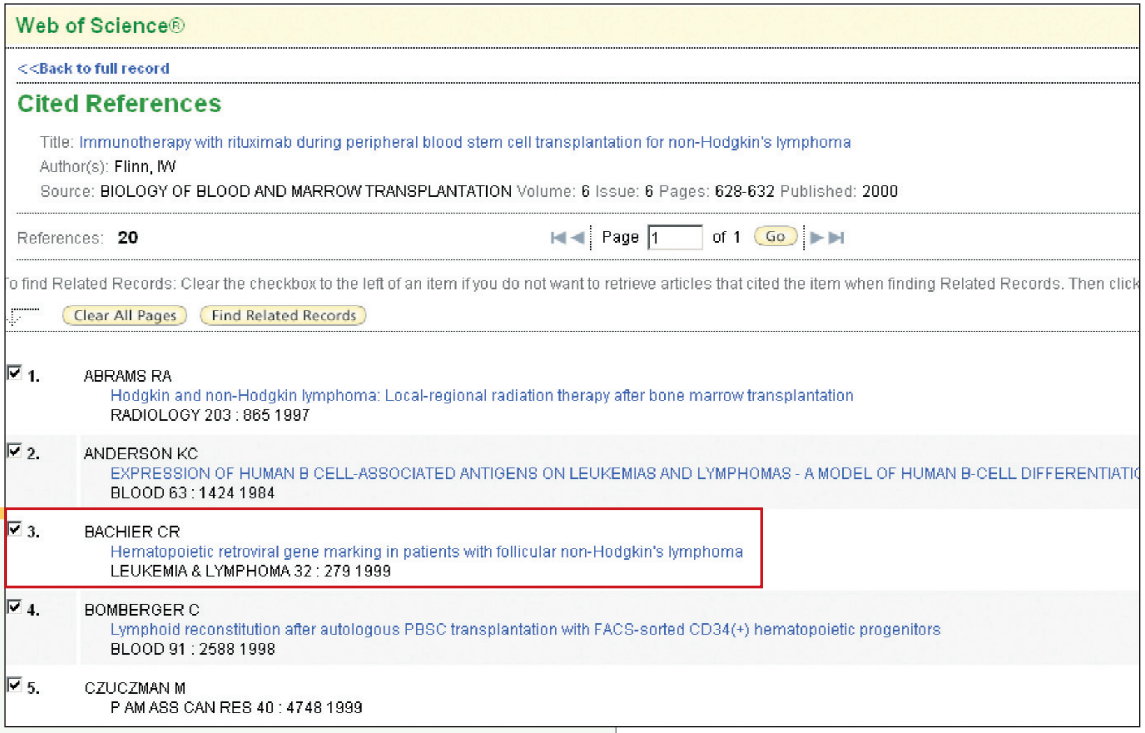


1 Cited Author

Only the first cited author is indexed and displays with the reference. Secondary cited authors are searchable, but only for those records that are source records within your subscription limits.

2 Cited Work

All Cited Works are indexed. The full work title and article title will display for citations that refer to source records in *Web of Science*.

3 Cited Year

The cited year is indexed and searchable.

4 Cited Volume

The cited volume is indexed to four characters.

5 Cited Page

The cited page is indexed to five spaces.

REFINE AND ANALYZE

1 Refine your Results

Use Refine to mine a set of up to 100,000 results to find the top 100 Subject Categories, Source Titles, Document Types, Authors, Publication Years, Countries, Institutions, and Languages.

2 Sort Results

Sort up to 100,000 records by

- Latest Date (default)
- Times Cited
- Relevance
- Publication Year
- Source Title
- First Author

