First Edition

Teaching through Text

Reading and Writing in the Content Areas

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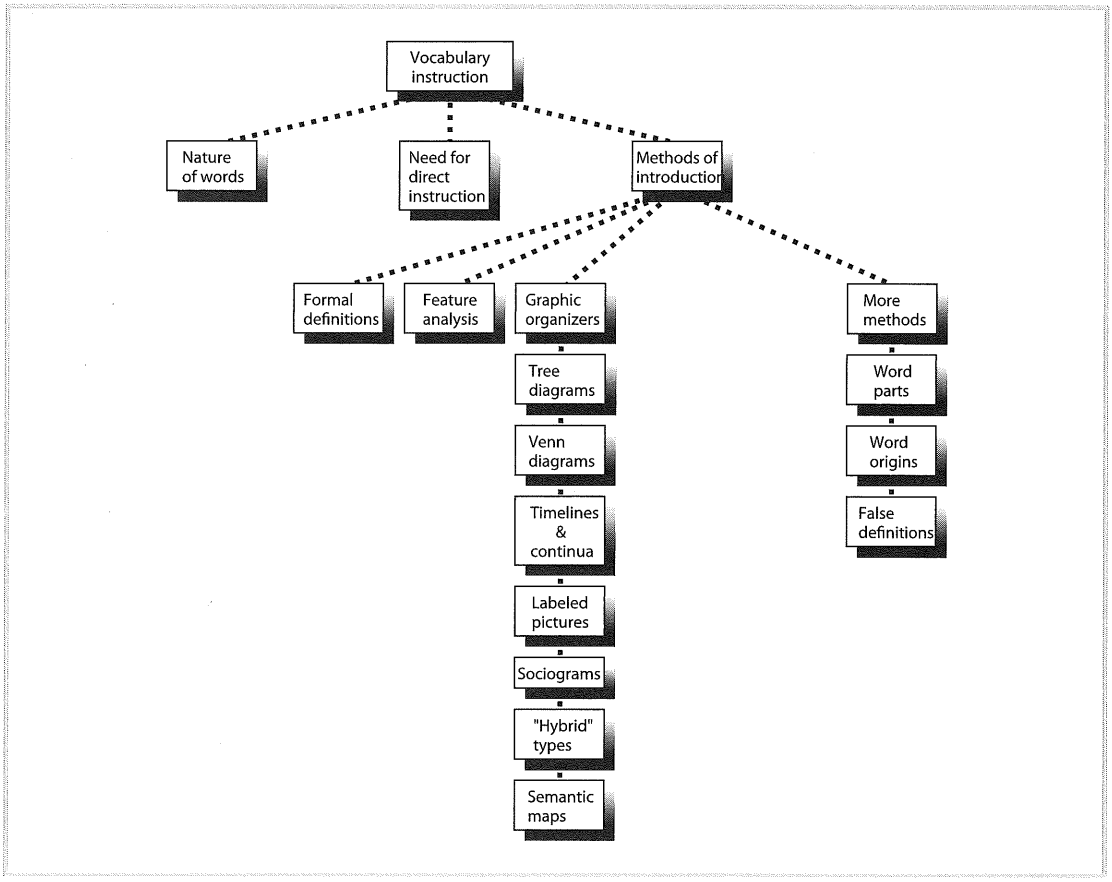
CHAPTER 6

Introducing Technical Vocabulary



The investigation of the meaning of words is the beginning of wisdom.

—Antisthenes

One of the more painful memories many people have of their early school experiences is the vocabulary lesson. You may recall being faced with a list of words and their definitions and being asked by your teacher to associate one with the other. The words may have had little relationship to one another or, if they did, such relationships were lost because the words were presented randomly, in list form. We suggest that the memories of such experiences may be painful because this approach to vocabulary instruction tends to be inefficient and tedious. Research indicates that the most effective methods of introducing new words involve introducing them in groups that share some characteristic or relationship (Blachowicz & Fisher, 2004; McKenna, 2004).

Research has also confirmed the need to introduce terminology before students read, as a means of removing roadblocks to comprehension. No matter which of the global lesson designs you select, there is a place for the introduction of new key words prior to reading. Bromley (2007) underscores the importance of preteaching key words to improve comprehension. However, choosing which words to preteach and how much time to devote to them can be perplexing. Flanigan and Greenwood (2007) suggest that there are four types of vocabulary contained in a reading selection. Some words are essential in order to grasp the meaning of the selection and must be carefully taught before students read. Others are important for comprehension but teachers can get by with introducing them quickly. Still other words will be useful for students to learn eventually, but are not immediately necessary to understand the selection; these can be visited during a postreading discussion. Finally, some words, although rare and unknown to students, are not closely connected to the content of the selection and should not be taught at all. Once a teacher has identified which words to introduce, the key is to employ effective instructional strategies. That is the focus of this chapter.

Let us consider two teachers who are preparing to introduce such terms. One is a language arts teacher who will ask the students to read "The Gold Bug," a short story by Edgar Allan Poe. The teacher carefully lists all the words likely to be unfamiliar to the students—words like *mortification, consequent, palmetto,* and *horticulturists* (all from the first page!). The teacher writes out a brief definition or common synonym for each of these terms and makes a transparency to introduce them to the students. The second teacher is a biology instructor about to assign a chapter devoted to insects. This teacher also looks through the material and lists terms that might be troublesome: *thorax, pupa, antennae,* and so forth.

Although their actions were similar, there is a crucial difference in the lists of words produced by these two teachers. The biology teacher has concentrated on *key* terms, that is, the important new concepts introduced in the chapter. Many of the terms have natural relationships to one another, a feature that makes them easier to introduce, as we will see. The language arts teacher has listed words that, while useful to know, are not central to understanding the story. Moreover, they will prove very difficult to introduce (many transparencies will be needed!) because they lack logical relationships that link them together.

Of course, there is another difference in the assignments about to be made by these two teachers. One assignment is nonfiction, a textbook chapter designed for the specific purpose of introducing important new terms that are linked in meaningful ways. The other is fiction, and its primary purpose is not to instruct. Even in the example of the short story, however, we suggest that there are key terms, concepts so central to understanding the story that they warrant brief discussion by the teacher prior to reading. Such terms would include the names of characters and places as well as any critical words not adequately defined in context.

Our point in contrasting these two teachers is that introducing key terminology during the prereading phase is important for any reading assignment. It is up to the teacher to decide *which* words to present and *how* to present them.

It is impossible to dissociate language from science or science from language. To call forth a concept, a word is needed; to portray a phenomenon, a concept is needed. All three mirror one and the same reality.

ANTOINE LAVOISIER

Objectives

Your reading of this chapter should improve your ability to make these kinds of decisions. Specifically, when you have finished, you should be able to

1. describe the nature and function of words and their relationship to human experience;
2. identify the two elements of a classical definition;
3. incorporate feature analysis into prereading discussions;
4. construct and use graphic organizers of various kinds; and
5. describe the Guided Writing Procedure, List-Group-Label, and other techniques.

The Nature of Words

Words are symbols for concepts. As we noted in Chapter 2, a schema is all the information and experiences that an individual has learned in association with a given concept. Your schema for books includes all your many experiences with having read and used books. It may include a formal definition, and it probably involves emotional associations you tend to make with the notion of books. Such a process, which depends heavily on personal experiences, obviously leads to differing conceptualizations of just what is meant by the word *book*. The written symbol itself does not "carry" meaning; rather, the reader *brings* meaning *to* the symbol (Smith, 2004).

"When I use a word," Humpty Dumpty said in a rather scornful tone, "it means just what I choose it to mean—neither more nor less."

LEWIS CARROLL, *Through the Looking Glass*

Words therefore come to have many associations for us. Those associations concerned with the word's general meaning and which are likely to be shared by most users of the word are said to be *denotative*. The word's dictionary definition is sometimes called its denotation. Associations that are not directly connected to a word's denotative meaning are described as *connotative*. Such associations vary with individuals because their experiences vary. To some, the word *golf* might connote doctors, presidents, and country clubs. To others it might connote frustration, fatigue, and wasted hours. These diverse sets of connotations are not directly connected with what the word *golf* denotes. Both denotations and connotations are very much a part of a student's schema for a given word.

