CHAPTER 6

From: "Teaching College Freshmen": book → "Classroom Assessment Techniques"

Presenting and Explaining

For most of our students and for many of us, teaching is lecturing. That equation makes sense if the aim is to transmit information that students are to remember for an exam; research indicates that the lecture is about as effective as other teaching methods when recall of information is tested. The lecture, however, turns out to be less effective than other methods when instructional goals include retention of information beyond the end of the course, application of information, development of thinking skills, modification of attitude, or motivation for further learning (Bligh, 2000; McKeachie, Pintrich, Lin, and Smith, 1986). In short, there is more to effective teaching than lecturing.

We titled this chapter "Presenting and Explaining" to put the lecture in its proper place as a method for presenting information that students are to remember, explaining by way of example, and demonstrating how one might use the information to solve a problem or think through a variety of situations. Presenting and explaining are rarely sufficient if the goals call for understanding or thinking, but a clear explanation or demonstration is often a good place to start instruction.

Before suggesting some things we might do to improve our presentations, we explore briefly how the mind works—or at least how psychologists currently think the mind works. A passing acquaintance with the research on cognition sheds some light on what our students are doing (or should be doing) while we are presenting, and it lays the foundation for recommendations to follow. Because our discussion is necessarily brief, we suggest consulting other sources for additional information (J. R. Davis, 1993; Leamnson, 1999; McKeachie, 2002; McKeachie, Pintrich, Lin, and Smith, 1986; Norman, 1982; Zull, 2002).

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How We Process Information and Construct Meaning

We do not see things as they are or hear things as they are said. Instead, we catch bits and pieces, work them over, and reassemble what registers on our senses. To use the metaphors that currently dominate discussion of learning, we *process information* and *construct meaning*, and apparently we do so in stages. We will talk about the process in three stages, an oversimplification but one our colleagues have found useful in planning their classes.

Our first encounter with new information occurs through the senses. Zull (2002) opens his discussion of the biological processes involved in interpreting sensory information by proclaiming "How sense-luscious the world is!" (p. 135). We are talking metaphorically rather than biologically, but the idea of a sense-luscious world is a good reminder that at any moment we experience many more sights, sounds, and sensations than we are capable of interpreting. Learning requires that we ignore some of these stimuli, and how we do that has been the focus of much research. In brief, it appears we have complex filtering systems that enable us to ignore stimuli unrelated to our immediate concern and focus only on relevant information. Students are largely in charge of what they focus on, but we can help them by directing their attention to goals, stressing relevance, minimizing distraction, and presenting the same information via multiple sensory registers.

If we can get students to attend to our presentation, our next concern is with the processes that enable students to remember. Here, a distinction between short-term memory and long-term memory is helpful. Short-term memory, or working memory as it is sometimes called, keeps information temporarily in mind while we try to make sense of it and decide what to do with it. Short-term memory, however, is severely limited in the amount of information it can hold—usually not more than seven-plus-or-minus-two pieces of information. Also, information cannot be stored there for long; we have only a few seconds to make some sense of it before we lose it.

A simple experiment illustrates both the limits and the possibilities for short-term memory. Show this sequence of thirteen letters to a few colleagues: SATIQGPAABCDF. Let them look at it for a few seconds, and then ask them to recite the sequence. Chances are good that they will not be able to repeat the sequence accurately. Then, repeat the experiment, but present the letters in this way: SAT IQ GPA ABCDF. Most faculty will exhibit perfect recall of the sequence because the information is organized into "chunks" that are meaningful to them.

By presenting the information in chunks, we reduce the load on short-term memory from thirteen pieces of information to four. Be-

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cause the chunks already have meaning for most faculty, it takes only a few seconds to make sense of them. A word of caution is in order here because we sometimes forget that meaning does not reside in the content itself. Those of us schooled in American education systems quickly make sense of SAT and GPA, but those sequences of letters may have little or no meaning to faculty in other educational systems. The same is true for students. Meaning resides in the *relationship* between new material and what they already know.

