# 1 | Conceptual Learning and Detail Worrying

*There is no point in lying here any longer*, you think while staring across the room at the bright numbers of your alarm clock. It's 6:30 a.m., and your alarm isn't set to go off for another fifteen minutes. But you can't fall back to sleep. You're too excited. Today is your first day of medical school class! Coursing energy propels you through your morning routine. You triple-check your backpack before you leave home. "Can't ever have too many highlighters, right?" you mutter to yourself as you head toward the door. You're comforted by the thought that you might reach school early.

Then you're there.

You knew you would get to class early, but this early? It's 7:00 a.m., and class doesn't begin for another hour. Of course, being early is better than being late, but what are you going to do with all this downtime? *Well, at least I'll get a good seat*, you think. As you enter the lecture hall, you see half your fellow classmates are already seated and chatting. "Why is everyone here so early?" you say under your breath. Your plan to sit in the front row has been dashed as it's filled save for those awkward seats on the end that nobody wants. You nestle into the fifth row, next to someone you met at orientation. The conversation quickly moves to how early each of you got up this morning, how neither of you was able to sleep as much as you wanted to last night. Your excitement and anxiety are almost palpable as the clock ticks toward 8:00. The desk barely has enough room for your laptop, notebook, pencil, pens, and multitude of highlighters. Luckily, no one is sitting on your left, so you claim that seat in the name of your possessions. As the clock hits 7:55, the door opens and everyone falls silent. Your professor strolls into the lecture hall and makes a beeline for the computer console. You all watch him intently. As he begins to load his lecture slides, it dawns on you: this is it. You are moments away from starting medical school. You are ready. You have been waiting for this. You want this.

"Today's lecture is on the anatomy of the back and spine," your professor proudly intones. *This shouldn't be so bad*, you think. *How complicated can it be?* Before delving into the material, your professor offers an introductory speech. What he is saying is thoughtful and nice, but it's the same thing you heard throughout orientation. You grow steadily impatient until at last your professor says, "Okay, that's enough of that. Let's start!"

*Finally, here we go*.

The first few lecture slides are about the different anatomical planes. You're relieved at the thought that this is not an unfamiliar topic. The words *sagittal* and *coronal* recall memories, and you're easily keeping up with the slides. The focus shifts to the spinal cord. You hang on every word. The pace of the lecture seems to have picked up, and you find yourself saying under your breath, "Hey, I wasn't done with that slide yet!" You calm yourself by remembering that all the lectures are recorded online; you can spend time reviewing the slide in the near future. But now you've missed another one because you were too busy thinking about the first missed slide. Your focus intensifies as your brain is confused by words like *efferent*, *afferent*, and *dorsal root ganglia*. Is this even English? With each passing minute, this anatomy lecture is starting to feel like a foreign language class. Peering at the clock, you realize that only fifteen minutes have passed, and you're already hopelessly lost. You can't believe the professor is talking so fast. *I can't possibly be responsible for all this information*, you think as you glance around and see other confused faces. After forty more minutes of a constant knowledge barrage, the lecture is done. You couldn't wait for it to start, but now you're simply relieved it's over.

Once the professor stops talking, you look at the classmate on your right. When you see her looking overwhelmed, you're glad to know you're not alone. Talking to her makes you feel better, knowing everyone is in the same boat. But suddenly your conversation is interrupted. "Okay, this is your first lecture in embryology—let's get started," your professor casually says. "Wait, wait, no! Another lecture already?" you exclaim, and before you can even look at your neighbor, the next hour is underway. By the end of this hour, anxiety is creeping in. You always knew medical school moved at a fast pace, but you had no idea it would be like this. You feel almost as if you're drowning.

The main difference between medical school and undergraduate course study is the sheer amount of information for which you'll be responsible. It is not uncommon for a student to do well in undergraduate courses by focusing on the central concepts rather than worrying excessively about the details. Unfortunately, medical school requires the student to learn the central concepts and to focus on the details, and the number of those details can be, at first, staggering. A popular analogy likens the medical student's efforts to absorb all the information presented in class to trying to drink from a fire hose. Don't feel alarmed if at first you're overwhelmed. Everyone is.