As students mature, their schemata for various concepts develop more fully and new concepts are continually added, each represented by a word. Research into vocabulary knowledge has suggested these rather startling facts:

> There is good reason to believe that the average high school senior's vocabulary is in the neighborhood of 40,000 words. Such vocabulary size estimates imply a tremendous volume of word learning, around 3,000 words per year during the school years. This astounding rate of vocabulary growth by average children sets a mark against which the contribution of any program of vocabulary instruction must be measured. (Nagy & Herman, 1984, p. 6)

If each of these newly acquired concepts were associated with only one visual symbol (word), vocabulary learning would be difficult enough. It is complicated, however, by the fact that many concepts may share the same word. Vocabulary users must be able to distinguish which of several meanings is the intended one, and problems can result when a reader's knowledge and experiences are limited to definitions not intended by a writer. As an extreme case, consider the following:

> When they took their sixth wicket in the 30th over, there appeared to be some hope for Surrey. But when the fly slip couldn't stop Allan Warner's drive from becoming a four, Derbyshire looked in good nick, and Geoffrey Miller's 4-bye in 38 was sufficient to make sure Surrey was pipped at the post. (Margolis, 1990, p. 3)

Unless you happen to be familiar with the game of cricket, this paragraph has little, if any, meaning for you. The reason for the difficulty in understanding the example is not entirely that the vocabulary is unusual; for most readers the example does not bring to mind any previous experiences with the topic being discussed.

Many of the technical terms likely to be introduced in content areas have everyday meanings that can distract and confuse students. Such words as *set, field,* and *ring,* for example, have

highly specific applications in mathematics—meanings that have little or no relationship to their more common ones.

Introducing vocabulary must therefore account for, and build on, the past experiences of students (Stahl, 2004). Techniques must be sought that relate new vocabulary to old and that stress the interrelationships among words. We shall discuss several major techniques for accomplishing this aim, but first it is necessary to dispel a myth that frequently surrounds vocabulary acquisition.

The Myth That Words Teach Themselves

Many adults, including a great many teachers, are convinced that deliberate teaching of new terms is largely unnecessary. This belief may in part be the result of ineffective teaching episodes recalled from past experiences, episodes based on the teaching of words one by one, in relative isolation. They account for knowing so many words by having met each word in their vocabulary countless times in a variety of contexts. They believe that, over a long period, these repeated exposures allow an individual to internalize word meanings.

The difficulty with this notion is that it is partly true. We suggest, for example, that no one directly taught you the word *book,* certainly not by stating its formal definition for you to remember. Instead, you learned what a book is by encountering numerous examples, both physical (that is, books you came across in the real world and that others referred to as books) and linguistic (uses of the word *book* to describe books that were not actually present). By exposure to so many examples of books, you were able to arrive at certain generalizations about what makes a book a book. Your conceptualization became more fully developed with each new example you encountered. This is an *inductive,* or incidental, approach to vocabulary acquisition, in which general rules or characteristics are inferred from numerous examples.

The meanings of many common words are acquired inductively. It may therefore be natural to suppose that such a method is adequate for introducing virtually all new words. That is, it is easy to assume that by providing students with enough contexts (both physical and linguistic) in which a word is encountered, a teacher can assure conceptualization. This assumption has three major difficulties.

First, research has revealed that context is often not very useful in helping students infer new word meanings (Beck, McKeown, & Kucan, 2002). Context is always helpful for narrowing the range of possible meanings a word might have, but it is seldom sufficient to allow a reader (or listener) to conceptualize the meaning of a word not previously encountered.

But in an inductive approach, one can argue, the student is confronted by so many instances that the deficiencies of any particular occasion will be offset by others. The result would be adequate conceptualization. This reasoning leads to the second difficulty: Such conceptualizations are often inadequate, even after innumerable encounters with a word in context. The notion of a book, which we have used as a familiar, thoroughly internalized concept, is probably not rigorously conceptualized at all. You would have no difficulty classifying a hardbound volume like this one as a book, but there are less clear examples that would challenge how precise your idea is. If the cover were removed, would it still be a book? What if the spine were severed so that it became a stack of unattached pages? What about its word-processed form? The content is, after all, the same, but is it a book in that form? Despite your many encounters with the word, the notion of a book remains a bit murky. This circumstance may be acceptable in a case like the word *book*, but with technical terms possessing precise definitions and important features that distinguish them from related terms, this lack of precision is unacceptable.

The last difficulty with the inductive approach is that many technical terms are not encountered frequently enough to expose students to an adequate number of examples. For instance, the following terms, associated with the content of science and art, were estimated by Nagy and Anderson (1984) to occur less than three times in a billion words of text:

ammeter
cyanide
anneal
template
fresco
ventilate

To argue that the student will encounter such words with far greater frequency while studying them in a given course is true, but the number of repetitions needed for induction to occur may still not be reached. (Nagy and Herman, 1985, suggest that twenty contextual encounters with a new word are required for adequate learning to occur.) Moreover, the authors of textbooks used in these courses do not rely on the inductive approach. Rather, they tend to introduce new terms along with formal definitions, an approach we consider in the following section.

Formal Definitions

When a teacher (or text) introduces a new word by stating its definition and then offering examples that may or may not conform to the definition, the approach is *deductive*. In deductive instruction, learners progress from a general rule (in this case, a definition) to the consideration of individual examples (here, encounters with the word in contextual settings).

Aristotle suggested that the formal definition of a noun should contain two elements: (1) the class, or category, to which the concept belongs and (2) specific features that allow us to distinguish examples of the concept from any other member of the category. Consider the following definition of the word *hammer:*

a tool for driving nails

We see that any hammer is a member of the larger category, tools, and that we can distinguish a hammer from other tools by its primary function, driving nails. If other tools were used to drive nails, it would be necessary to add more specific features. Plato, half in jest, once defined a man as simply "a two-legged animal." When a friend good-naturedly pointed out that this definition would not enable him to distinguish a man from a chicken, Plato modified his definition: "a two-legged animal without feathers."

Knowing the nature of formal, or classical, definitions can assist teachers in a number of ways. First, the class and distinguishing features can be identified for the students as the definition is presented. Schwartz (1988) has suggested that content teachers take the few moments required to acquaint students with the two elements of classical definitions (see also Schwartz & Raphael, 1985). Second, students can be asked to *construct* formal definitions once they know the two required components. They begin by selecting the category to which a concept belongs and then proceed to add features that would allow it to be distinguished from other category members. They can then compare their definitions with those of a dictionary or glossary. Finally, knowledge of the classical components of a definition makes possible a number of recent techniques that have proved to be highly effective in the introduction and reinforcement of vocabulary. We now examine these approaches.

Feature Analysis

When introducing a group of concepts, all of which are members of the same category, a teacher can employ an efficient approach called feature analysis (Johnson & Pearson, 1984). This technique makes use of a simple chart, like that in Figure 6.1. In the upper left-hand corner of the chart, the name of the category is written. The category members are written in the first column. Across the top of the chart, the column headings identify various features that each concept might or might not possess. The chart is completed by placing a plus sign (+) in a particular position if the concept in that row has the feature for that column. If not, a zero (0) is indicated. Some teachers find the letter *s* helpful if the concept *sometimes* has that feature.

The feature analysis chart permits comparisons of any pair of concepts by noting features shared, features possessed by only one of the concepts, and features possessed by neither concept. The chart also facilitates the analysis of each feature by considering which concepts possess it (Blachowicz & Fisher, 2004).

The relationship of feature analysis to formal definitions is obvious. Both are ways of considering a concept in relation to its category membership and its key features. From a completed

FIGURE 6.1
Feature analysis chart based on tools

Class: Tools	For driving nails	For inserting screws into wood	For gripping with leverage	For cutting metal	Has c-shaped frame	No movable parts
Hammer	+	0	s	0	0	+
Phillips-head screwdriver	0	+	0	0	0	+
Flathead screwdriver	0	+	0	0	0	+
Hacksaw	0	0	0	+	+	+
Pliers	0	0	+	0	0	0
...						