If new information in short-term memory has meaning or can be made meaningful, it is transferred to long-term memory. Long-term memory is somewhat like the filing system many of us use. We collect ideas and information, put them in a file, and affix a label indicating the file's contents. Barring flood, fire, or a compulsion to clean, those files and their contents are there forever. In theory, we should be able to pull out their contents whenever we need them, months or even years later. In practice, however, we do not label our files very well and rarely cross-reference the content, so often we cannot find information when we want it. Eventually, we may forget it is even there. Information in long-term memory may suffer the same fate. If it is "filed" in isolated bits, chances of remembering it are not good. Worse, if we never or seldom use what we learned, whatever tenuous connections exist in long-term memory tend to weaken further and make access to information even more difficult.

To illustrate what this looks like in instruction, think about an all-too-typical class week. We present and explain new information or ideas in one class, include several good examples to demonstrate processes and importance, and give a summary at the end of class. In the next class, we pose a question or problem intended to review the content of the previous class, a good practice before moving on to new content. Unfortunately, students respond as if it is the first time they have encountered such a task. They seem not to know where to start. Prompts and hints appear not to help. If our review takes the form of a quiz, some students complain we never taught them how to answer such questions or solve such problems. These are not good signs; they suggest students may be storing information and ideas in isolated files that can only be accessed if a new task, problem, or question is identical to or closely resembles those presented during instruction.

In contrast, if the information in long-term memory is organized around meaningful concepts and if those concepts are connected, the chances of remembering information and procedures substantially increase. When we encounter a new problem or question, we recognize some cue that prompts us to recall one of those interconnected concepts. The concept we initially retrieve may not be the one we need, but one thought leads to another and eventually we find the needed information. In short, our ability to think and solve problems depends a great deal on whether the information and ideas in long-term memory are interconnected.

How, then, can we prompt students to make those connections? Here, the research that distinguishes between surface processing and deep processing is helpful. Ideally, students are actively involved in *deep processing* of new material. They integrate, elaborate, and extend new ideas by connecting them to what they already know, considering them in other contexts, thinking of new examples and applications, noting similarities and differences. Along the way, students reconsider previous experience and prior learning, see new meaning in those events and ideas, and revise how they have interpreted or connected them. Students who engage in these activities are more likely to see the need for and remember information across a variety of contexts and problems.

Unfortunately, students—and this may be especially true of first-year students—often take a *surface processing* approach to learning instead. They set out to learn information exactly as it is presented. They memorize phrases and definitions verbatim. They consider only those examples and problems that the instructor happens to present. They do little to elaborate and extend the meaning of ideas or to relate them to what they already know. Some students take this approach because it is the only one they know; others make a conscious or quasi-conscious decision to do so. They explain: "I'm not interested in this subject; just tell me what I need to do to pass"; "I'm overwhelmed this semester, so I need to focus on courses that are important and do the minimum in others"; "It's impossible to learn everything in this course, so I just try to get what I think will be on the test." Whatever the reason, students who adopt a surface learning approach store information in long-term memory, but the information is inaccessible unless the prompt to retrieve it—the question, problem, or context—closely resembles that presented during discussion. (For more detail on surface and deep approaches to learning, see Marton and Säljö, 1984.)

In the end, students determine how involved they will be in elaborating the meaning of ideas and connecting them with other information stored in long-term memory. We cannot do these things for them, no matter how good our lectures. As we present material, however, we can inhibit or encourage students to process information at these deeper levels.

Avoid surface; adopt deep processing/learning

Suggestions for Presenting and Explaining

Many of our suggestions for presenting and explaining boil down to two connected pieces of advice: avoid practices that lead to surface processing, and adopt practices that promote and support deep processing.