3 Analyze Results

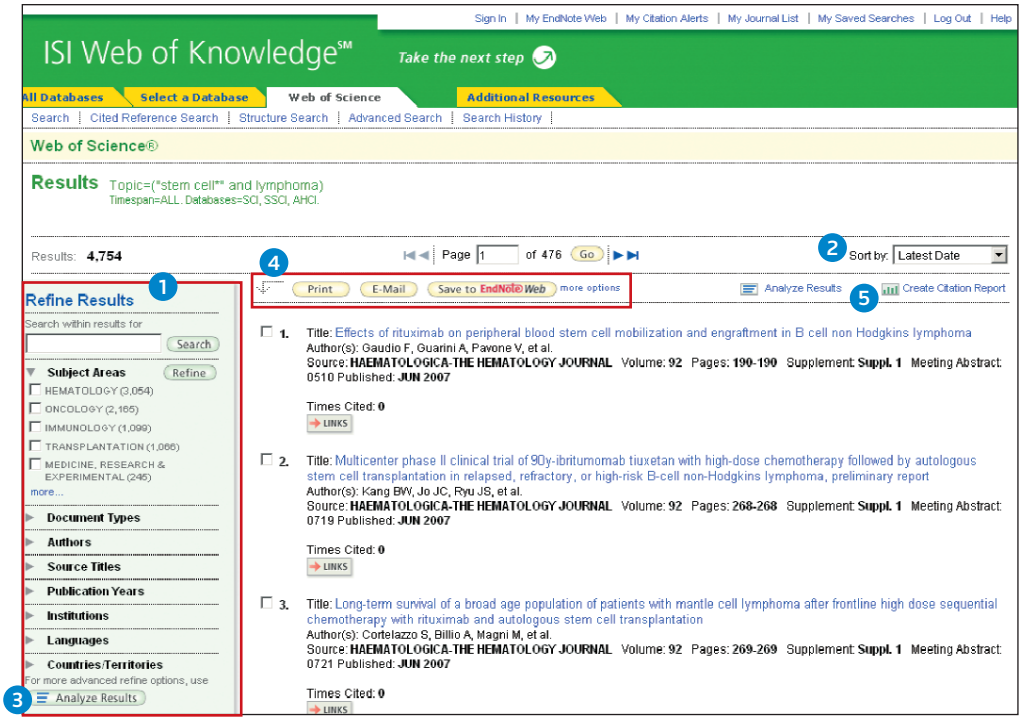
Like Refine, with Analyze you can mine a set of up to 100,000 results. With Analyze you can output the results to Microsoft® Excel to create your own graphs.

4 Output Records or Save to Endnote Web

Quickly print, e-mail, or save selected records to Endnote Web. Click "more options" to save (as text) or export records to ResearchSoft Reference Software (*Endnote, Reference Manager*, and *ProCite*).