Note: A plus indicates the tool has the feature; a zero indicates it does not; *s* indicates it sometimes has the feature.

feature analysis chart, definitions of the concepts could actually be written. From Figure 6.1, the following definition of the word *hacksaw* can be composed:

a tool used for cutting metal and consisting of a thin blade attached to a c-shaped frame

This is close to the dictionary definition, though some of the definitions composed from a feature analysis chart tend to be longer and more awkward. Nevertheless, the two required elements are present: the category and the distinguishing features. Definition construction is an excellent writing activity that can be used to follow up a reading assignment that has been introduced by means of feature analysis.

The link between feature analysis and formal definitions has an important implication for determining which features to include in a chart. If any two concepts have the same set of codings (+, 0, and *s*), the chart is incomplete. Note that in Figure 6.1 there is no way to distinguish a Phillips-head screwdriver from a traditional flathead screwdriver. The codings are identical. The chart must be expanded by adding one more feature concerned with the tips of these tools—for example, "has a flat, bladelike end." The coding would then differ for the two concepts.

Feature analysis is not limited to a particular subject or even to technical terminology in the usual sense. For example, a useful chart involving characters from a short story or novel, analyzed by character traits, is quite possible. Such charts are so useful and versatile that we offer a blackline master in Figure 6.2 that can be duplicated as needed.

Graphic Organizers

The term *graphic organizer* has been defined in a perplexing variety of ways (Rice, 1994). We adopt here a rather narrow definition and suggest that a graphic organizer is *a diagram showing how key concepts are related.* While diagrams of this sort have existed for years, Barron (1969) first suggested their use for introducing related clusters of new terms. He viewed the graphic organizer as a streamlined version of the advance organizer, a technique pioneered by Ausubel (1960) and consisting of a prose introduction to a reading assignment. Research has demonstrated that graphic organizers are highly effective devices for helping students understand the relationships among concepts (Baxendell, 2003; Brunn, 2002; Merkley & Jefferies, 2001). In addition, graphic organizers have been used successfully with a wide variety of populations, such as students with various types of language disorders (Ives & Hoy, 2003), physical disabilities (Luckner, Bowen, & Carter, 2001), learning problems (DiCecco & Gleason, 2002), and LEP children (Johnson & Steele, 1996; Webster, 1998). Other beneficial applications

In Chapter 2, we used graphic organizers to depict how a student's schemata for concepts might be represented. Because memory is structured this way, doesn't it make sense to use an instructional technique that builds on that structure?

FIGURE 6.2
Master feature analysis chart for duplication

Feature Analysis Chart

Class:

include improving media literacy (Hobbs, 2001), promoting general vocabulary development (Ainslie, 2001; Allen, 2002), and enhancing comprehension ability (Vasilyev, 2003). It is hardly surprising that the National Reading Panel (2000), in its comprehensive review of research, concluded that using graphic representations of a text's content is a highly effective instructional technique.

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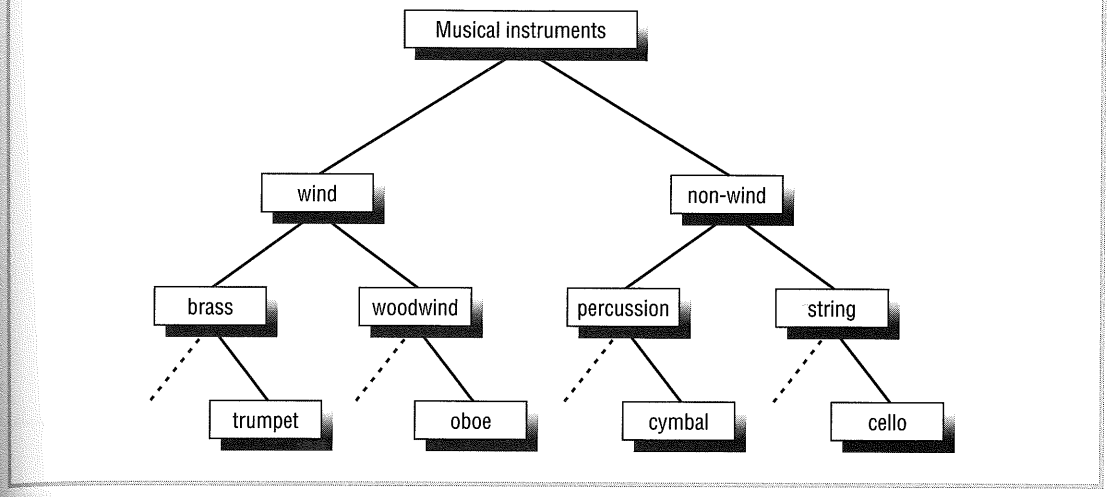
FIGURE 6.3
Graphic organizer: Tree diagram for musical instruments



Types of Graphic Organizers

Barron's (1969) original notion of graphic organizers entailed only one type, the tree diagram. Fry (1981), however, has demonstrated the great variety of diagrammatic forms available. We will consider a few of the most broadly useful types.

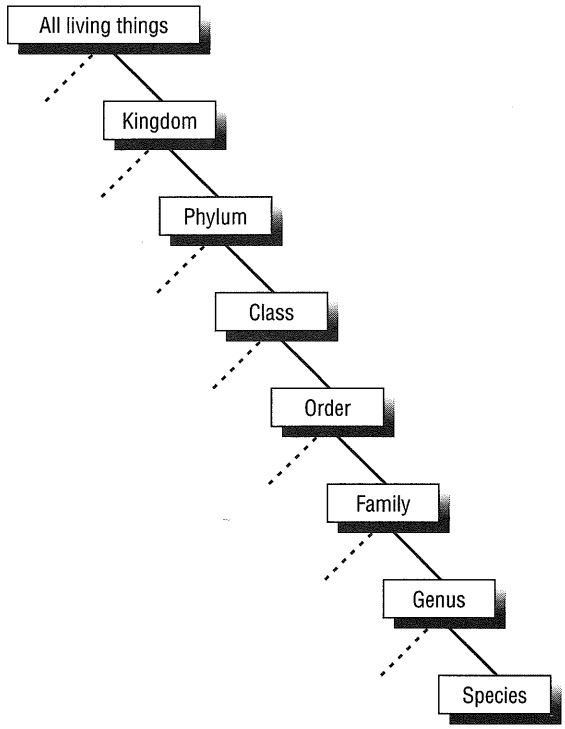
Tree Diagrams. When some of the concepts to be taught represent subdivisions of other, broader concepts, the relationship can be depicted by means of a branching arrangement known as a *tree diagram*. The branching usually runs downward so that one encounters smaller and smaller subdivisions as one moves down the page. (These "trees" grow upside down!) Figure 6.3 depicts how a large concept, musical instruments, could be delineated into subconcepts. (Broken lines indicate undeveloped portions of the diagram.)

Because so many concepts bear this sort of relationship, it was perhaps natural for tree diagrams to be developed first, as a principal type of organizer. Some have argued that much of human knowledge is organized in this hierarchical fashion. Figure 6.4 illustrates how biologists systematize the classification of organisms. It is reasonably clear that semantic memory (our personal store of concepts) is organized as a network of associations that can be diagrammed in this way. The biology teacher who constructs a portion of Figure 6.4 on the chalkboard to introduce a new plant or animal is actually providing instruction that is consistent with the nature of memory. Imagine how useful such a framework might be to the student struggling to relate species after species encountered in class.

Venn Diagrams. When concepts cannot be broken down cleanly into narrower concepts—that is, when overlapping is possible—a Venn diagram may be helpful in depicting the relationships (Moyer & Bolyard, 2003; Padak, 1997; Tompkins, 1998; Yopp & Yopp, 1996). This device is borrowed from mathematical set theory and employs overlapping circles to represent related concepts. Figure 6.5 illustrates the relationship between liberals and Republicans. An individual can be classified in one of three ways: (1) as a non-Republican liberal (the left-hand crescent), (2) as a nonliberal Republican (the right-hand crescent), or (3) as a liberal Republican (the overlapping, football-shaped intersection). If it were not possible to be both a liberal and a Republican, a tree diagram would be more appropriate because the two Venn circles would not overlap.