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Abandon the Nonstop Fifty-Minute Lecture

This may be the most important thing we can do to improve learning, but even the most well-intentioned of us find it hard to give up the nonstop lecture. Our content is important, and we can cover a lot of it in class if we are not interrupted. Most of us will, of course, acknowledge that it makes no sense to cover material if students do not understand it and do not remember it. Nevertheless, covering content is a powerful drive, and it often rules the day—usually at the expense of activities that would result in greater learning.

Compulsion to cover so much material in class is usually counterproductive, but it is especially destructive in a course with first-year students. Lecturing without pause tends to reinforce the passive-listening, verbatim note-taking, and superficial information-processing strategies that many students bring to college. Students must learn course content, to be sure, but first-year students also need to be weaned from their conviction that material cannot be important if it is not covered in class. For our part, we must give up the belief that students cannot learn it unless we say it. Once students develop the deep-processing strategies noted earlier, they are able to get more from reading and process information faster during a lecture. Meanwhile, we should restrain our inclination to cover everything in class and abandon those nonstop lectures.

We make more productive use of class time if our presentation lasts no more than ten or fifteen minutes before we allow time for students to work with the ideas presented. Wilbert McKeachie (2002) reports research indicating that attention increases during the first few minutes of a lecture but students' minds begin to wander after about ten minutes. Daydreaming is sometimes the lure, but students often tune out because the information is coming too fast and there is no time to think. Indeed, most of us have found ourselves not hearing what a speaker is saying because we were thinking about an idea presented earlier.

Ten minutes is usually enough time to introduce a concept or procedure and give an example or two. Then students need time to think about the ideas—to summarize the material in their own words, come up with their own examples, or try using the ideas to solve a problem or analyze a situation. Once students have tried their hand at working with the material, we can come back to elaborate and extend or move on to the next topic.

Define Objectives

After identifying two or three topics to be explained in class, we need to decide what students should be able to do with the information. Do they merely need to remember definitions, procedures, factual

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information? Should they be able to recognize new examples or illustrations? Will they be asked to use the information somehow? A clear vision of what students should be able to do with information presented indicates what the presentation itself must include and points to the questions, problems, or tasks that should follow.

Plan an Introduction

A good introduction captures students' attention and focuses it on the objectives, usually in that order. Getting students' attention is no small challenge, but the problem with many lectures is that they do not play to curiosity. They jump to a conclusion, solution, or resolution before raising the issues, posing the problem, or identifying the conflicts. Students have no time to become curious or see how course material relates to things about which they are already curious. If they did, students would pay more attention.

Opening with a problem, question, quandary, or dilemma is one way to capture attention. If the problem is grounded in student experience, all the better. There are a variety of ways to do this. For example, start with something students take for granted and confront them with information or observations indicating things are not so obvious or certain as they initially appear. Present a list of incongruous facts or statistics, and ask, "How can this be?" Show an experiment or a film clip and ask, "What is going on here?" Remind students of a campus incident or current event and promise that the day's material will shed some light on it.

Introducing a topic

The first order of business is to get students' attention; the second is to focus it on the objectives. Knowing what they are expected to do with information presented in class influences how students listen to a presentation. Most first-year students assume that they will be asked to recall the information, so they go to great lengths to get it all down in their notes, and they memorize every definition, example, and detail presented. Many students assume this is all there is to it. They do not attend to our instructions on how to recognize or use the information in a new context, nor do they engage in the thinking activities—extending, elaborating, relating—that we have developed to help prepare them to cope with new problems or situations. If we tell students what the objectives are for each class, what they should know and what they will be asked to *do* with what they know, we take a first step toward transforming how they listen to the lecture and think about the ideas presented.

