
CHAPTER 1



Pathways to Knowledge®

Pathways to Knowledge is a process model that can be used by anyone who wants to find, use, and evaluate information. In this chapter we describe the Pathways model and show how students in various learning scenarios might use it.

The Pathways model has been developed in two formats. One is a graphic version that shows the stages and strategies of the model laid out in curved bands. The graphic was designed purposely to reflect the nonlinear aspect of the searching process. The other version of the model is the Extended Text Version, which presents the stages and strategies in descriptive form and includes additional details about each stage. Both versions of the Pathways model are in Appendix A.

OVERVIEW OF THE PATHWAYS MODEL

The stages of the Pathways model appear across the top of the graphic version (see Figure A.1 in Appendix A). The strategies are arranged in bands under each stage and are included to provide the information seeker with a wide variety of options. Those seeking information should understand that, typically, only a few of these strategies will be used in any specific research project or to fulfill any information need. The model is a holistic process, so we explain it here in a holistic manner before exploring specific stages and strategies.

Pathways Is a Nonlinear Process

The Pathways model has been designed to show that the information-seeking process is nonlinear. Professional information specialists (e.g., librarians) often pursue different pathways to finding and using information. This is partially related to differing learning styles and the nature of the information need. It seems appropriate to teach students that a nonlinear approach is not only accepted but is the norm. A serious effort was made to design the Pathways model so that the nonlinear nature of the process would be evident in the graphic version. The layout of the curved bands and the arrows that suggest a back-and-forth progression are visual clues of a nonlinear progression.

Stages of the Pathways Model

The Pathways model is composed of six stages: Appreciation, Presearch, Search, Interpretation, Communication, and Evaluation. The Appreciation and Evaluation stages transcend all the others. Appreciation is not necessarily a stage that must occur at the beginning of information seeking but rather continues throughout the process. Evaluation must occur within each stage and not just at the end of the process.

Function Statements

Function statements describe the primary actions information seekers will pursue within each stage. On the graphic version of the model there is **bold text** that appears in the first band of each section, with the exception of Appreciation. These are function statements. The model includes the following function statements:

Appreciation-No function statement

Presearch-Establishing my focus

Search-Planning and implementing my search strategy

Interpretation-Assessing usefulness of my information; reflecting to develop my personal meaning

Communication-Constructing and presenting my new knowledge

Evaluation- Thinking about my process and product

The function statements are presented in the first person to personalize each stage for the information seeker.

Pathways Strategies

The Pathways model includes general and specific strategies. The general strategies are those statements that appear in the circles beginning with Presearch. These were developed to give the information seeker a broader view of the specific strategies within each stage. The general strategies are listed in Table 1.1.

As it is shown in this arrangement, an information seeker might decide that Pathways is a linear process. However, keep in mind that the research process can begin with a variety of general strategies. For example, Sara wants to purchase a new computer. Her information need is to locate information about the price of computers, components, and rating of models so that she can make an informed decision. She knows that the latest issues of the computing magazines have articles that describe and rate all the new computer models. She starts her search with the general strategy *Select information resources and tools*.

Table 1.1 Pathways Stages and Strategies

Pathways Stage	Pathways General Strategies
Appreciation	No general strategy
Presearch	Develop an overview Explore relationships
Search	Identify information providers Select information resources Seek relevant information
Interpretation	Interpret information
Communication	Apply information Share new knowledge
Evaluation	Evaluate process and product

Evaluate process and product

As Sara peruses several computing magazines, she realizes there are so many options and features that she must first decide which of these she wants to have in her computer. She needs to establish a more narrow focus for her search, which causes her to apply a Presearch strategy. Sara began her information seeking in the Search stage, which is where many information seekers often begin, but then went to Presearch. Her next step will be back to Search. This process of moving around in the stages of Pathways reflects a nonlinear path through the model.

Within each general strategy there are specific strategies. These strategies represent a range of options available to information seekers, who must select those strategies that are most appropriate for their specific information need or research project. Many strategies are shown on the graphic version of the Pathways model.

Extended Text Version

The graphic version has limitations due to space. The Extended Text Version, on the other hand, contains a more complete list of strategies. The Extended Text Version is a linear representation of the graphic Pathways model and includes a descriptive paragraph about each stage. The function statements and general strategies are included with each stage in a similar manner to the graphic version but often include additional specific strategies. Many of the specific strategies were developed in language that can be used in curriculum documents as part of outcome or benchmark statements.

The following sections explore each stage of the model in depth.

APPRECIATION

SCENARIO 1.1

Mrs. Rogers's seventh-grade art class is creating murals that depict daily life in Native American villages. The students are also studying Native Americans in their social studies class with another teacher, Mr. James. Mrs. Rogers began this art project by showing students a sampling of mural reproductions from her personal collection. She asked them to talk about how the murals were different and how each mural represented various cultures. Several students remembered seeing murals when they were traveling in the western United States. Their discussion led them to be curious about the artists who painted murals and the different techniques each of them used. The students decided they needed more information about styles and techniques related to murals. They also wanted to find more examples, specifically those that might have come from Native American cultures.