Create Citation Report

5 Click **Create Citation Report** for a graphical overview of the articles in a set of search results.



PERSONALIZE

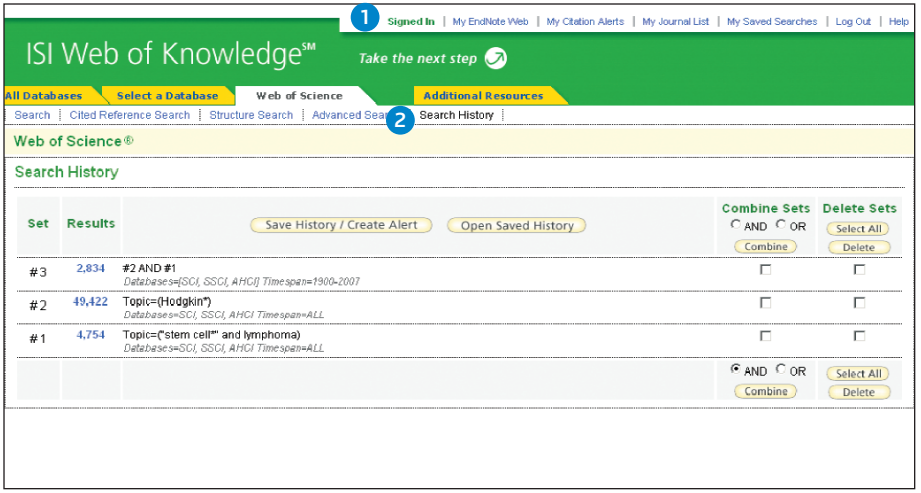
1 Create Personal Profile

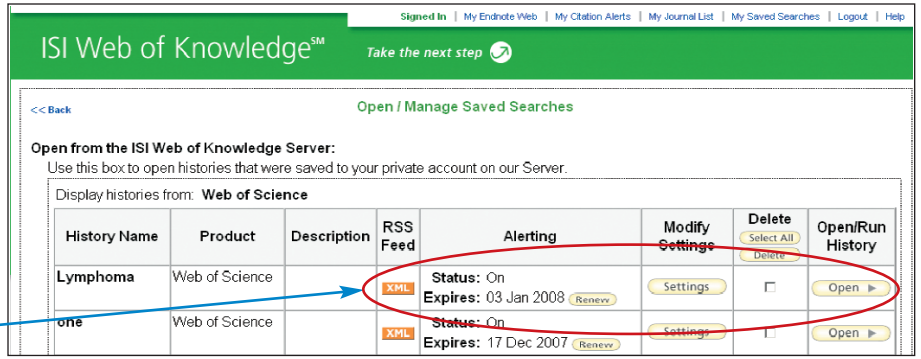
Any *Web of Science* user can create a personal ISI Web of Knowledge profile to take advantage of powerful personalization options. Creating a personal profile allows you to save:

* Unlimited saved searches and search alerts
* Unlimited citation alerts
* An **Endnote Web** library of up to 10,000 references

2 Save Searches and Create Search Alerts

Click **Search History** to view your search sets and create set combinations. Save up to 20 sets as a Search History or an Alert. Alerts will be based on the last search statement in your history. Alerts will remain active for 24 weeks but can be renewed at any time. Click "My Saved Searches" and "My Citation Alerts" to manage and renew your alerts. If an alert expires, it will remain as a saved search strategy in your personal profile until you delete it. Searches can also be saved as RSS feeds; simply click the XML icon after clicking Save History.



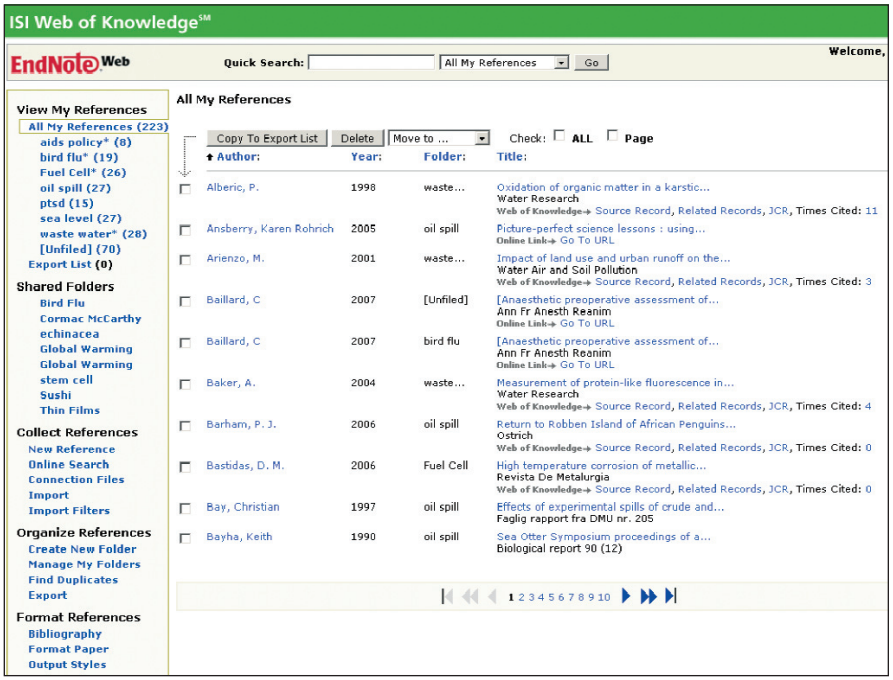


* Click "Renew" to set a new expiration date for any alert.
* Click "Settings" to turn alerts on or off.
* Click "Open" to run the saved search
* Click XML to set an RSS Feed

MANAGE

EndNote Web

Save up to 10,000 records in your EndNote Web library. EndNote Web also allows you to add and format references in a document and search other online databases and library catalogs. References imported from ISI Web of Knowledge resources will remain marked with an EndNote Web icon and you can link back to the full record and view up-to-date citation information. EndNote Web also allows you to add and format citations to documents you are writing and perform searches of other online databases. Once you have created your EndNote Web library you can access your library at any time, either from your Web of Knowledge profile or by going to www.myendnoteweb.com and using your ISI Web of Knowledge user ID and password.



Getting Help

Click the **Help** button on any page to get detailed help on features as well as detailed search tips and examples.