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Highlight the Major Points

Key ideas may be obvious to those of us who have worked with the material for years, but they are not obvious to beginning students. At least once, we all should try asking students at the end of class to jot down the main ideas discussed that day. The results may be shocking, but they are instructive. Students have trouble distinguishing generalization from example, conclusion from evidence, trend from isolated event, the main idea from the details that surround it. If the examples, evidence, isolated events, and details are vivid and compelling, as they should be, students are even more likely to forget what is being exemplified. The ability to sort out these things comes with experience with the subject matter. In the meantime, students lament after an exam that they "studied the wrong things." Outlining key ideas on the board or in presentation software, reviewing them periodically, and summarizing them at the end of class are all good strategies for highlighting major points. It also helps to label explicitly the various parts of a presentation: generalization, examples, conclusion, evidence, and so forth.

Select Appropriate Examples

Much of what we learn is by way of example, illustration, or demonstration. Indeed, some evidence suggests that what we retrieve from memory is not the description of a concept or principle. Rather, we recall some prototypical example or image and use it to reconstruct the appropriate definitions and relationships (Norman, 1982; Park, 1984; Zull, 2002). Good teachers know the power of a telling example, and they go to great lengths to find one. Several things merit consideration in selecting examples.

First, it is crucial that the examples and illustrations in fact embody the key ideas students are to remember. Examples should clearly depict the characteristics that define a concept; demonstration should clearly show how principles or laws look in action; models for problem solving or reasoning should clearly indicate critical considerations and procedural steps. We cannot afford to settle for examples, illustrations, or demonstrations that miss or muddy some critical point; our students are using these examples to construct the prototypes they store in memory.

Second, explanation should begin with relatively clear-cut examples and gradually introduce more complex and subtler illustrations. Our first task is to show the key properties or relationships. If the early examples are too complicated, abstract, or unfamiliar, students get lost in the complexities and lose sight of the key ideas. On the other hand, if all the examples and problems are simple ones, students will not learn to handle more complex situations.

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Third, examples, illustrations, and problems should come from a variety of situations and settings. Our hope here is that if students see a few good examples or illustrations, they will be able to transfer their learning to new situations and problems. It is an optimistic hope because the research shows that not much transfer of learning occurs even in the best instructional circumstances. It appears, however, that students' ability to transfer their learning improves if the examples and problems used during instruction sample the range of contexts in which we expect them eventually to use the information.

Fourth, most of us underestimate the number of examples and illustrations that students require. The concepts and relationships we teach are highly complex, abstract, and usually unfamiliar to our students. Yet we often assume our students will understand them after seeing two or three examples. Eventually, when we give an assignment or an exam, we discover how foolhardy those assumptions are. How many examples and illustrations do students require? Obviously, the answer depends on the nature of the material, and it differs from student to student. One way to find out if students have seen enough is to pose one more example and ask them to explain how it illustrates a concept or how they would solve the problem. If they cannot do it, they need more illustrations and practice.

Finally, we should have available in our notes a few more good examples than we anticipate using. Many of the best instructors tell us they spend much, if not most, of their preparation time on examples. Having a sufficient number of good examples avoids the embarrassment of being unable to produce one on the spur of the moment if needed or of creating one that confuses or misleads rather than clarifies.

Discuss Examples

It is important for us to state explicitly how examples, illustrations, and demonstrations relate to the broader generalizations they are intended to exemplify. Students need help in recognizing how particular examples embody the characteristics of conceptual categories—what features of a painting make it an example of Impressionist art, what specifics exist in a novel that lead us to call it an initiation story, why we classify a chemical reaction as oxidation-reduction. In the absence of these explicit cues, students may attend to other details in the example, mistakenly take them as the characteristics that define the concept, and miss entirely the points we regard as important. Similarly, our students often get so caught up in watching us solve particular problems that they miss the problem-solving procedures and steps that we intend to demonstrate. Presenting the example, illustration, or demonstration is an important step. Explaining how the particular relates to the general increases the likelihood that students will get the point.