To illustrate this difference, consider a science textbook chapter on birds. Assume that the author has employed a very simple organizational pattern in which each species is discussed in succession. If we choose two of the concepts (say, turkeys and robins), we might depict the relationship by means of the simple tree diagram in Figure 6.6. The division is clear-cut in that it is

FIGURE 6.4
Graphic organizer: Tree diagram for biological classification system



impossible for a bird to be both a turkey and a robin. If we used a Venn diagram, the result would be Figure 6.7, showing lack of overlap.

A special kind of Venn diagram is useful in depicting concepts that are contained (or "nested") within other concepts. Figure 6.8 illustrates the nested nature of number systems, for example. It is true that we could have used this arrangement in our bird example, as in Figure 6.9, but the nested Venn diagram is useful primarily in cases of *successively* nested concepts, as in the case of number systems.

FIGURE 6.5
Graphic organizer: Venn diagram for liberals and Republicans

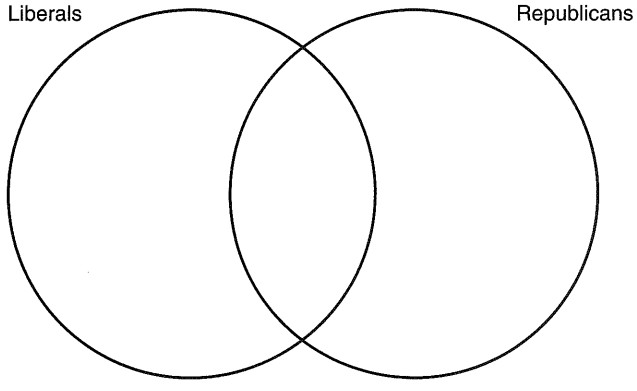


FIGURE 6.6
Graphic organizer: Tree diagram for birds

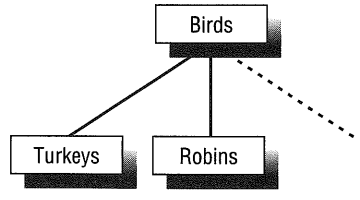
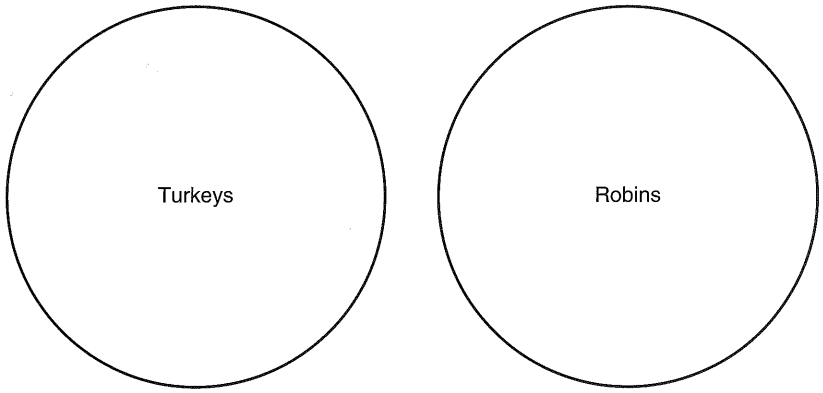


FIGURE 6.7
Graphic organizer: Venn diagram for birds



Timelines and Other Continua. When concepts are related along some linear dimension, they can be effectively presented by means of a very simple organizer. Timelines (Parker & Jarolimek, 1997), such as the one depicted in Figure 6.10, are appropriate whenever the terms are related by chronology. When specific dates are known, the timeline can be marked off accordingly. When they are not known, as in a novel, a timeline can still be used to sequence the key events (see Figure 6.11).

FIGURE 6.8
Graphic organizer: Nested Venn diagram for number systems

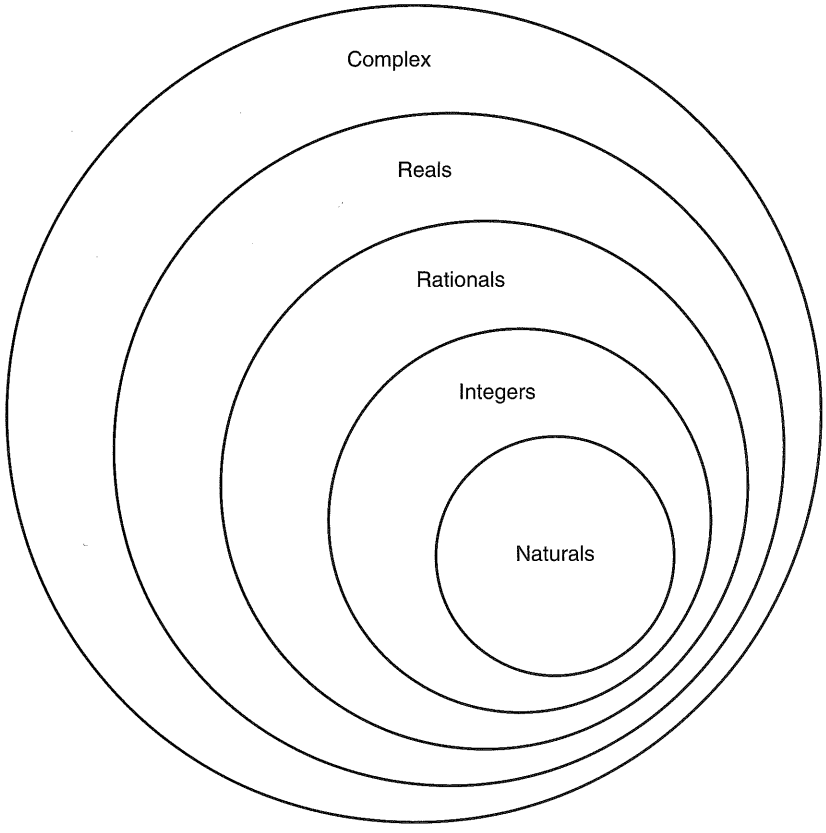


FIGURE 6.9
Graphic organizer: Nested Venn diagram for birds

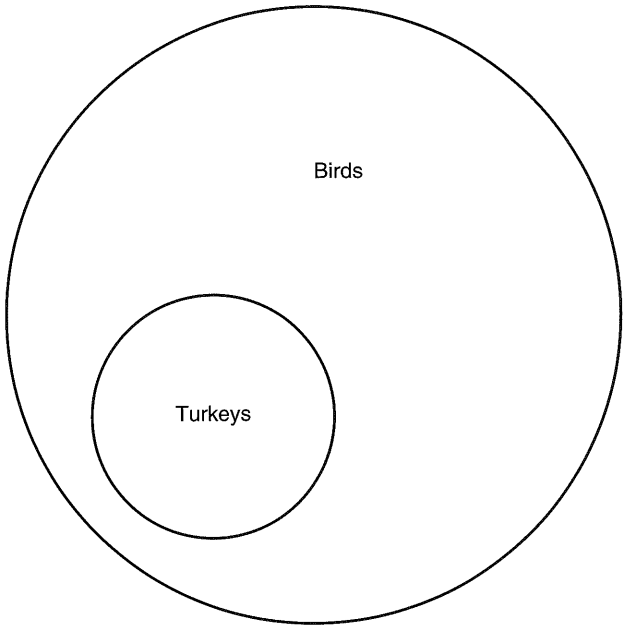


FIGURE 6.10
Graphic organizer: Timeline for World War II

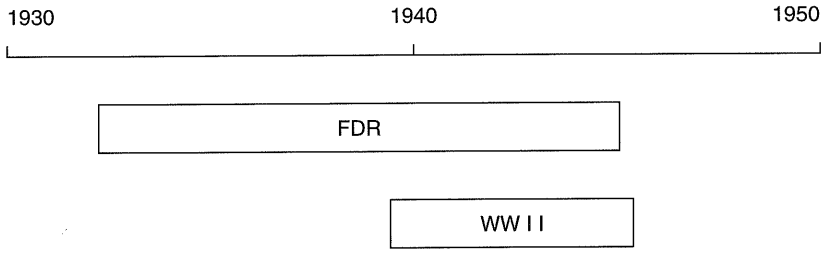
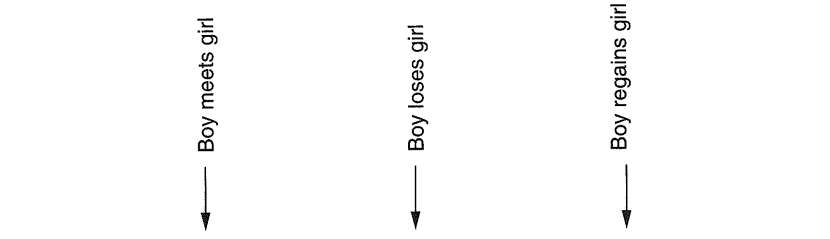