Some medical students worry that they are at a disadvantage to those students who have already taken medical school–like courses such as biochemistry, genetics, and even anatomy. The truth is that even though some may have had a course on a medical school topic, that course was not likely to have included the same volume of detail as a course in medical school. Also, it's likely, particularly if some time has passed since they took those courses, these students have already forgotten the details they did learn. This is not to say they don't have some advantage—their minds are already primed for learning. But the truth is, these students still have to study hard. Don't be discouraged if you majored in history, English, philosophy, music, dance, or any other nontraditional major. After a few months of medical school you'll find your general medical knowledge base is just as good as that of your fellow student who majored in biology. In other words, in medical school, the playing field quickly becomes leveled, and those with a nontraditional major ultimately will be grateful for the fund of knowledge amassed in other fields, making them well-rounded and occasionally providing them insights someone with a purely medical or biological background doesn't have.

Besides, no matter the undergraduate courses taken or the level of preparation felt before school starts, every medical student feels the strain of information overload. So what to do with the colossal amount of information being forced upon you daily? The smartest thing to do is to develop a learning plan. Luckily, medical school faculties want their students to learn, so they try hard to combine information in a way that makes sense. Lectures aren't designed as random assortments of facts—even if at first they sometimes seem to be.

If lectures were truly random, your professor might sound like this: "So here we can see a good example of mitral stenosis. Notice the fish-mouthed appearance of the valve. The Sylvian fissure separates the frontal and parietal lobes from the temporal lobe. Malate follows fumarate in the citric acid cycle," thus leaping from the heart to the brain to biochemistry. You'll discover that won't happen. Each lecture you'll hear in medical school has an underlying architecture. When faculty create a lecture on mitral stenosis, for example, they combine all the facets of the disease and try as best as possible to teach students in a logical progression, usually resulting in a thorough presentation of the topic, containing a mix of concepts and details.

## Conceptual Learning

Conceptual learning is special in the sense that it has predictive power. Once you understand a general concept, you can apply it to any specific situation. In other words, if learning can be likened to building a house, the concepts are the beams that hold it all together.

Consider the following two images: (1) a boat with a hole in it and (2) a submerged underwater research laboratory named Aquarius located in the Florida Keys. It probably seems obvious that if a hole is poked in the bottom of a boat, water will rush in. It likely seems less obvious why Aquarius, an underwater laboratory bolted to the ocean floor, doesn't flood when divers enter the hatch from outside. The divers have to get into the vessel somehow, and if that vessel is underwater and it has a hole in it, why doesn't it flood?

You can answer that riddle once you understand the concept that fluids (liquids or gases) flow from areas of high pressure to areas of low pressure. As it turns out, Aquarius has a special room in which the air pressure inside is equal to the water pressure outside. Since there is no pressure difference there is no flow of fluid, so the divers can enter the hatch without risking gallons of water pouring in and flooding the facility.

Let's put a medical twist on this concept. Picture what would happen if there were a hole between the left and right ventricles of the heart (ventricular septal defect). Since blood pressure is normally greater in the left ventricle than in the right ventricle, blood would flow from the left side of the heart to the right. Now imagine the blood pressure in the right ventricle is greatly increased (due, say, to pulmonary hypertension causing the right ventricle to hypertrophy). Though you cannot predict precisely what will happen, you will understand that if the pressure in the right ventricle is greater than that of the left ventricle, blood will flow from right to left. If the pressure in the right ventricle remains lower than in the left, blood will flow from left to right. If the pressures in both chambers are equal, no blood will flow across the defect. Simply by understanding the concept that fluid flows from areas of high pressure to areas of low pressure, you can answer a thousand questions about fluid flow. If instead of learning concepts you attempt to memorize which way the fluid flows in every imaginable situation, you might still be able to answer a thousand questions, but you'll have had to spend your time memorizing a thousand facts. It is plain to see which route is easier.