An educational tutorial is available at:
scientific.thomson.com/tutorials/wos7/

Contact the Technical Help Desk for your region at:
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Contact the education team at:
scientific.thomson.com/support/training/contacttraining/

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Performing Subcutaneous Injections: A Literature Review

Magdalena Annersten, RN, MNs, Ania Willman, RN, BEd, PhD

ABSTRACT

Background: Persons using daily subcutaneous injections to administer medicine perform them in different ways and thereby increase the risk of skin complications related to the injection. It is often part of nurses' role to administer medicine and educate the patient in injection technique. Course literature in nursing education, commercial patient education pamphlets, and instructional leaflets do not give consistent advice regarding subcutaneous injection technique.

Aim: The aim of this review was to identify the scientific foundation for the technical performance of subcutaneous injections. The question to be answered was: How should a subcutaneous injection be administered to achieve the right dose in the right place with minimum complications?

Method: The review included a search in three databases, a screening process at abstract level, followed by a quality assessment of included articles. The quality assessment was done independently by two people and followed specific protocols.

Result: A total of 38 articles were assessed for quality and covered information on dose, location, and complications of subcutaneous injection. The assessed studies are heterogeneous in design and describe different aspects of the subcutaneous injection technique. Therefore, the scientific foundation for technical performance is weak. However, several studies indicate that the amount of subcutaneous fat and appropriate needle length are of high importance for the drug to reach the target tissue.

Conclusion: More research regarding effective subcutaneous injection technique needs to be done.

Worldviews on Evidence-Based Nursing 2005; 2(3):122–130.

KEYWORDS administration of medication, diabetes, heparin, injection technique, insulin, insulin pen, lipohypertrophy, needles, subcutaneous injection, literature review, syringe

INTRODUCTION

In Sweden, approximately 200,000 injections are administered subcutaneously every day (Apoteket 2001). In Sweden, as in other countries, it is part of the nurse's role to administer medication and teach patients how to inject correctly. Nurses, as well as patients, perform subcutaneous injections in different ways. This increases the risk of skin lesion and complications related to the injections. Epidemiological studies have shown 30% prevalence of lipohypertrophy in insulin-treated patients (Becton Dickinson 2000). It is therefore important that injection administration is based on scientific evidence of how best to perform this role. However, at present, it is difficult for nurses to incorporate best available evidence because literature used in nursing education, commercial patient information pamphlets, and instructional leaflets gives inconsistent advice regarding subcutaneous injection technique. These difficulties are not mitigated by compiled literature reviews, since the assessment process is not explicitly presented (e.g., Thow & Home 1990; Beyea & Nicoll 1996; Nicoll & Beyea 1996; Strauss et al. 1999). Therefore, the aim of this study was to review, with a systematic approach, the scientific literature regarding the practical and technical performance of a subcutaneous injection. The specific question to be answered by the review was: How should a subcutaneous injection be administered to achieve the right dose in the right place with minimum complications?

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1545-102X1/05

METHOD

Using a traditional evidence-based practice approach, the following steps were taken: asking answerable questions, accessing best information, appraising information for validity and relevance, and applying information in patient care (Swedish Council on Technology Assessment in Health Care [SBU] 1993). A subcutaneous injection includes several components. To identify these and to specify the search terms, Flemming's work (Flemming 1998) was used as a guide. By defining the situation, intervention, counter intervention, and outcome of the intervention, three outcomes emerged: dose, location, and complication.

Inclusion criteria for studies to be examined were

- published between the years 1966 and 2003 and written in English, German, Spanish, Swedish, or Danish;
- the population investigated needed to be human—adults or children;
- the equipment (i.e., syringes, needles, injection pens, etc.) used in the studies had to be in clinical use in Sweden from the 1980s and later; and
- the intervention should be an injection into the subcutaneous fat layer, or the activities around it such as preparation of the dose, cleaning of the skin, etc.

Studies on intramuscular or intravenous injections were excluded. The preferred outcome was either right dose, right location, or report on any complications (see Table 1). To build a foundation for practice recommendations, the assumption was that included studies should have used descriptive or controlled methods.

The literature search was performed using the databases Medline and CINAHL. It was assumed that both these databases would include studies reporting on the administration of medication. The pedagogy-focused database ERIC was also searched, as teaching the patients the self-injection technique is an important role of nurses. To identify other potential sources of evidence, written documentation from two conferences held in Strasbourg in 1997 (Strauss 1998) and in Barcelona in 2000 (Becton Dickinson 2000) for researchers with a special interest in injection technique was read, and some of the participants were contacted via e-mail for further information and documentation.