FIGURE 6.11
Graphic organizer: Timeline without specific dates



Variations of timelines depart from the traditional left-to-right straight-line arrangement. Figure 6.12 illustrates how the biology teacher we described at the beginning of the chapter might have presented one cluster of closely related terms. Figure 6.13 exemplifies a variation of the timeline developed by computer scientists: the flowchart. Flowcharts are useful whenever decision points are encountered in a repeatable process.

FIGURE 6.12
Graphic organizer: Variation of a timeline

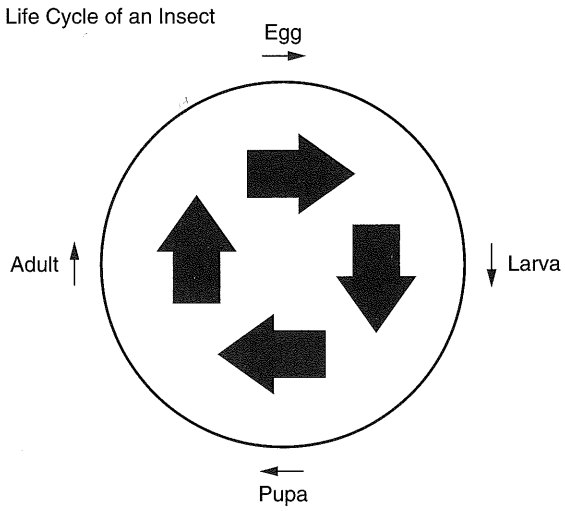


FIGURE 6.13
Graphic organizer: Flowchart for a mathematical process

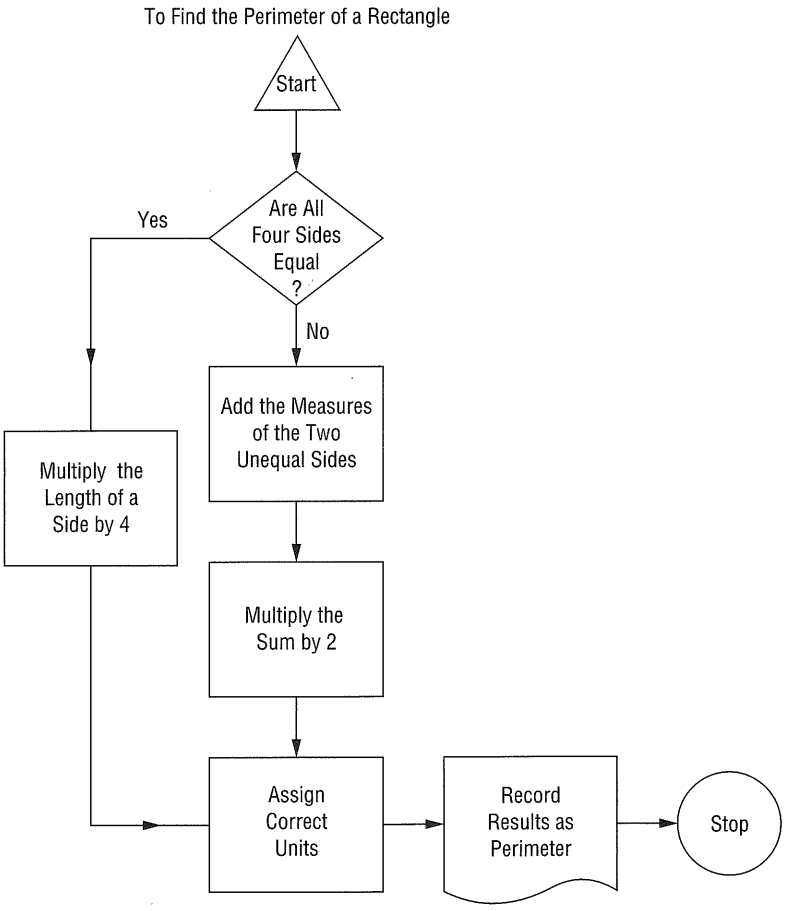
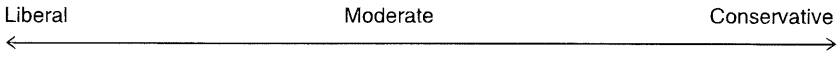


FIGURE 6.14
Graphic organizer: Continuum showing political orientations



Turn back to the Saffir-Simpson hurricane chart in Chapter 5. Would the information have been presented more effectively in a straight-line scale?

Straight lines (surely the simplest type of diagram!) can be used to represent nearly any continuum and are not limited to time. Figure 6.14 is sometimes used by social studies teachers to introduce the concepts associated with political philosophies. Well-known politicians might be added to the scale at points determined by the students to be appropriate. A music teacher developed the "speedometer" depicted in Figure 6.15 to demonstrate the distinctions among the Italian terms used by composers to indicate the pace at which a piece is to be played. The diagram was posted as a reference chart on the band-room wall behind the podium. Finally, Figure 6.16 is a straight-line scale used in classifying minerals by their hardness.

Labeled Pictures. When a cluster of terms is related chiefly by the *location* of the things to which they refer, a picture with the terms as labels can be highly effective. Consider again the biology teacher preparing to assign a chapter on insects. Some of the terms to be introduced may represent the main body parts of any insect. The labeled picture in Figure 6.17 presents these terms in an extremely efficient way.

We suspect that the oldest form of graphic organizer is a map. Note that maps serve the function of graphic organizers perfectly: They present key terms (the names of places) in a diagram depicting their most important interrelationships (location). Imagine the task of converting all the information contained on an ordinary highway map into the form of prose. Volumes would be required!

Sociograms. When the terms to be introduced represent people or groups of people linked by social relationships, a sociogram can be used to depict these relationships diagrammatically. Figure 6.18 contains an organizer often used by social studies teachers to convey how the system

FIGURE 6.15
Graphic organizer: A musical "speedometer" (some elements omitted)