They decided to assign different information resources or providers to small groups in the class. One group checked out the resources in their school library, where the library media specialist helped them use the catalog and periodical databases. Another visited a local museum that had a Native American art exhibit. Another group visited the library media center and did some searching on the Web. They found the NativeWeb site to be very helpful. Several days later they shared their new information. They were very excited about all the different examples of murals they were able to find. After some discussion, the students decided that if they were going to create authentic murals, they needed more information about Native American tribes that actually created murals. So they returned to gathering information.

The Pathways model provides the following description of the Appreciation stage:

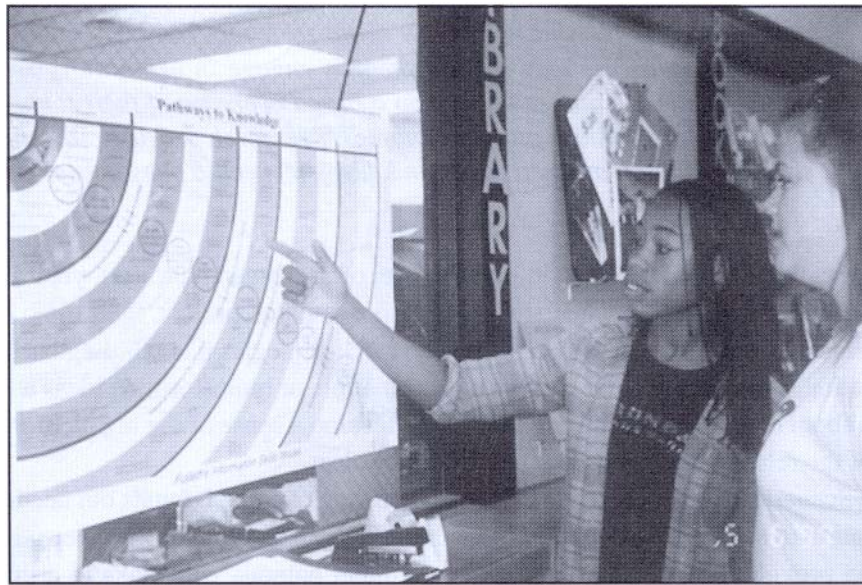
Individuals appreciate literature, the arts, nature and information in the world around them through varied and multiple formats, including stories, film, paintings, natural settings, music, books, periodicals, the Web, video, etc. Appreciation often fosters curiosity and imagination, which can be a prelude to a discovery phase in an information seeking activity. As learners proceed through the stages of information seeking their appreciation grows and matures throughout the process.

Students in Mrs. Rogers' s class began by viewing pictures of murals. Their subsequent discussion caused them to be curious about different types of murals and the techniques used to create these pictures. Their curiosity led them to gather information using search strategies, and they evaluated this information in their class discussion. Their evaluation created an enjoyment of this art form that they verbalized in their discussion. After some analysis of the information, they realized that they needed to search for more information.

In Scenario 1.1, students began their research process by viewing pictures, an Appreciation strategy, but they used other stages of the Pathways model as they pursued

their research project. In previous research assignments, students had begun with a research topic, using Presearch and Search strategies to gather information. At various times in their process they may come across a story, picture, video, or artistic piece, or even visit a local park. Each of these provides them with information but also opportunities to apply Appreciation strategies such as enjoying, listening, reading, or viewing.

Appreciation is an important element of the research process, and all learners should be aware of when they are using this stage. The importance of Appreciation is under- scored in the *Information Literacy Standards for Student Learning* (AASL and AECT , 1998). Standard five states: "The student who is an independent learner is information literate and appreciates literature and other creative expressions of information." (p. 26).



PRESEARCH

SCENARIO 1.2

Susan and Tara have begun to explore animal habitats. Their teacher, Mr. Simms, talked with the class about the places where animals live and why they choose those places. The students in their class brainstormed and made a web about the places where animals live, but the web was limited in scope. They knew that the pond just beyond the playground, and the forest in the park were habitats but could not name any others. Mr. Simms suggested they might go to the library media center to gather some general information about habitats.

Susan found a great article in the science encyclopedia that had many pictures showing animal habitats. She learned that deserts, marshes, and swamps can also be habitats. Susan had never heard about a marsh before, so she located some general information in the encyclopedia. Miss Lewis, the library media specialist, suggested the students might try looking in the electronic encyclopedia using the subject tree. Both Susan and Tara were amazed at how many habitats that search produced. "If you want specific information on any of those habitats listed in the hierarchical list, you will need to search for each animal and its habitat: Miss Lewis told them.

When the students returned to their classroom, Mr. Simms asked them to share their new information, which he added to the web they had developed earlier. "Now," Mr. Simms said, "You have a web that shows many of the habitats that animals use. How might we discover which of these habitats are located around where we live?"

The function of the Presearch stage is to establish a focus for the research project or information need. In this stage information seekers can develop an overview of their topic and explore any relationships between this topic and other related ideas or concepts. The Pathways model provides the following description of the Presearch stage:

The Presearch stage enables searchers to make a connection between their topic and prior knowledge. They may begin by brainstorming a web or questions that focus on what they know about their topic and what they want to know. This process may require them to engage in exploratory searching through general sources to develop a broad overview of their topic and explore the relationships among subtopics. Presearch provides searchers with strategies to narrow their focus and develop specific questions or define in-formation needs.