TABLE 1
Inclusion criteria

YEAR	1966–2003
Languages	English, German, Spanish, Swedish, Danish
Population	Adults and children
Injection equipment	Used in Sweden from 1980 and later
Intervention	Injection in the subcutaneous fat layer, or dosage
Outcome	Right dose, right location, report on complications
Design	Controlled trials or descriptive studies

Literature Search

The literature search in Medline (via PubMed) was conducted in December 2003, using the MeSH (medical subject headings) terms:

- "Injection, Subcutaneous"
- "Needles"
- "Insulin"
- "Heparin Low-Molecular Weight"
- "Nursing Evaluation Research"
- "Lipodystrophy"
- and the free text words "Injection Site" and "Subcutaneous Injection Complication"

The terms were used independently or in various combinations, using "AND." In the German search, the free text terms "Injektzion technik" AND "Diabetes" were used; in Spanish, the free text terms "Jeringa," "Inyeccion," "Diabetes Mellitus," "Enfermeria" were used. In the Danish search, the free text term used was "injektionsteknik," and the same term was used in the Swedish search.

The search in CINAHL was also conducted during December 2003, using subheadings:

- "Injection-Subcutaneous-Methods"
- "Heparin-Administration-and-Dosage"
- "Insulin-Administration-and-Dosage"
- "Injections"
- "Injection-Sites"
- "Injection-Subcutaneous-Adverse-Effects"
- "Syringes"
- "Lipodystrophy"

The search in the database ERIC, using the search term *Subcutaneous injection,* did not identify any abstracts that could address the research question.

The references from previous literature reviews on this subject were manually searched (Thow & Home 1990; Beyea & Nicoll 1996; Nicoll & Beyea 1996; Strauss et al. 1999), and it was found that this search covered their included references.

A total of 102 abstracts were screened, using the inclusion criteria to select articles for further appraisal. From the 102 abstracts, 87 full-text articles were retrieved for closer screening; another 15 articles were received from European researchers. Criteria for this later screening included the following: whether the study had investigated right dose,

right place, or complications; whether the injection studied had actually been subcutaneously placed and verified by CT scanning, ultrasound, or by lifting up a skin fold; and finally whether the problem studied was measurable with the method used. If there was no description of how the injection studied had been placed, and how this was controlled for in the study, the article was excluded. After excluding articles that did not meet this later criterion, 36 articles from Medline and CINAHL were included together with two from other researchers. Therefore, a total of 38 articles were critically appraised.

Assessment

The 38 full-text documents were assessed by two independent reviewers, using assessment sheets modified from available literature about critical appraisal (Greenhalgh 1997; Polit & Hungler 1999; Willman & Stoltz 2002). The assessment sheet included data on the inclusion and exclusion criteria, the number of study subjects, what outcome was investigated, how this was measured, and whether the method chosen was appropriate. Data on the procedure for randomization, group comparability, blinding process, duration, and follow-up was also assessed, together with the statistical analysis. The reviewers met to compare and discuss their responses to the assessments. The quality for each article was graded on a three-point scale where one point refers to high scientific quality, three points refers to low scientific quality, and two points to moderate. This is the grading system used by the SBU for systematic reviews (SBU 1993, 1997, 2000). The studies were divided into two groups: descriptive studies and controlled studies. No studies using a qualitative approach were identified.

The results of the assessment were integrated in evidence tables including the following information: name of the author, publishing year, country, method design, investigated population, intervention, outcome and quality level, a short summary of the author's own result, the length of the needle used, and proven subcutaneous position.

FINDINGS

The 38 articles assessed for quality reported on many different aspects of the subcutaneous injections. In the quality assessment, 8 studies scored one point, 23 scored two points, and 7 scored three points. The eight one-point scoring studies are briefly presented below alongside the 23 two-point scoring studies in Tables 2, 3, and 4. The studies are presented in three tables according to three different aspects of the research question: dose, location, or complications.