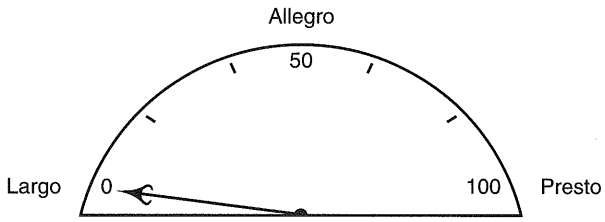


FIGURE 6.16
Mineral hardness scale used by geologists

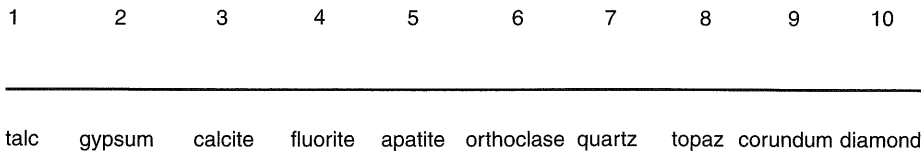
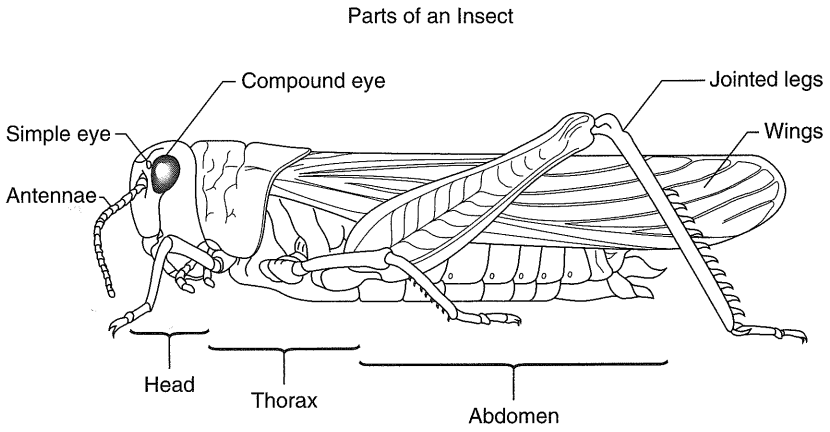


FIGURE 6.17

Graphic organizer: Labeled picture for parts of an insect



of checks and balances operates among the three branches of government. The arrows represent methods of exercising power or influence. Sociograms vary widely in nature but are always designed to depict some form of social relationship. The organizer used in Figure 2.1 (page 16) depicts a very specific relationship linking a reader and a writer in the social process of written communication.

"Hybrid" Types. Some graphic organizers combine the characteristics of more than one basic type. The family tree in Figure 6.19, for example, is an effective combination of basic types of organizers. The organizer has the appearance of a tree diagram (it is a *family* tree, after all), but it differs from most tree diagrams in that large concepts are not delineated into narrower components. It is, in some respects, a timeline since the generations progress in time from top to bottom, but it is also a sociogram in that it portrays familial relationships. In constructing a graphic organizer, it is less important to stick with one of the conventional types described here than to produce a diagram that effectively communicates the relationships that link concepts.

Semantic Maps. A more open-ended approach to graphic organizers is the semantic map (e.g., see Johnson & Pearson, 1984; Stahl & Nagy, 2006). Open-endedness means that students contribute to the map as it is being constructed by the teacher on a chalkboard, overhead, or wall chart. Stahl and Vancil (1986) offer a description of how semantic maps are used (see Figure 6.20).

FIGURE 6.18

Graphic organizer: Sociogram for checks and balances among the three branches of government

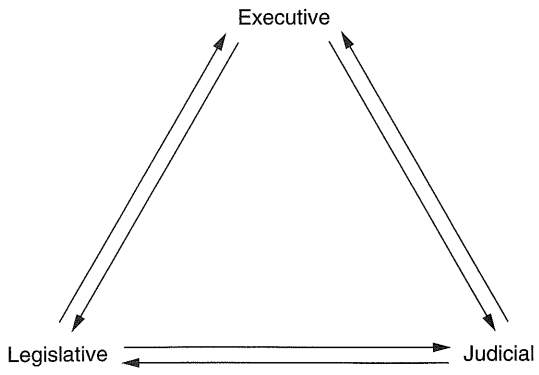


FIGURE 6.19

An American family tree: Part timeline, part sociogram, part tree diagram!

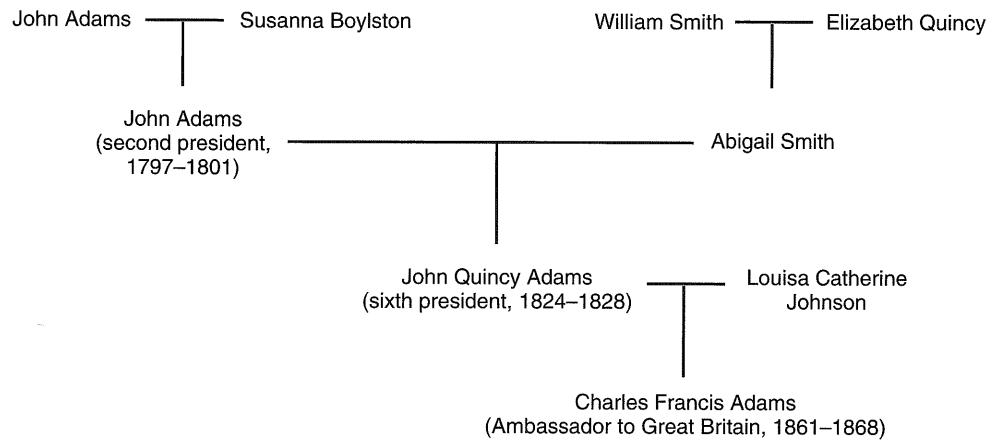
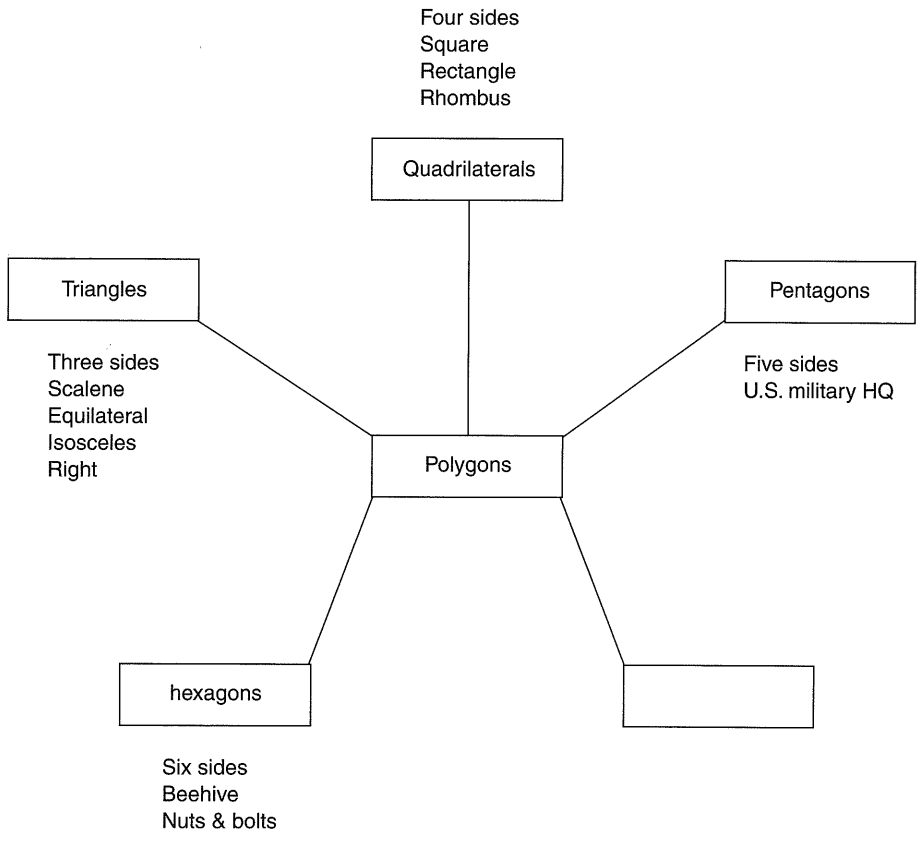


FIGURE 6.20

Semantic map for polygons



The teacher first directly teaches the words in boxes. The semantic map is then built during class discussion. The words outside the boxes are contributed by the students. Some of these (e.g., isosceles, rhombus) might have been taught during previous lessons. The blank box may be contributed by the students as well (e.g., heptagons).

In semantic mapping, a teacher chooses a key word and other target words from material that the students will read. The key word is listed on the board and students are asked to suggest terms associated with the key word. The teacher writes the suggested words in a list on the board as the students suggest them.

From this list, a map is constructed. The relationships between the key word and the target words are discussed thoroughly. Students are then asked to try to categorize each section of the map.