Presearch is one of the most important parts of the research process, yet it is one of the most underused. Often, when students begin a research project, their topic is either too broad or too narrow. They need to use Presearch strategies like building background information, exploring general sources of information, or brainstorming ideas and information about their topic, which can help them develop a sense of the big picture and see some of the relationships between their topics or ideas.

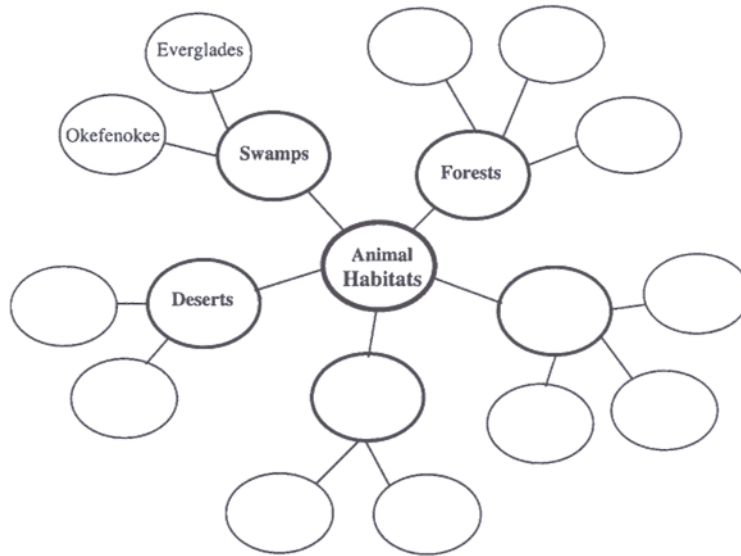
In Scenario 1.2, Tara and Susan knew about some animal habitats but needed more information to see the broad picture of habitats. The subject tree of the electronic encyclopedia provided them with a list of many animal habitats with links to articles that would give them some general background information on each habitat and the animals that live in it.

Often students are trying to find information about a topic that has absolutely no meaning to them. They cannot relate the topic to any prior experience or learning opportunity. Cognitive psychologists tell us that learning takes place as learners make connections between their existing mental schema and the new information just acquired. When that link is not apparent, students can become frustrated. Their research process lacks focus and becomes very inefficient. Students must recognize when this situation has occurred and apply appropriate strategies to help fill that gap between existing knowledge in their schema and a new research topic. One of the best strategies is to look in a general resource like an encyclopedia. A marsh habitat was a new idea to Sara, but she found some general information in the science encyclopedia. Exploring general sources like an encyclopedia or an almanac can be a very useful strategy at this point in the research process. The encyclopedia may only provide learners with a short summary of their topic, but that might be enough to relate the topic to a past memory or experience.

Brainstorming can also be a useful strategy and might be pursued either in a group or individually. As students brainstorm they can create a web (e.g., see Figure 1.1) or develop a list of statements and/or questions about their topic. For example, a KWL chart allows them to identify what they **K**now, what they **W**ant to know, and what they **L**earned about a topic.

Figure 1.1. Animal Habitat Web.

Animal Habitat Web



Throughout this Presearch stage students should be developing questions about their topic that focus on what they want to know or are related to the initial essential question asked by their teacher. Before they leave this stage, students should develop a specific research question or identify an information need. That provides them with a focus for the search process.

SEARCH

Mrs. Hunter's high school health class is studying the effects of alcohol and smoking, particularly on young people. Mrs. Hunter asked the class how the effects of smoking and alcohol abuse influenced the lives of people. These students have been using the Pathways model throughout the year, so they know the stages and strategies fairly well. They began their project by brainstorming a list of questions that might be related to the broad question asked by their teacher. Then they divided their list of questions into related subtopics and formed small groups to gather information. Several students wanted to interview people from a local Alcoholics Anonymous group and the health department.

The students met with the library media specialist to talk about information providers who might have information about their subtopic. They decided that both the public library and the university library might be helpful. Mr. Foster, the school library media specialist, reviewed the use of *SIRS Researcher*. He also suggested that they might find some useful information by using both *Yahoo* and *Google*. Each group had developed a research question and they used a keyword graphic organizer given to them by Mr. Foster to plan specific search strategies. Several students found books in the collection by using the electronic catalog; others used data-bases to find articles in magazines. One student found a collection of fact sheets on addictions on a Web site titled the *Web of Addictions*. Other students called the health department and set up an interview with a social worker. As they began to gather information,

students used the T chart given them by Mr. Foster to gather information about their topic on *one* side of the page and their thoughts and reactions on the other side. As students compared their information in small groups, they discovered that they had some conflicting information about the results of alcoholism. Mr. Foster suggested that they needed to find at least one other source to validate their information.

The function of the Search stage is to plan and implement a search strategy. The Pathways model provides the following description of the Search stage:

During the Search stage, searchers identify appropriate information providers, resources and tools, then plan and implement a search strategy to find information relevant to their research question or information need. Searchers are open to using print and electronic tools and resources, cooperative searching and interaction with experts.

This stage is probably the one element of the process that teachers, library media specialists, and students have emphasized the most. However, technology has greatly changed the search process, and information seekers who do not understand a search process and specific strategies will soon learn that technology, specifically the World Wide Web, can be very frustrating.