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Use Visual Aids

Many of us have learned from experience that audiovisual aids are helpful both in holding student attention and in explaining difficult material. Neuroscience research underscores the importance of such aids. Zull (2002) recommends that whenever possible we convert ideas into images because they are the easiest thing for the human brain to remember. Further, he suggests that playing to multiple senses helps strengthen the interconnection in long-term memory. Current technology offers many more practical options for audiovisual aids than were available a decade ago, but not all of us need to be producers of high-tech multimedia. Simple outlines, diagrams, flow charts, and concept maps help to highlight key ideas and show their relationships. Slides, videotapes, and films present examples far more vividly than does verbal description alone. A single slide can lend visual focus in defining a concept; a series of four or five can trace a course of events. Videotape, DVDs, and film offer ways to bring life outside the classroom into it, magnify the microscopic, quicken or slow the pace of time. Students learn more from watching an experiment run than from hearing it described. We know, of course, that searching for visual aids is time-consuming, and there is often a significant initial investment in preparing them for classroom use. Many, however, can be used for several semesters, and given their impact on students it is usually worth our trouble.

struggle to find that "perfect clip"

Guide Note Taking

By and large, first-year students are not good note takers. They furiously try to get down every word spoken and are so desperate to have an exact transcript that they often ask us to repeat relatively unimportant details. Yet if we ask them about an important point just made, they often cannot answer. If we chance to look at their notebooks, the errors and omissions are disturbing. The only thing more depressing than their lack of skill in taking notes is their belief in them. Some students measure learning by the number of pages filled in their notebooks. Comments such as "The course was good; she gave a lot of notes" are not infrequent on course evaluations. Because people do not generally abandon bad habits until they have better ones to replace them, telling students to stop taking verbatim notes is likely to go unheeded. We will have more success if we think in terms of weaning first-year students from verbatim note-taking habits. To that end, here are some things to try.

First, present a skeletal outline of the main points covered (point by point as you come to them, or all at once at the outset) and allow time for students to get the outline in their notes. The outline supplies the basic structure first-year students need.

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Second, pause from time to time and ask students to paraphrase what they have written in their notes in their own words, as if they were telling a friend—to rewrite a definition, restate a relationship, retell an example. First-year students often find this difficult to do, and they will need more time for it in the beginning. However, the time is well spent. Paraphrasing is a step toward making material meaningful, and developing this skill increases understanding and retention.

Third, encourage students to elaborate their notes by completing thoughts such as "Another example of this might be . . ."; "The last time I saw a problem like this was . . ."; "I remember talking about this issue with . . ."; "This information might explain why. . . ." When we prompt students in these ways, we encourage them to forge a connection between new material and what they already know—another step toward meaning, understanding, and retention. Several of the writing-to-learn techniques discussed in the next chapter are also useful in helping students develop better note-taking strategies.

Attention to how students take notes is important not so much because students need to have good notes. They do, but if that were all then we could simply hand out copies of *our* notes—a practice we do *not* recommend (except for students with specific disabilities) because it promotes even more passivity on the part of students. Our primary interest in student note taking is that the activity is a means to engage them in processing information more deeply. (For a more detailed review of the research on student note taking and additional suggestions, see DeZure, Kaplan, and Deerman, 2001.)

Check for Understanding

Because our aim in presenting and explaining is to develop better understanding, it makes sense for us to stop now and then to see whether or not students *are* understanding. Pausing to ask, "Are there any questions?" is better than nothing, but not much. For students to respond to this invitation, they must both recognize that they have not fully understood and also be able to formulate a question quickly. Our carefully planned and smoothly presented explanations tend to lull students into complacency. Not until later, when they review their notes or try an assignment, do they realize that they have missed or misunderstood something critical. Students and the instructor lose time and energy in having to go back over material explained two days or two months earlier.