How to Achieve the Right Dose

Bell et al. (1991) investigated, in a descriptive study of 90 patients and 28 health care professionals, the accuracy of dosage, using industrial pre-mixed insulin compared to self-mixed insulin. At low doses, both patients and professionals showed greater accuracy with achieving the right dose with pre-mixed insulin than with self-mixed insulin. Jehle et al. (1999) assessed whether Neutral Protamine Hagedorn (NPH) and insulin were accurately re-suspended by 109 patients measuring the content of their own vials and cartridges. Mixing of insulin by a mechanical device showed that at least 20 cycles of tipping the vial are necessary before complete re-suspension is achieved. Insulin content in patients' own cartridges or vials ranged from 5 to 214% of 100 IU/ml. The cartridge or vial was tipped and rolled more than 10 times by 9% of the patients. For all patients, there was a correlation between the absolute error of NPH insulin suspension and cycles of rolling and tipping the insulin ($r = 0.23$, $p =< 0.05$).

TABLE 2
How to achieve the right dose

AUTHOR/YEAR	CONTENT	SUBJECTS (*n*)	NEEDLE PLACEMENT PROVED BY	DESIGN/ QUALITY
Bell et al. (1991)	Dose accuracy	118 subjects (1,080 doses)	No injection performed	Descriptive PGC 1
Silva et al. (1996)	Dose accuracy	15 caretakers of children (540 doses)	No injection performed	Descriptive 2
Ltief & Schwenk (1999)	Dose accuracy	32 children and 16 parents (144 doses)	No injection performed	Descriptive 2
Jehle et al. (1999)	Dose accuracy	109 vials from 109 diabetes patients	No injection performed	Descriptive CT 1
Annersten & Frid (2000)	Drip after injection with injection pen	20 healthy volunteers (480 injections)	Lifted skin fold	Descriptive 2

PGC = parallel group comparison; CT = controlled trial.

TABLE 3
How to achieve the right place

AUTHOR/YEAR	CONTENT	SUBJECTS (*n*)	NEEDLE PLACEMENT PROVED BY	DESIGN/ QUALITY
Frid & Lindén (1986)	Amount of fat at six measuring points	10 patients with type 1 diabetes	Computer Tomography Scanning	Descriptive 2
Frid et al. (1988)	Amount of fat at three injection sites; exact needle position	10 patients with type 1 diabetes (30 injections)	Computer Tomography Scanning	Descriptive 2
de Meijer et al. (1990)	Correlation between amount of fat and absorption time for insulin	12 healthy volunteers, 25 patients with type 1 diabetes (74 injections)	Lifted skin fold and ultrasound	CT WSC 2
Frid et al. (1990)	Amount of fat at three injection sites; exact needle position	10 patients with type 1 diabetes (30 injections)	Computer Tomography Scanning	Descriptive 2
Thow et al. (1990)	Absorption time after injection into healthy skin or lipohyper-trophy	10 patients with type 1 diabetes (20 injections)	Ultrasound	Descriptive WSC 2
Beshyah et al. (1991)	Absorption time after injection in two injection sites	11 healthy volunteers (22 injections)	Lifted skin fold	CT WSC 2
Smith et al. (1991)	Amount of fat at seven measuring points	32 children (224 measuring points)	Ultrasound	Descriptive 2
Thow et al. (1992)	Amount of fat at five measuring points; exact location of injection	50 patients with type 1 diabetes (250 measuring points)	Ultrasound	Descriptive 2
Engström & Bergman (1993)	Two different techniques with injection pen	28 patients with type 1 diabetes (12,544 injections)	Lifted skin fold	CT Crossover 2
Clauson & Linde (1995)	Amount of fat and absorption time from two injection sites	20 patients with type 2 diabetes (80 injections)	Ultrasound	Descriptive WSC 2
Pergallo-Dittko (1995)	Aspiration for blood, using syringe and needle	102 healthy volunteers (204 injections)	Lifted skin fold	Descriptive 2
Polak et al. (1996)	Exact placement of a bolus of insulin	59 children with type 1 diabetes (59 injections)	Lifted skin fold and ultrasound	Descriptive 2
Monaco et al. (1996)	Identification of injection site using a teddy bear	58 children (116 measurements)	No injection performed	Descriptive 2
Birkebæk et al. (1998)	Amount of fat at 11 measuring points; exact location of an air bolus	47 children (517 injections)	Ultrasound	Descriptive 1
Tubiana-Rufi et al. (1999)	Amount of fat and needle placement using 8-mm and 12-mm needles	50 children (100 injections)	Ultrasound	Descriptive 1

CT = controlled trial; WSC = within subject comparison.