To shed more light on the topic of conceptual learning, let's play two games. For the first game, you will set a timer for one minute and look at a group of letters. After the minute is up, you will cover the letters, grab a piece of paper, and write down as many letters as you can in the order in which they were presented. Below are twenty-three letters. Ready? Set your timer and begin.

**OTTFFSSENTETTFFSSENTTTT**

How many did you get? Ten? Fifteen? All twenty-three? You can approach playing this game in two ways.

The first approach is to look at the letters and try to memorize them as best you can. Perhaps you memorized the letters one at a time. Or maybe you turned the letters into words and memorized the funny sentence you concocted. Trying to memorize all the letters is work intensive. It's also the least efficient way to "win."

If you used memorization and were able to reproduce all twenty-three letters, I must compliment the strength of your memory, but now I'll ask you to try a harder game. Being the competitive, type A person you probably are (a common personality type in medical school), my guess is you want to rise to the challenge. So the same rules apply for this game as the last. Try to memorize all eleven rows in order. This time instead of one minute, give yourself four. Set your timer. Go.

**1**

**1 1**

**2 1**

**1 2 1 1**

**1 1 1 2 2 1**

**3 1 2 2 1 1**

**1 3 1 1 2 2 2 1**

**1 1 1 3 2 1 3 2 1 1**

**3 1 1 3 1 2 1 1 1 3 1 2 2 1**

**1 3 2 1 1 3 1 1 1 2 3 1 1 3 1 1 2 2 1 1**

**1 1 1 3 1 2 2 1 1 3 3 1 1 2 1 3 2 1 1 3 2 1 2 2 2 1**

Again, this game has two methods for success, but I doubt you were able to memorize your way to victory this time. Although the first game offered a lot of letters, you could turn these into words. This time I've given you far too many numbers. You might memorize the first four lines as one, eleven, twenty-one, and one thousand two hundred and eleven, but after four lines, memorizing in this way becomes cumbersome. If you had an hour to memorize the above lines, you might be able to reproduce them all, but memorization, while sometimes a decent solution, is most often inefficient and least useful for those trying to succeed in learning.

The second method for playing these games involves barely any memorization. Let's examine the first game again. You may have noticed the following pattern:

**O**ne

**T**wo

**T**hree

**F**our

**F**ive

**S**ix

**S**even

**E**ight

…

**T**wenty-three

In other words, in this collection of letters, each letter stands for a number, starting at one (O) and moving to twenty-three (T). Once you recognize this pattern, you can predict the thirty thousand eight hundred fifteenth letter without any problem at all. Thus the first game is less a game than a puzzle, and once you have puzzled out the pattern, your success at predicting future letters and reproducing those with little effort is assured. Recognizing the pattern in this game is essentially understanding the concept of the solution. Trying to memorize the letters in order requires the same time, focus, concentration, and effort that trying to memorize a slew of facts requires, but learning the concept involved provides you with the ability to answer specific questions about the topic without straining to memorize each letter (or every detail).

Don't worry if you didn't recognize the pattern in this game. I gave you just one minute to play, and I didn't alert you to the fact that it was a puzzle! The only tip-off was the repetition of letters, but you wouldn't necessarily have known that each letter stood for a number. You might have guessed that something fishy was going on since a truly random collection of letters would be unlikely to contain so many of the same letters grouped beside each other. The whole idea here is to show you that seeking to learn concepts will help you tremendously in all kinds of learning situations.