Tools, Resources, and Information Providers

Information and resources are available today in many locations beyond the walls of the school classroom and library media center. The learning environment is open, with an array of information providers. It is important for students to consider all potential information providers as they develop a plan for finding information related to their research question or information need. Classroom teachers and library media specialists must assist students in this process. One way to help might be to hold a brainstorming session with students about potential information providers. This list could include local libraries (e.g., academic, public, private), nature centers, historical sites, planetariums, zoos, museums, cable television, and community businesses and industry. Some examples are provided on the graphic version of the Pathways model, but classroom teachers and library media specialists should understand that this is only a representative list. Each local area will have unique information providers that should be considered when students are working on a research project.

In Scenario 1.3 the students in Mrs. Hunter's class discussed possible information providers and identified the local public and academic libraries, the local Alcoholics Anonymous Association, and the health department as potential information providers. These are high school students, so they might make those connections without any facilitation on the part of the classroom teacher or library media specialist. Classroom teachers who have younger students might want to make some initial contacts with these information providers before sending students out to gather information. For example, doctors or social workers in the community might be able to provide some valuable insights into the alcohol abuse problem, but a call from the teacher beforehand might pave a smoother route to an interview.

As students continue to develop a plan for finding information relative to their research question, they also must consider appropriate information tools and resources. The possibilities for resources seem almost limitless in this world of information access

at both the local and global level. However, some resources will be more useful or more available than others. Efficiency becomes an important element in this information-seeking process.

Students should begin with information tools because these tools enable access to information. An information tool might be a catalog (print or electronic), an index, a bibliography, a search engine, a subject tree, or a database. At this point, students are confronted with the issue of which information tool(s) to select. Important criteria to consider are:

Time frame. Is the topic current or historical? Information on current topics will be more readily available in periodicals rather than in books. By the time a book is published, the information is typically more than a year old. Historical information can be found in periodicals but more likely will be available in books. Historical information on the Web is growing through the sites that store the information in primary source documents such as old newspapers, diaries, and maps. Current information can be found by using periodical indexes or databases and Web search engines and subject trees.

Scope and depth. Does the research question require a broad scope or narrow, shallow or deep level of information? Information that is broad in scope and with depth about the topic will more likely be found in a library's book collection. To locate this information, students should use the catalog. Some Web sites will also provide information that is rich and broad in scope. To locate this information, students should use Web indexes, subject trees, and search engines. Information that is shallow or narrow is typically located in general reference resources (e.g., encyclopedias, almanacs, atlases).

Location. Is the topic related to local, state, national, or international issues? Local and state information is typically more difficult to find than national or international information because local information tools are not as readily available. Locally produced bibliographies, indexes, or databases would be useful tools. On a broader scale, using catalogs, indexes, and databases or Web-based indexes, subject trees, and search engines can help locate national and international information.

The students in Mrs. Hunter's class (Scenario 1.3) used both the catalog and periodical databases to find resources about alcohol abuse. *SIRS Researcher* is a full-text database, so the information tool (i.e., the database) and resources are held within the same software.

Information resources include books, magazines, video, film, audiotapes or discs, radio, people, artifacts, Web-based resources, CD-ROMs, multimedia, maps, newspapers, and pictures. Many students have a tendency to begin their search with the Web, but sometimes the best information and the most efficient route to that information are through the use of a book found in the library media center.

Once resources have been located, students need strategies to appropriately use the resources. Students learn to use books at a young age. They learn that books are organized in a linear manner, with pages numbered consecutively and text read in a left-to-right, top-to-bottom sequence. They also learn that a book has a table of contents and

an index, tools to help them locate information efficiently in the book. The index is organized in alphabetical order, another linear sequence. Electronic information is organized in a nonlinear manner using hyperlinks (buttons, hot spots, etc.) that make connections from one page or item of information to another. This nonlinear aspect requires different skills for searching. Regardless of the format, linear or nonlinear, it is important for students to be able to use information resources appropriately.

Another type of information resource is people, including a conversation with parents or grandparents, professional people, fire and safety personnel, students in other places, or experts who communicate through the Web. For example, students in Mrs. Hunter's class interviewed a social worker in the health department of their town. Interviewing is another strategy for effectively using an information resource and requires prior planning and well-developed questions.



Developing Search Strategies for Print and Electronic Resources

People who search for information in the print environment (e.g., books, magazines) use strategies that they have developed over time. For example, many nonfiction books have both a table of contents and an index. Either of those tools is a more efficient way to find specific information within the resource than simply reading through the text from beginning to end. If there are strategies for locating information in print resources, then it is logical that there should be strategies for locating information in the electronic environment. Typically, what information seekers know initially are those strategies used with print resources. That represents their prior knowledge. The search

strategies on the Pathways model begin with those strategies, using the same common language, then extend beyond that to strategies that apply only to electronic resources.

The Pathways model includes four specific search strategies for finding information within print and electronic resources: Explore search, Browse search, Hierarchical search, and Analytical search.