Instead of asking, "Are there any questions?" we might better assess students' understanding if *we* ask the questions. For example, to determine how well students understand a concept, we might say: "We have gone over several examples. Look at one more and tell me whether it illustrates this concept and why." If we want to know how

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ready students are for independent practice in problem solving, the check for understanding might begin: "We have worked through several problems. Now you try one just to make sure you understand." When students try to answer questions on their own, they frequently discover that things are not so simple or so obvious as they thought and that they do not fully understand after all. At that point, they may be ready to respond to our traditional invitation, "Are there any questions?"

Summarize Often

Sometimes a lecture tailored for a particular class of students is clearer and more understandable than a text, but only if we compensate for what is lost as students listen to rather than read an explanation. In reading, students control the pace of ideas, stopping often to retrace their steps—to look more closely at an idea passed by quickly, to reassure themselves that they read it right the first time. In listening to a lecture, however, students do not control the pacing or retracing. They may stop to think (at least the best ones do) but the presentation continues. Students miss a phrase here, a sentence there, and sometimes even a whole paragraph. They need to go over it again, but in a lecture they cannot scan a paragraph or turn back to a page. They can only hope that we will repeat the information and review the important points. Frequent repetition and periodic summaries throughout a presentation help compensate for not having pages to turn back.

importance of summarizing.

Summarizing at the end of class is also important. Although time seems to pass more quickly as the class session draws to a close, we cannot afford to run out of time before drawing things to a conclusion. If we do not supply a concluding summary, we can probably expect to hear students say "The class was interesting, but I didn't see the point" or "There was a lot of discussion, but we didn't really learn anything." A strong conclusion does three things. First and most obviously, it reviews key points, issues, and ideas—the scaffolding for organizing more detailed information and ideas. Second, a concluding summary reminds students what they should be able to *do* with the information now that they have heard it. Finally, a strong conclusion includes an assignment designed to give students practice in doing whatever it is they should be able to do.

In *Learner-Centered Teaching*, Maryellen Weimer (2002) makes a good case for asking students to take over learning tasks such as summarizing a lecture or other instructional activity. Though acknowledging that many students are not very skilled at summarizing, she reminds us that this is an important learning skill that students need to develop if they are to be lifelong learners, and she warns that students are not likely to develop the skill simply by watching their instructor summarize. We agree and think first-year courses can be a good training ground for practicing and developing such skills.

We might, for example, use the last five or ten minutes of class to ask students to review their notes and list the main ideas discussed that day. Earlier we noted that instructors who ask students to identify the main ideas are often shocked to discover how student lists differ from one another's and from the instructor's. Building in feedback on students' attempts at summarizing is important, at least at first. Asking students to compare their lists with those of one or two people sitting next to them is a way to provide feedback and a correction mechanism. Collecting a sample of student summaries, presenting them at the beginning of the next class, and asking students to compare the summaries in their notes with those presented can work both as feedback on students' summaries and as a review of the previous class.

Assess Learning and Request Feedback Frequently

Students can be of great help to us in determining what is working in class and what might merit more of our attention. Taking five minutes at the end of class to ask students to summarize the ideas presented, solve a sample problem, or apply information to a new situation is a good strategy for finding out what students understood and what they did not. We do not need to do it every class, but collecting such feedback from time to time is useful in tracking student learning.

Similarly, asking students to take five minutes to write their reaction to the day's class and doing so several times during the semester can help us determine what we might do to strengthen our instruction for a particular class of students. Exhibit 6.1 presents a questionnaire that our colleagues have found useful in collecting feedback from students. They like this questionnaire for several reasons: it focuses on a single class, it takes only five minutes to complete, it can be used several times during the semester, and it elicits feedback about several of the issues discussed in this chapter.