As you may have surmised, the second game involves a trick as well. It is also a puzzle but a much more difficult one. Again, the repeating numbers may have clued you in to the fact that there is a pattern, which is shown below:

| | |
|---|---|
| 1 | |
| 11 | The line above has one one. |
| 21 | The line above has two ones. |
| 1211 | The line above has one two, and one one. |
| 111221 | The line above has one one, one two, and two ones. |

This puzzle is significantly harder than the first. The first time I came across it was during my undergraduate physics research. One of my lab

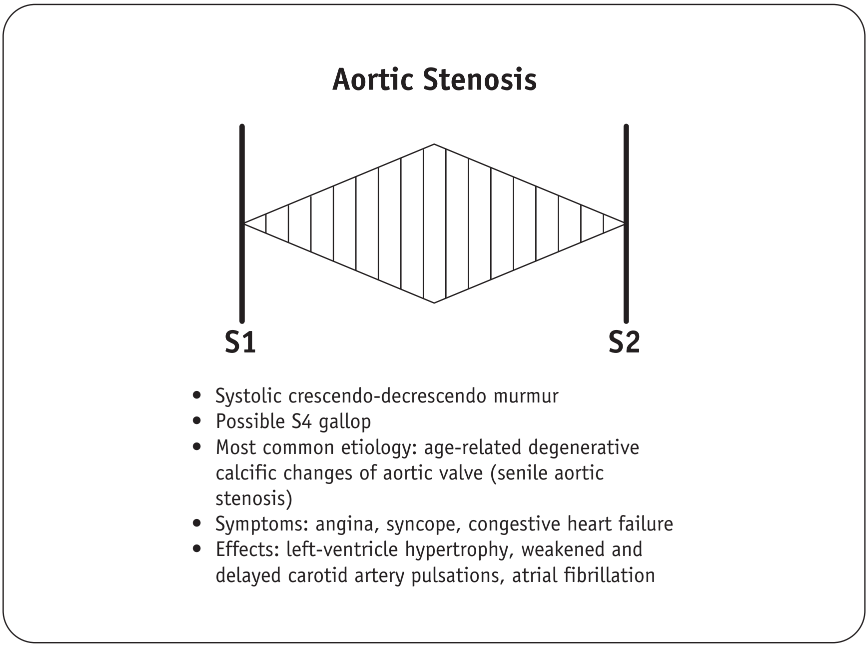


**Figure 1.1** Example of a lecture slide on aortic stenosis

mates asked me and the graduate student in charge of the lab to try to solve this puzzle. Needless to say, we got no work done that entire day, so if you solved this puzzle in four minutes, you may just be a genius.

The point of the second game is to demonstrate how difficult it is to succeed through memorization alone. Recognizing the pattern and understanding the concept of how to reconstruct the number strings (the solution to the puzzle) is the only realistic, reasonable, and possible way to reproduce the pattern.

These previous two games show that a concept is much more powerful than the ability to memorize facts. The strength of concepts isn't relegated only to the sphere of puzzles. Rather, it will assure you an easier and more fulfilling way to absorb all the knowledge you will be offered in medical school. So instead of looking at a bunch of numbers and letters, let's now examine the topic of aortic stenosis (fig. 1.1).

Figure 1.1 shows what a medical school slide looks like. Each medical school lecture normally contains thirty or more slides, and you'll usually hear multiple lectures each day. Thus you see the vast amount of information presented in one week. An average test will cover weeks of lectures. I imagine the thought of studying for such a test sounds terrifying, but it's your job as a medical student to understand and remember all the subject material presented to you. You have no choice—you're going to have to retain vast quantities of knowledge in one way or another. And the point of the two games I gave you is to guide you to understanding how to retain the knowledge on aortic stenosis offered on the slide. If you choose memorization as your technique, you'll have to remember that aortic stenosis has a systolic crescendo-decrescendo murmur, with a possible S4 gallop, most commonly caused by age-related degenerative calcific changes, and that it causes left ventricular hypertrophy, as well as weakened and delayed carotid artery pulsations. You'll have to memorize the symptoms, which can include angina, syncope, congestive heart failure, and atrial fibrillation.

You can memorize all this quickly, but remember, you'll be presented with dozens of other slides in this same lecture and have many more lectures to go before test day. You've probably had the experience of going to a party with unfamiliar people and struggling to learn everyone's name at once—one illustration of the fact that our memories aren't perfect.

But just as in the games, there is a way to succeed that's easier than relying on memorization. Take a look at figure 1.1 and see if you can recognize a theme that ties all the information together in a logical way. In other words, is there a guiding principle on that slide that will allow you to predict the presented information about aortic stenosis?