Explore Search

An Explore search is looking, "surfing," and hyperlinking with a general topic. In the print environment, an information seeker might pursue an Explore search by using the table of contents, casually thumbing through records in a catalog with only a general topic in mind, or using chapter headings and subheadings in a book. This method of Explore searching tends to follow a more linear pathway, whereas in the electronic environment the pathway is nonlinear. For example, an information seeker might hyperlink from one Web page or site to another or from one article to another in a CD-ROM resource.

Whether in the print or electronic environment, there is a useful purpose to applying an Explore search for finding information. Typically, information seekers who engage in an Explore search lack focus regarding their research topic. They are more casually interested in the information they might find. Sometimes this is similar to looking through a coffee table book: It's just fun to look at the pictures and enjoy the scenery. This takes on the guise of appreciation, which relates back to the Appreciation stage of the Pathways model. Many people enjoy hyperlinking through Web sites in this manner, indulging their curiosity, and discovering new ideas. Sometimes Explore searching enables information seekers to build background information or make connections to prior knowledge, which are strategies related to Presearch. Sometimes it stimulates redirection of the search topic.

Browse Search

A Browse search is examining a list or index by topic. In the print environment, indexes and bibliographies are fairly common information tools. Both of these information tools are organized in an alphabetical sequence, which is a linear organization of information. To locate information using a print index, an information seeker would look for the subject or word related to the research topic within the alphabetical sequence of words, then use the accompanying page number(s), volume number, or issue number to find the information in book text, specific volume, or magazine. For example, a student in Mrs. Hunter's class might find information on alcohol abuse in several magazines by looking under that topic in the *Readers' Guide to Periodical Literature* (H. W. Wilson). When the subject is found, there might be a list of entries, and each of these entries typically will include the title of the article, author, volume, issue, and page number, which becomes the location information.

The electronic environment also includes indexes, which are usually features in specific resources or separate information tools on the Web. Electronic indexes are lists of titles, subjects, or both arranged in an alphabetical or numerical sequence. Locating information by using an electronic index requires the information seeker to key in a word

or title in a search box or select the appropriate letter from the alphabet, then select a title from the resulting list that follows in the next window or screen. As a feature in an electronic resource, electronic indexing software searches only through the alphabetical list, not through the full text of the resource.

For example, one of Mrs. Hunter's students might have started the information-seeking process about alcohol abuse by looking in the *Grolier's Multimedia Encyclopedia* (Grolier), which has a feature called Browse, to locate some background information (Presearch strategy). This Browse feature is an alphabetical list of article titles that appear in the encyclopedia. A portion of this list is visible in a window on the screen, and the list changes in relation to the topics that are keyed into the search box positioned above the title list window. This feature does not search the full text of the encyclopedia but only the title list.

Hierarchical Search

A Hierarchical search is examining a body of knowledge from a broad concept to a specific topic. There are very few examples of print resources that reflect a hierarchical structure or organization of information. Some science books have sections that show classifications of scientific elements, and the print version of the ERIC Thesaurus is organized in a hierarchical manner. The electronic environment includes a growing number of tools and resources with a hierarchical feature for locating information. Many of these hierarchical features are called *subject trees*, or *directories*. On the Web, examples of directories are *Yahoo*, *Yahooligans*, and *Look Smart*.

To locate information using a Hierarchical search strategy, the information seeker first selects a topic from a list of disciplines or broad subject areas. If the information seeker cannot make that first connection, then a Hierarchical search strategy will not work for her. When that first selection is made, a new screen or window opens, showing another list of more specific topics. This process continues until a list of article titles appears and the information seeker can hyperlink from the article title to the full text of the article. Typically, this process would include a minimum of three window changes.

Several students in Mrs. Hunter's class searched *Yahoo*, a directory, for information on alcohol abuse. On the *Yahoo* start-up page they selected *Health* from the list of general subjects. As new windows appeared, they selected *drugs*, then *substance abuse*, and *alcoholism* from subsequent subject lists that appeared in windows. The last topic selection finally opened a list of articles about alcohol abuse.

Analytical Search

An Analytical search is electronically searching specified or full text using keyword, Boolean, concept searching, and so forth. Analytical search features are feasible only in the electronic environment. Searching through the full text of a print resource and examining the text for a topic is certainly possible, but this process would be time-consuming and not very efficient. Searching through full text for two subjects that are related in a print resource would be almost impossible. Analytical searching features are what make electronic resources so powerful in terms of locating information, especially

when the information seeker is trying to find words or phrases that are related in some way.

Analytical searching is represented on the Web and in CD-ROM resources in a tool called a *search engine*. A search engine is software that looks for specified words or phrases in databases and/or the full text of resources. Search engine software can be part of an electronic resource such as an encyclopedia, periodical database, or full text magazines. For example, *Encarta Encyclopedia* is a full text resource located on CD-ROMs and on the Web. Both versions include a search engine to help information seekers find specific information. Search engines are also stand-alone tools on the Web that enable information seekers to look for specific information located on Web sites. For example, *Google*, *Excite*, and *Alta Vista* are search engines on the Web.