TABLE 4
How to achieve a minimum of complications

AUTHOR/YEAR	CONTENT	SUBJECTS (*n*)	NEEDLE PLACEMENT PROVED BY	DESIGN/ QUALITY
Koivisto & Felig (1978)	Existence of skin bacteria before and after cleaning with alcohol	13 patients with type 1 diabetes (1,700 injections)	Not described	CT WSC Crossover 2
Vanbree et al. (1984)	Existence of complications using three different injection techniques	43 heparin-treated patients (129 injections)	Lifted skin fold	CT WSC 2
McGowan & Wood (1990)	Existence of complications using four different injection techniques	96 heparin-treated patients (380 injections)	Lifted skin fold	CT 1
Fahs & Kinney (1991)	Existence of complications using three differnt injection sites	101 heparin-treated patients (299 injections)	Lifted skin fold	CT PGC 2
Schuler et al. (1992)	Existence of bacteria and inflammation after reusing needles for insulin pens	20 patients with diabetes type 1 or type 2 (87 needles; >33,000 injections)	Not described	Descriptive 2
Ross & Soltes (1995)	Existence of complications after heparin injection with or without ice on injection site	71 volunteers (141 injections)	Lifted skin fold	CT 1
Seyoum & Abdulkadir (1996)	Systematic inspection of injection sites	100 patients with type 1 or type 2 diabetes (n = 100)	No injection performed in the study	Descriptive 2
Hadley et al. (1996)	Existence of complications using 1-ml or 3-ml syringe	29 heparin-treated patients (58 injections)	Lifted skin fold	CT 1
le Floch et al. (1998)	Existence of biological material in injection pen and needle after injection	120 patients (120 injections)	Lifted skin fold	Descriptive 1
Comley et al. (1999)	Existence of complication after 1 or 2 daily injections	76 GCSF-treated patients (246 injections)	Lifted skin fold	CT PGC 2
Klingman (2000)	Existence of complications after changing or not changing needle prior to injection	31 heparin-treated patients (62 injections)	Lifted skin fold	CT WSC Crossover 2

CT = controlled trial; PGC = parallel group comparison; WSC = within subject comparison; GCSF = recombinant granulocyte colony-stimulating factor.

How to Achieve the Right Place

Birkebæk et al. (1998) in a descriptive study evaluated cutis/subcutis thickness on 47 children, at 11 measuring points at injection sites. Location of an air bolus injection with 8-mm and 12-mm needles was assessed by using ultrasound. The result showed that girls generally had more subcutaneous fat than boys and that compression of the skin reduced the distance from the surface to muscle fascia by 33%. The air bolus injection was inappropriately placed by 19% of the children using an 8-mm needle. Tubiana-Rufi et al. (1999) in a prospective crossover study of 50 children explored whether 8-mm needles could reduce the frequency of intra-muscular injections when compared with 12.7-mm needles. Using ultrasound, researchers assessed the localization of the needle tip on injection of insulin. The result showed that 88% of the children had < 12.7 mm and 40% had < 8-mm subcutaneous fat at the injection sites. At the time of the study, the needles most commonly used were 8 mm or 12.7 mm in length. Of the 50 injections performed with a 12.7-mm needle in a two-finger-pinch lifted skin fold, 86% were placed in the muscle instead of the fat layer. With an 8-mm needle, 38% of the 50 injections were placed in the muscle instead of the subcutaneous fat layer.

How to Achieve Minimum Complications

McGowan and Wood (1990) in an experimental study compared the relationship between four different injection techniques and bruising after an injection with heparin. The injections were given to 96 patients, using a 16-mm needle. There was no statistical difference between the four injection techniques used and the existence of bruises. Ross and Soltes (1995) in a quasi-experimental study compared whether ice applied on the skin pre- and post-injection with heparin on 70 healthy volunteers had any impact on the existence of, and size of, haematoma. The result of 141 injections with a 16-mm needle in a lifted skin fold showed no significant difference in the incidence or size of hematoma. Hadley et al. (1996) assessed incidence and size of haematoma after heparin injection with a 1-ml syringe and a 3-ml syringe in a lifted skin fold in 29 patients (n = 58 injections). The incidence of bruising did not differ significantly between 1-ml and 3-ml syringes, but the use of a 3-ml syringe resulted in significantly smaller bruises.