A copy of an incomplete semantic map is next handed out to the students. They are asked to fill in the words from the map on the board and any other additional categories or words they can add. . . .

The reading is assigned, with instructions for students to work on their maps during reading. After reading, the maps are discussed once more and new terms and categories are added.

In the map shown, the categories and boldfaced words were provided.

The other words listed were student contributions and their relation to the categories and the boldfaced words were discussed in class. The blank category was filled in by a number of students after reading.

Semantic mapping offers an interesting alternative to the use of preplanned, conventional graphic organizers. It has the advantages of encouraging student involvement during the introduction of words and of helping students discern relationships between new terms and those previously encountered (Avery et al., 1997; Lipson, 1995; Parker et al., 1996; Stahl, 1999; Zapprich, 1997). Not surprisingly, the research base underlying semantic mapping supports its effectiveness (Avery et al., 1996; Johnson & Steele, 1996; Lipson, 1995; Rosenbaum, 2001; Webster, 1998).

The freewheeling nature of semantic maps offers a unique advantage as well. In addition to the vital links between the target word and its category membership, other associations can be attached as offshoots of the diagram. A word's connotations, for example, as supplied by students, can be added. The result, admittedly, can be a cluttered, weblike maze (semantic maps are often called webs), but they act in much the same way that a spiderweb traps insects: The more strands the insect touches, the less likely it is to escape. Similarly, the more associations a teacher can provide for a new word, the more likely it is to remain in the student's memory.

Recall that in Chapter 5 we stressed the usefulness of analogies in linking the new with the known. We hope our own analogy comparing semantic maps with spiderwebs illustrates their power.

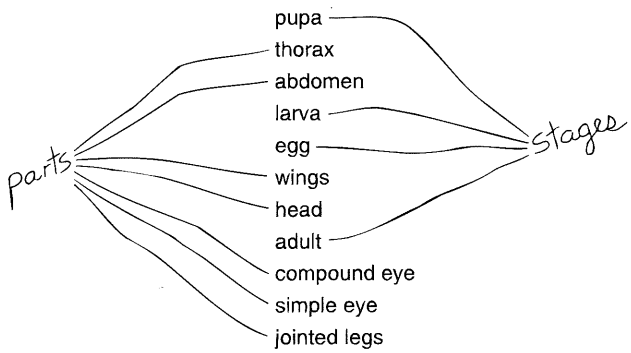
Constructing Graphic Organizers

Many textbook authors have begun incorporating graphic organizers and other aids into prose material. In these cases it is merely a matter of discussing the diagram with students before they read (Fiderer, 1998; Readence, Moore, & Rickleman, 2000). Where no organizer exists, one or more can be developed easily, and we offer the following steps.

1. *Make a list of key terms.* Such a list may have been produced by the textbook authors, but it may be necessary to construct one. Do not be concerned with how long the list becomes. In fact, it is a good idea to include terms introduced in previous lessons that bear directly on the new content. The biology teacher discussed earlier might have produced the following rough list:

pupa
thorax
abdomen
larva
egg
wings
head
adult
compound eye
simple eye
jointed legs

2. *Identify clusters of highly related terms.* Go through the list and mark terms that are highly related to one another. You may have several clusters in the overall list constructed in Step 1. The idea is to construct a graphic organizer for each cluster (or for those clusters that organizers might in your judgment help to teach). Attempting to construct a single organizer that incorporates all of the terms from the master list is nearly always a mistake, because the interrelationships are too varied and complex. Simple diagrams are almost always more effective than complicated diagrams. The biology list would have been earmarked into clusters as shown:



3. *Choose a diagram type that reflects how the clustered terms are related.* Study each word cluster. Ask yourself what the chief relationship is that links the terms together. The answer to this question will suggest the type of diagram that will be most useful in communicating this relationship. If the terms are related chronologically (steps in a process, phases, events), a timeline is called for. This is true for one of our biology clusters; the result was Figure 6.12. If the terms represent people, groups, or institutions, a sociogram may be best. If the terms are hierarchically related, so that some are components, aspects, or examples of others, a tree diagram is suggested. When the terms are spatially related, a labeled picture (such as the one in Figure 6.17) is called for. This brief analysis is essential to the construction of a straightforward organizer that efficiently conveys the most important relationships.

Presenting Graphic Organizers

A sizable body of research has determined that graphic organizers are highly effective tools for helping students understand the important relationships that exist among technical concepts (Dunston, 1992). Researchers have therefore often looked at how best to use organizers. (The question of *whether* to use them has been answered affirmatively!)

Moore and Readence (1980) observed that while graphic organizers are effective devices for introducing vocabulary prior to reading, they may be even more effective when used *after* reading; accordingly, we reconsider their use in Chapter 11. Of course, these uses do not preclude one another: An organizer used to introduce terminology could be revisited following reading.

Darch, Carnine, and Kameenui (1986) contrasted the use of graphic organizers with groups of students and with individuals. They observed that group settings produce the best results, perhaps because of the contributions students might make to the *discussion*. Stahl and Vancil (1986) found indeed that discussion is a critical component during the introductory process. Students must become involved with the organizer—cognitively engaged in considering what it conveys—in order for learning to be maximized (Dinnel & Glover, 1985).

Reinking (1986) has indicated the need of some students to learn exactly what graphic aids are for. Teachers should not take for granted that an organizer, perfectly comprehensible to them, will be equally meaningful to their students. A few moments spent explaining how an organizer "works" and what its purpose is will be time well spent.

In summary, we offer the following tips regarding the most effective uses of graphic organizers:

1. Keep them simple.
2. Discuss them thoroughly while you present them.
3. Include previously encountered terms where appropriate.
4. Be flexible in using them before or after reading—or both.
5. Make use of organizers developed by others.

Writing with Graphic Organizers

Constructing a graphic organizer is an excellent means of preparing to write. Because the diagram depicts important relationships among concepts, the student's task is to note those relationships and turn them into prose. There often is a close connection between a graphic organizer and one of the organizational patterns presented in Chapter 5. For example, Figures 6.10, 6.11, and 6.12 consist of timelines, and the Time Order pattern would be useful for writing a summary of the diagram's content. A student might organize a summary of Figure 6.12 like this:

Stage 1	Egg
Stage 2	Larva
Stage 3	Pupa
Stage 4	Adult

A few sentences would then be devoted to each stage. Another good example is the semantic map represented in Figure 6.20. This diagram suggests a Systematic Listing pattern. The student might write about each type of polygon, but not at random. It would be better to start with triangles and then add to the number of sides (quadrilaterals, pentagons, and so forth).

Centering a short writing activity around a graphic organizer presented in class is a good first step toward content area writing. The next step is to encourage students to rough out their own graphic organizers in a situation in which they are asked to write but do not have an organizer already in hand. A teacher must first model how to construct graphic organizers and then how to convert them into prose.

Additional Methods

The techniques we have presented thus far are nearly always useful, regardless of the nature of the material to be read. We now offer some approaches that will occasionally be appropriate, depending on the specific vocabulary to be introduced.

Word Parts

Many words, especially technical terms, were originally coined by combining familiar word elements from Greek and Latin. In mathematics, for example, the family of polygons is made up of words containing clues to the number of sides: *triangle, quadrilateral, pentagon, hexagon,* and so on. The terminology of the entire metric system was similarly constructed from these and other word elements.

When a teacher takes a few seconds to discuss a word's structure, the connection between the word and its meaning is strengthened. The language arts teacher who writes the word *autobiography* in parts on the chalkboard, and then discusses its meaning in terms of these parts, has given students an added tool for remembering and understanding. Of course, not all words lend themselves to this sort of structural analysis; stay alert for those that do.

Word Origins

Most words have historical sources in languages no longer spoken. Tracing their origins through linguistic antiquity has little to recommend it as a means of sparking the interest of students, but some words are different. These words have engrossing, sometimes fascinating, stories that can assist students in learning their meanings.

Some words are based on the names of people (e.g., *chauvinist, einsteinium, pasteurize, decibel, hertz, diesel,* and *sideburns*), whereas others are based on the names of places (*francium, tuxedo, bayonet, hamburger, limerick*).