A Look Back and Ahead

This chapter offers suggestions for presenting course material in ways that are likely to enhance student understanding and ability to recall information. Our suggestions are grounded in research on learning, which we summarized in metaphorical terms at the beginning of the chapter with a note acknowledging that the biological processes involved in learning are far more complex than our discussion revealed. Many of our colleagues have found this metaphorical discussion

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Exhibit 6.1. Class Reaction Survey

I would like to know your reactions to today's class. Please read each of the statements below and circle the letter corresponding to the response that best matches your reaction in today's class. Your choices are:

a. No improvement is needed. (Terrific! This works for me. Keep it up.)
b. Little improvement is needed. (Maybe a ragged edge or two, but don't lose any sleep over it.)
c. Improvement is needed. (Not awful, but this merits some attention.)
d. Considerable improvement is needed. (This is causing me problems. Please help.)

Today, the instructor

a b c d 1. Limited what was covered to a manageable amount of material

a b c d 2. Made it clear why the material might be important

a b c d 3. Told us what we would be expected to do with the material (memorize it, use it to solve problems, or whatever)

a b c d 4. Highlighted key ideas or questions

a b c d 5. Presented plenty of good examples to clarify difficult material

a b c d 6. Provided enough variety to keep us reasonably alert

a b c d 7. Found ways to let us know whether we were understanding the material

a b c d 8. Helped us summarize the main ideas we were supposed to take away from class

a b c d 9. Let us know how we might be tested on the material

a b c d 10. Provided exercises or an assignment so that we could practice using the material

11. What is your overall rating of today's class?

A Excellent B Good C Satisfactory D Fair E Poor

12. What made you rate today's class as high as you did?

13. What kept you from rating today's class higher?

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helpful in designing instruction, and it suited our purpose for discussing effective lecture practices. As we look ahead to several chapters devoted to additional strategies for engaging students actively, we need to discuss more concretely the biological processes involved in learning.

Learning involves physical changes in the brain. To discuss those changes, we need to talk about *neurons*, the basic cellular unit in the brain. In the process of learning, neurons bud and grow *axons*, which connect to other neurons and form connections or *synapses*. Offering a glimpse of how amazing all this is, Robert Leamnson (1999) notes that "neurons in the embryonic brain are crudely programmed . . . to divide and spread out in rough patterns until there are a hundred billion of them, more or less" and that in the normal adult "one neuron has a thousand connections to other neurons" (p. 12).

Initially, the connections between neurons are tenuous, and they degenerate if not used. If those connections are used repeatedly and in a variety of situations, however, they become familiar and almost automatic pathways—the neural rendition of "one thought leads to another" and the neural argument for "practice makes perfect." This process does not occur quickly. As Leamnson points out, "Even with the best of intentions, students cannot produce in one pass the hard-wired circuitry that makes a concept familiar" (p. 16). This is the rub. Too often, first-year courses proceed at a pace that permits only a brief encounter with the concepts and theories of a discipline.

The biological changes involved in learning that endures require students to repeatedly practice recalling ideas, their connections, and their many applications. These activities are so important for learning that we devote our next several chapters to the discussion of strategies for engaging first-year students in those critical practices.

For Further Exploration

- Bligh, D. A. *What's the Use of Lectures?* San Francisco: Jossey-Bass, 2000.

  Donald Bligh presents perhaps the most comprehensive and detailed discussion of lecturing tasks and techniques. Topics include lecture organization, making a point, providing reasons and explanations, student note taking, preparing and using handouts, obtaining feedback, and incorporating other methods when lecturing is not enough.

- Svinicki, M. D. *Learning and Motivation in the Postsecondary Classroom.* Bolton, Mass.: Anker, 2004.

  Marilla Svinicki summarizes current research and theory about learning and motivation and discusses implications for college teaching and learning. The book is organized around the kinds of learning emphasized in college and draws on several theoretical perspectives to inform recommendations for teaching.

- Zull, J. E. *The Art of Changing the Brain: Enriching the Practice of Teaching by Exploring the Biology of Learning.* Sterling, Va.: Stylus, 2002.

  James Zull, a biologist, states at the outset that learning alters the brain and suggests that understanding the biological processes involved in learning can aid selection and understanding of best practices. Zull describes the brain and the biological processes involved in learning in clear, nontechnical language.