Le Floch et al. (1998) conducted a prospective study with 120 patients. A nurse injected insulin with the patient's own insulin pen and an 8-mm or a 12.7-mm needle. A cytopathological examination was performed on the material obtained from the needles and found in the cartridge after the injection. Air bubbles were found in 45% of the cartridges. Biologic material was found in 30% of the needles and in 58% of the cartridges, and in 25% of both needle and cartridge.

These 38 studies included here do investigate different aspects of the subcutaneous injection technique, but they differ in study design, subjects included, and outcomes measured. Therefore, it is difficult to formulate clear recommendations. From the literature reviewed here, there is no evidence to support general recommendations for the technical performance of the subcutaneous injection. Conclusions might be made from the findings—that the size of the injection needle should be adjusted to the amount of subcutaneous fat a person has. In practice, this amount can sometimes be difficult to estimate. Complications in connection with heparin injection seem to depend more on heparin itself rather than the injection technique used. The research evidence also seems to point toward individualizing care. However, to achieve this, the practitioner needs an explicit practice foundation so that she/he knows how individual changes should and can be made.

DISCUSSION

The result of this literature review reveals that there is little research evidence to support the formulation of recommendations regarding the performance of subcutaneous injection.

The fact that studies have been performed on many different aspects of subcutaneous injection reveals that this is an important clinical area for nurses and others. The most relevant approach to measuring effectiveness is a well-conducted randomized clinical trial. This design is difficult to perform on injection technique, since many of its components cannot (like choice of injection site), or should not (like dose accuracy), be blinded. To provide information regarding anatomical facts, such as fat depth, descriptive studies are relevant and indeed were included in this literature review. Case studies are informative regarding complications but are not a sufficient foundation for general conclusions and were therefore excluded. In the abstracts from Medline and CINAHL, several articles included 1- to 10-step instructions about how to perform an injection. These abstracts were excluded, since there is no convincing evidence that a certain technique is better than another just because it has been practiced for a long time. However, the frequent occurrence of step-by-step instructions reveals the need for further research, to build up a scientific foundation for such instructions.

Ideally after the search for studies has begun, the inclusion and exclusion criteria used should not be modified (SBU 1993). However, with regards to this particular review, it was soon revealed that many studies before 1980 were performed with injection tools no longer in use in Sweden. Therefore, studies published before 1980 were excluded from the result except for one that had studied skin

bacteria, as alcohol swab is still in use (Koivisto & Felig 1978).

The use of MeSH terms in Medline became cumbersome. The initial search turned out to include clinical trials regarding any medication intended for injection, giving a lot of pharmacological information but no information about which injection technique had been used. This is a weakness in the reporting of a new drug, as there is no information about whether the correct dose is given in the intended tissue. The abstracts from the chosen subheadings in CINAHL were surprisingly often medically oriented, referring to medical effects or side effects of different drugs, with little or no information on the injection technique or other nursing aspects.

Of the published studies, only a small number were performed on persons suffering from diabetes mellitus type 2, in spite of the fact that these patients constitute the largest group receiving subcutaneous injections in Sweden and many other countries. Many of the excluded studies regarding absorption of drugs could not be included, as the authors did not explain how the injection had been performed and whether the injection had reached the intended fat tissue or not. Several studies on heparin injection had more than one dependent variable, which makes it hard to draw any conclusions. Previous literature reviews included studies covered by this search, but the authors did not explain how the selection of included articles had been carried out.

Implications for research and practice

- Habits and practices of people who inject medication subcutaneously need to be described further, including the existence of injection-related complications.
- Factors that influence patients' actual injection technique compared to nurses' recommendations need to be investigated.
- Differences in the rate of injection complications in people receiving injections from nurses/health care staff compared with people taking the injections themselves need to be explored.
- More studies should target diabetes type 2 patients, obese people, and elderly people, as these are the largest groups receiving insulin (and low-weight-heparin) injections.
- Methods for estimation of subcutaneous fat tissue need to be evaluated to facilitate the choice of correct injection equipment and needle length.
- Studies on people with different skin colour could facilitate the development of methods to identify skin complications.
- Studies need to be done on the leakage of drugs at the injection site and the eventual clinical importance of drug leakage.
- Injections sites should have a sufficient amount of fat.
- Children and lean adults need short needles to avoid intra-muscular injection.
- Patients need instruction and follow-up when beginning self-injection therapy.
- Injection sites should be systematically inspected and routinely documented.

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