Some words—called *portmanteaus,* or blends—are combinations of other words:

smog	=	smoke + fog
lox	=	liquid oxygen
bit	=	binary unit
brunch	=	breakfast + lunch
motel	=	motor hotel

Assisting Students with Special Needs

Which Vocabulary Techniques Work Best?

Introducing key terms prior to reading assignments can effectively enhance the comprehension of *all* students. However, some of the techniques presented in this chapter have been shown to be especially useful with poor readers. Outstanding examples are feature analysis (Bos & Anders, 1990) and graphic organizers (Horton & Lovitt, 1989; Langer, Bartolome, & Vasqueze, 1988; Torgesen & Kail, 1985).

Several possible factors may explain the effectiveness of these techniques. Poor readers tend to decode slowly and to direct their attention and effort toward word recognition rather than meaning construction. Diagrams and charts, although rich in meaning, require little effort to "read." In addition, the content presented in many assignments tends to be abstract and difficult to visualize. Charts and diagrams provide a means of envisioning concepts and their interrelationships. Finally, poor readers often do not recognize the need to organize concepts. To combat this tendency, Tobias (1982) recommended techniques that make concept organization clear and salient. Feature analysis and graphic organizers do exactly that.

Portmanteaus have an important significance for teachers in content areas because a surprisingly large number of new technical terms are deliberately coined in this manner (Simonini, 1966). For a discussion of these interesting words, see McKenna (1978).

In Chapter 5, we discussed anecdotes as a stimulating way of building prior knowledge. Stories about words like *tank* represent a specific kind of anecdote.

A few words have unusual stories associated with their origins. When a new type of heavily armored vehicle was shipped from England to the Continent in World War I, these vehicles were packed in huge wooden crates commonly used for shipping benzene tanks. For security reasons, the word *tank* was painted on the side of each crate. The name stuck.

Discussing word origins does more than increase student interest and engagement. It adds connotative associations to the denotative values of words. The web of meanings for the new word becomes stickier! Locating words with unusual origins is easy. While books on word origins are available, there is a simpler way. All standard dictionaries include an etymology for each word as part of the entry. The *etymology,* or history of the word, is usually in brackets. While most etymologies recount the evolution of words from dead languages, brief anecdotes are also included when the origin is more colorful.

False Definitions

Common words are occasionally "redefined" by skillful writers in ways that are thought-provoking and often humorous. Consider a few of these false definitions drawn from a variety of content areas. (In the case of *hammer,* contrast Bierce's definition with its real definition, given on p. 82!)

hammer	an instrument for smashing the human thumb (Ambrose Bierce)
government	the worst thing in this world, next to anarchy (Henry Ward Beecher)
football	committee meetings, called huddles, separated by outbursts of violence (George Will)
esophagus	that portion of the alimentary canal that lies between pleasure and business (Ambrose Bierce)
engineering	the art of doing that well with one dollar which any bungler can do with two after a fashion (Arthur M. Wellington)
literature	news that *stays* news (Ezra Pound)
mathematics	the science that draws necessary conclusions (Benjamin Pierce)
science	an exchange of ignorance for that/which is another kind of ignorance (Lord Byron)

circle	the highest emblem in the cipher of the world (Ralph Waldo Emerson)
GOP	Grand Old Platitudes (Harry Truman)
grammar	that which knows how to lord it over kings and with high hands makes them obey its laws (Molière)
education	what survives when what has been learnt has been forgotten (B. F. Skinner)

False definitions have the form of real definitions and are therefore useful in making contrasts with their dictionary counterparts. As in the case of word origins, they are peripheral to teaching denotative meanings but add additional associations that may help students retain the actual meanings. Any book of quotations can be scoured for quips that have the form of classical definitions; also, McKenna (1983) has compiled an entire volume devoted exclusively to false definitions.

SUMMARY

An important part of teaching in content areas is the introduction of new concepts, represented by words. Vocabulary instruction is complicated by the fact that the same visual symbol (word) can represent numerous concepts and that what a word formally signifies (what it denotes) is only one of many associations a reader may have for the same word, including what the reader may have experienced in regard to that concept (what the word connotes). Many teachers assume that as students are exposed again and again to a given word, the word's meaning will be acquired inductively. However, while this process may occur to a degree, the precise meanings of key terminology often need to be explicitly taught through a more deductive approach.

Numerous methods have been developed for introducing new words. One of the most effective is feature analysis, which involves construction of a chart in which the left-hand column lists category members and additional columns represent various features either possessed or lacked by the members.

One of the most important advances in our ability to introduce new words is the graphic organizer, a diagram that depicts relationships among key terms. Major types of organizers include tree diagrams, Venn diagrams, timelines, labeled pictures, and sociograms, although many others are possible, including combination (hybrid) types. Semantic maps are a modified form of graphic organizer with a more freewheeling structure conducive to student input. To construct a graphic organizer, students first list all key terms in a selection, then identify clusters of closely related terms, and finally construct a diagram for each cluster that best represents the relationship among the terms.

Numerous other techniques have been used successfully to introduce new terminology, either alone or in association with the techniques previously mentioned. One approach is to analyze words on the basis of meaningful word elements (prefixes, suffixes, root words, etc.). Another approach is to explore the historical origins of words whenever the origin offers insights into a word's meaning or provides an additional colorful association that may create an interest in the word *and* improve the chances that students will retain it. False definitions are quotations from writers who have offered their own renditions of what certain widely used words mean. These "definitions" can provide the basis of useful contrasts with the word's denotation.

Getting Involved

1. For each of the following sets of terms, select the most appropriate type of graphic organizer. Choose from among the following types:
   a. timelines and other continua
   b. tree diagrams
   c. Venn diagrams
   d. labeled pictures
   e. sociograms

1. cats, tiger, leopard, jaguar
2. adulthood, infancy, adolescence, childhood
3. cerebrum, cerebellum, cranium, brain stem
4. fuselage, wing, rudder, tail
5. generals, presidents, Grant, Lincoln, Lee
6. student, teacher, principal, superintendent
7. cars, U.S. cars, foreign cars, Japanese cars, Saab, Honda, Ford
8. Republicans, Democrats, conservatives
9. general practitioner, specialist, referrals, consultations
10. red, blue, yellow, orange, purple, green, brown

There is often more than one way to depict a cluster of terms using a graphic organizer. The following answers are *suggested* for the sets of terms presented above:

1. b, 2. a, 3. d, 4. d, 5. c, 6. e, 7. b, 8. c, 9. e, 10. c

For additional practice, try actually constructing the diagrams for these clusters.

2. Figure 6.21 provides an incomplete feature analysis chart based on the instructional techniques described in this chapter. Use the codings +, 0, and *s* to complete the chart, based on your knowledge of the techniques.

3. The following words are drawn from a variety of subject areas. Each has an interesting origin that is provided in the etymology section of a standard dictionary entry. Choose the words associated with your own area and look up their histories in a dictionary. Don't be surprised if you find yourself looking up *all* the words!

sandwich	gorilla	transistor	saxophone
Teflon	quark	boycott	crowbar
nylon	googol	agnostic	Dixie
scuba	Pacific	bazooka	forsythia
quasar	magenta	braille	poinsettia
shrapnel	silhouette	radar	laser
bikini	badminton	calico	damask
marathon	plutonium	uranium	bloomer
derringer	gardenia	sousaphone	bolt
watt	zinnia	good-bye	gas
blurb	bleacher	boondocks	cowlick
dynamite	goatee	hydrogen	iron curtain
jackrabbit	jeep	serendipity	spoof
teetotaler	zilch	yippie	jumbo

For additional reading on the educational uses of word origins, see McKenna (1977a).

FIGURE 6.21
Feature analysis chart for selected chapter terms

Class: Vocabulary introduction devices	Type of graphic organizer	Used only with highly related terms	Developed by Aristotle	Most open-ended of organizers	Helps categorize terms by class and characteristics
Timeline					
Word parts					
Formal definition					
Semantic map					
Venn diagram					
Tree diagram					