Many electronic resources have features that allow an information seeker to do both a simple and a complex search. A simple search requires an information seeker to key in one word in the search box and then the software examines the text looking for articles containing that specific word. A complex search might be called Advanced, Analytical, or Boolean as a software feature. Regardless of the name, the search feature allows the information seeker to key in multiple words in a search box joined by Boolean operators, typically AND, OR, and NOT. This type of search enables the information seeker to examine text for words that have a relationship. For example, students in Mrs. Hunter's class might want to find information about teenage drinking. If they searched on the topic of *alcoholism* they would find a significant list of articles in their hit list, only a small number of which might be about teenage drinking. However, if they used a complex search with the search phrase *alcoholism AND teenage*, the software would produce a hit list that was limited to articles that included references to both of those topics.

Information seekers and software producers refer to the search engine features of electronic resources by using different names that frequently have the same meaning. For example, people often talk about a *keyword search*. Sometimes this refers to the simple search feature that allows an information seeker to key in one word in a search box. In other situations, the reference is to a Boolean search. There are many similar examples of this confusing use of names for features in electronic information tools and resources, which makes using the software more challenging.

There are a growing number of search engines on the Web today. Consistency of terminology and function does not exist from one search engine to another. Information seekers are encouraged to use the Help features that are usually available with these search engines. If you use specific search engines frequently, you might want to make a print copy of the Help section for easy access to specific instructions. Chapter 4 has more information on using search engines.

Gathering Information from Authentic and Human Resources

Students engaged in inquiry-based learning often discover that they need to gather information from "authentic" sources. These sources include people who are experts in the chosen subject area, community information providers such as a land lab or a museum, or primary source documents (e.g., historical documents, letters, journals, logs,

maps). This type of information access often requires students to be effective interviewers, so they should develop strategies to enable them to gather information from people.

Primary source documents are available from places like the historical society; and a rapidly growing collection is now on the Web. Primary source documents can provide very valuable information, but students must read these documents carefully with the understanding that the use of English is from another time period. Also, students should be aware that documents like letters, diaries, or journals can contain personal biases, so the information should be validated using another source.

Recording Information

The process of recording the information found during a search often defeats students, especially in today's information-rich learning environment. Students need to use the strategies of skimming and scanning to determine if the information they have located is even relevant to their research question or information need. As students attempt to determine this relevance, they should consider whether the information is fact or fiction, the accuracy and currency of the information, and whether the information came from a primary or secondary source. Students may find they need to recheck their information and validate it in one or two other sources. Recording bibliographic information requires students to identify the author, title, publisher and/or journal title, date, etc., so the source of the information is always clear. Many teachers require students to prepare bibliographies of their sources in a specific format based on a style manual.

Note taking is a strategy that can be done in a variety of formats. Sometimes students use the computer and a word processor to take notes. Teachers often request that students take notes using 3-by-5-inch note cards or paper of similar size because the cards can be arranged easily in the order that the information will appear in the finished paper. It is important to remember that not all products today are research papers, which represents a linear organization of information. Teachers might want to provide students with different note-taking experiences so that they have strategies they can apply for the development of a product that is nonlinear. The students in Mrs. Hunter's class are taking notes using a T chart, which is a double-entry draft for recording information (see Table 1.2). On the left side of the paper, students record a summary of their information with at least a limited form of bibliographic information so their source is available. On the right side of the paper, students record their reflections about the information, including any ideas about the relevance of the information to their research question.

Table 1.2. T Chart for Summary and Reflection

Summaries of Notes	My Reflection
<p>Hepatitis can be one result of alcohol and drug abuse. People who have more than two drinks a day often have this condition. (Johns Hopkins Health Information at www.intelihealth.com)</p> <p>Alcohol abuse lots of times leads to other kinds of abuse. (Our school guidance counselor)</p>	<p>Check out what types of drinks cause this. Can two beers a day cause hepatitis? Or do you have to drink the hard stuff?</p> <p>I think Mr. Tomlinson said this when he gave our class the usual speech before homecoming—go see him—see if he has anything to back this up.</p>

INTERPRETATION

SCENARIO 1.4

Mrs. Reynolds's eighth-grade English class is studying mysteries and authors' writing techniques. The class is organized into several small groups, and the students in each group are reading a different mystery written by the same prominent mystery author. They have gathered some information on various techniques and styles authors use within the genre of mystery. Mrs. Reynolds has asked the students to keep a journal of the story elements (e.g. suspects, causes of death, alibis, detective strategies), as well as their reactions to the plot and character development, as they are reading their books.

In class discussions students have questioned the accuracy of some of these story elements, so they spent some time in the library media center trying to find information that would support or refute the statements. Each group created a timeline for their novel to show the sequence of events. They also created a comparison chart that analyzed the suspects and the clues related to each of them (see Figure 1.2). They used the chart to validate the information gathered from each of the characters in terms of conflicting information or supportive evidence for important clues.

Based on the evidence available in these comparison charts, Mrs. Reynolds asked the students to make a prediction about the solution of the mystery at various stages through the reading of the novel. With the final prediction occurring with only 20 pages left to be read. When students had finished reading their mystery books, Mrs. Reynolds asked each group to make a chart that analyzed the writing style and technique used by the author. Students presented this information to the full class using large poster paper so that comparisons could be made among the various books written by this mystery author. They also examined the timelines created by each group, looking for common patterns or themes that might support the notion that the author uses a formula for his or her writing.

Figure 1.2. Character and Clue Comparison Chart.

CLUES	Character #1	Character #2	Character #3	Character #4
1st Clue:				
2nd Clue:				

3rd Clue:				
4th Clue:				
5th Clue:				

The functions of the Interpretation stage are to assess the usefulness of the information and to develop a personal meaning. The Pathways model provides the following description of the Interpretation stage:

Information requires interpretation to become knowledge. The Interpretation stage engages searchers in the process of analyzing, synthesizing and evaluating information to determine its relevancy and usefulness to their research question or information need. Throughout this stage searchers reflect on the information they have gathered and construct personal meaning.

Interpretation is another very critical part of the research process, and, along with Presearch, one that is often neglected. Teachers do engage students in strategies of Interpretation, but this is often pursued in a shallow or hit-and-miss manner. Unfortunately, information seekers mistake information for knowledge; knowledge happens only as an individual constructs personal meaning from various bits of information. The Interpretation stage has less relevance and importance if the student's assignment or project does not require some level of critical thinking. A look-up assignment seldom requires students to engage in critical thinking but rather only to identify facts. The following sections discuss some specific strategies in the Interpretation stage.

Organizing Information

In our information-rich learning environment, students can often find much information about their topic, but the challenge is organizing the information into a frame- work to help them assess the usefulness of that information. The students in Mrs. Reynolds' s class organized the information they acquired about their mystery novel by developing a timeline, a character and clue comparison chart, and a list of story elements.

The timeline and comparison charts are graphic organizers, which can be very useful tools for organizing information. Comparison charts can be set up in columns to com- pare two concepts or in multiple columns to compare a variety of concepts. Sometimes information becomes clearer if it is organized into classifications or

categories. Venn diagrams help students discern how some concepts are related to others or perhaps not related. Another strategy for organizing information is paraphrasing. Teachers are often frustrated with students who simply copy information they find in resources and turn that in as their report. This behavior is enabled by the use of look-up assignments or topic assignments that are very general. Teachers must first set up assignments and projects that are driven by questions that foster inquiry and critical thinking, then require students to record their information by using paraphrasing and a limited number of quotations, which must be referenced with sources.

Higher-Level Thinking Strategies

Interpretation requires higher-level thinking strategies such as analyzing; comparing and contrasting; classifying; evaluating; drawing conclusions; synthesizing; and determining themes, patterns, or trends. These strategies enable students to carefully examine their information and ultimately construct their own personal meaning.

The students in Mrs. Reynolds' s class analyzed the plot elements of the mystery novel they read by comparing the clues that were related to each of the main characters. Their analysis enabled them to uncover differences in the stories told by each of the characters. This analytical process also pointed out similarities in the characters' stories, which required students to decide whether the evidence was substantiating or incriminating. Ultimately, this process can enable students to draw conclusions and make predictions to solve the crime.

The timeline developed by Mrs. Reynolds' s students enabled them to see the sequence of events. A similar timeline developed by character would allow students to uncover controversial evidence from one character to another. Mrs. Reynolds asked her students to evaluate the information they found in the story in the form of clues. When they questioned the accuracy of clues or other plot elements, she asked them to find information that would either support or refute the information used by the author.

At the conclusion of the mystery unit, the students analyzed the plot elements of each of the novels written by the same author, looking for patterns that might suggest the author's writing technique was based on a formula or whether the author is a very creative mystery writer.

Filtering Information

When students evaluate information, they need to apply some filtering strategies that enable them to assess issues such as point of view or bias. Bias is often reflected in information available today, yet students tend to accept information they find as fact merely because it appears in print or on the Web. Requiring students to have two different sources of information to support a perspective they want to use in a final report at least reduces the chances that the perspective is a totally biased point of view. Another strategy is to require students to find information that reflects two or more perspectives on their topic.

It's also important for students to consider that there are several perspectives or

points of view about a subject or a concept and to respect those points of view. When students are asked to solve a problem, often the solution process requires them to understand all points of view and employ compromise and negotiation to develop a viable solution.

Ethical Use of Information

Ethical use of information is founded on the principle of intellectual property rights. Knowledge has become a commodity, and people own the knowledge they have created in the same way individuals or companies own other types of property. The copyright law protects the intellectual property rights of people and companies. This notion of intellectual property as a commodity is going to be common in the world that the young people of today will inherit, so it is very important for students to understand and practice the ethical use of information. This means that when they use text, graphics, sound, pictures, and so forth that others have created, they must give credit to those other authors or creators. It is also important for students to understand that only a small portion of a work can be used without permission from the author or creator.

A part of ethical use of information is using and respecting information in a responsible manner. This strategy also appears in the Communication stage, where students should practice ethical use of information as they complete their projects.

COMMUNICATION

SCENARIO 1.5

Emily, Robin, Dylan, and Tad are working on a project about children in Colonial America. Their teacher, Mr. Pierce, asked them what they thought life was like for children living in the early colonies of America. All the students in the class brainstormed a list of questions they wanted to know about children living in that time, broke their questions into clusters of related topics, and divided into small groups based on those topics. Emily, Robin, Dylan, and Tad chose to research the home life of children in Colonial America, including things like their clothing, the foods they ate, and entertainment.

Each group gathered information and used graphic organizers to organize and analyze their information. As a large group they talked about the best way to present their information. Emily's group decided to create an authentic journal of a 10-year-old girl living in Plymouth Colony. Other small groups decided to write a newspaper and create a diorama. Two groups worked together to write a short skit. Another group focused on schools in Colonial America and decided to create an art exhibit of pictures showing scenes from an early schoolroom.

When the students were finished with their projects, Mr. Pierce arranged for them to present them to *two* other fifth-grade classes that were also studying Colonial America. He told the audience that the students had tried to represent the time period and the experiences of those colonial children in a historically accurate manner. At the end of each small group's presentation, he asked the audience if there was any information they thought was historically inaccurate. The *next* day he asked the students in each small group to do a self- and peer *evaluation* of their projects based on the appropriateness of the format used to present the information.

The function of the Communication stage is to construct and present the new knowledge. In this stage information seekers can apply their information and share their new knowledge. The Pathways model provides the following description of the Communication stage:

The Communication stage allows searchers to organize, apply, and present new knowledge relevant to their research question or information need. They choose a

format that appropriately reflects the new knowledge they need to convey, then plan and create their product.



Applying Information and Sharing New Knowledge

When searchers have gathered information and constructed new knowledge, their next step is to apply that knowledge in some manner. Too often students are led to believe that the conclusion of a project is to write a paper or give a report. It is important for students to understand that their new knowledge may allow them to answer a question or solve a problem.

For the next step of presenting the information to others, students must make decisions about an appropriate format. In many situations, teachers decide the format, but giving students the opportunity to make that decision based on their understanding of the information they want to present and the format that will most appropriately represent the information allows them to apply critical thinking skills. The Pathways model provides a list of formats by categories (e.g., visual, visual/motion, text, oral, and multimedia).

Teachers are encouraged to provide students with learning experiences that will give them the skills to create a variety of the formats shown on the model until students develop a repertoire of these skills through their years of schooling. Initially, younger students could be allowed to choose among a limited number of formats for presenting their new knowledge. As they grow older and more experienced with the production and creation of various formats, their choices will expand until, as high school students, they should be free to make their own decisions. Self-evaluation and teacher assessment of projects should include a focus on the appropriateness of the presentation format.

The students in Mr. Pierce's class made decisions about how they wanted to present their new knowledge about the lives of children in Colonial America. Their choices are interesting because they included text, visual, and oral presentations. The

appropriateness of their format choices was evaluated through both a peer- and self-evaluation process.

EVALUATION

SCENARIO 1.6

Miss Rivard's high school civics class is investigating how the news media influence local and state elections. These students have used the Pathways model for previous research projects and have a good understanding of the process. During one class session they brainstormed a list of potential problems and issues related to the media's role in the electoral process. Students spent some time building background knowledge until they felt they were ready to write their specific research questions. Miss Rivard asked students to keep reflective journals focusing on the information they were gathering and their reactions to that information. She also asked them to keep a log of their research process clearly showing the stages and strategies they followed using the Pathways model.

Working in small groups, the students began to search for information with a strong focus on local newspapers, television, and radio news programs. They interviewed journalists, candidates, campaign managers, and people who were potential voters. Students regularly used graphic organizers and made decisions about which organizer they might use to support various strategies in their process.

Periodically throughout this project, Miss Rivard, and Mr. Quinn, the library media specialist, met with small groups of students to check on their progress. Students analyzed news reports and compared various points of view. Miss Rivard and her students considered the most appropriate format for using their new knowledge, and they decided to hold a debate with students taking opposing sides on issues related to the news media and elections. They invited several members of the news media to be an audience for this debate and asked them to evaluate the results of the debate when it was concluded. The next day, after the debate, Miss Rivard requested that students bring their logs and journals to class. She asked them to write a reflection on their research process, responding to the question, "What were the most challenging parts of this research assignment, and how would you overcome those challenges with another research project?"

The function of the Evaluation stage is thinking about the process and product of a research process. The Pathways model provides the following description of the Evaluation stage:

Evaluation (self and peer) is ongoing in this nonlinear information process model and should occur throughout each stage. Searchers use their evaluation of the process to make revisions that enable them to develop their own unique information seeking process. It is through this continuous evaluation and revision process that searchers develop the ability to become independent searchers. Searchers also evaluate their product or the results of their communication of new knowledge.

Evaluation has typically been regarded as related to student projects, but there has been little focus on their research process. Although self- and peer evaluation of the products that students create is important, equal attention must be given to the process.

Evaluation is a critical part of the research process because information seekers can grow and develop with the process only if they have opportunities to reflect on their research experiences. Learning is a process of building on past learning experiences, reflecting on both successes and failures, and applying that knowledge to new learning experiences. If students are to become independent learners, they must use the Pathways model with many research projects, reflect on their process, and apply the knowledge they gain from each experience to the next project and information need.

Evaluation of process should be ongoing throughout all of the Pathways stages. The students in Miss Rivard's class used journals to reflect on the information they were gathering and the new knowledge they were constructing. They used logs to keep track of their research process. Graphic organizers were available for students at various stages, and both Miss Rivard and Mr. Quinn used these as they facilitated the evaluation process by students. The final reflection question that Miss Rivard asked students to write on caused them to examine the challenges they encountered and to think about other strategies they might use in future searches. The process of reflection is an important part of self-evaluation of process.

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