First, think about what aortic stenosis actually is. The aortic valve is the valve that separates the left chamber of the heart from the systemic circulation, meaning that it is the last valve the blood flows through while in the heart. Stenosis is, by definition, the narrowing of a passage. So when a patient is suffering from aortic stenosis, the valve through which the blood leaves the heart is smaller than it should be. If the valve is smaller, more effort will be required to push the blood through it and thus less blood could be supplied to organs that might need it. Therefore, the heart will have to pump harder to push out the blood.

So let's examine the symptoms of aortic stenosis. Angina (heart pain) could result from the combination of the heart pushing extra hard and yet receiving less blood flow. How can the syncope (passing out) be explained? The brain does not do well when it loses blood flow—just a few moments of lost blood flow to the brain can result in syncope, and if the aortic valve is narrowed, the blood has a harder time leaving the heart and moving upward toward the brain via the carotid arteries. Also, this would explain why the carotid pulse is weakened and delayed.

Since the aortic valve is narrowed, the heart must expend more effort to move the blood through it. To understand the effect this might have on the heart, think about what happens to any muscle that works harder day after day. It gets bigger. The only difference between other muscles and the heart is that since the heart is a hollow organ, the extra muscle growth happens on the inside as well as the outside, thus creating less space for holding blood. Since most of the strain will be put on the left ventricle, it will get larger and more muscular, and this explains the left ventricular hypertrophy. When the left ventricle becomes larger and more muscular, it becomes stiffer and is less able to hold a larger volume of blood. An S4 gallop results from a stiff ventricle. The decreased volume of the left ventricle also means that the blood will back up, and where does that backup go? The next place for it is the left atrium. So what happens to the left atrium? With the increased volume of blood it is forced to hold, it will naturally enlarge, and when any chamber of the heart enlarges, there is always the possibility of fibrillation, as the electrical conduction of the heart is a precise matter, and any change in the heart's architecture can throw it out of sync. Since the left atrium is now enlarged from volume overload, atrial fibrillation as a possible symptom of aortic stenosis makes perfect sense.

Thinking about this situation further, you can imagine that the volume overload doesn't simply stop at the left atrium. If left to progress, volume overload will begin to create congestion in the lungs, then the right side of the heart, and then the rest of the body, therefore explaining congestive heart failure.

Can the murmur and age-related degenerative calcific changes also be explained? Since the blood flows through the valve during systole, a systolic murmur makes sense. However, the conceptual learning method isn't perfect; I don't know of a way to logically conclude that the murmur is a crescendo-decrescendo or why the degenerative calcific changes happen, but that leaves just two facts to memorize rather than nine.

Through logical deduction we were able to explain seven of nine facts. While at first, logically explaining the knowledge concerning aortic stenosis may seem more daunting than does memorizing nine details, one of the payoffs of conceptual learning is long-term retention. Seeking to figure out why aortic stenosis causes the problems that it does, and then carefully examining the nature of aortic stenosis and proceeding to logically derive all the conclusions associated with it, enables us to create a true understanding of the condition. This means that just by thinking about it, we have the ability to recall almost all the details, thus removing our knowledge of aortic stenosis from the mercy of our fallible memory.

This process involves understanding the *pathophysiology*, which is just a fancy word for how negative changes to the body take place and the consequences of those changes. If you have ever wondered why your nose runs when you get a cold or why you need to wear glasses, without even realizing it, you have attempted to learn some pathophysiology.

If you are skeptical, you may be saying, "I have a good memory; memorizing nine facts is easy. Why should I waste my time learning the pathophysiology when I can just memorize everything and do just as well on the test as anybody else?" True, memorizing nine facts isn't difficult, but memorizing nine thousand facts is extremely tough. As good as your memory may be, you'll forget things here and there, especially when you're learning new facts every day. In addition, the more facts you try to memorize, the more you wind up forgetting.

The premise of this guide is this: the goal of every medical student should be to understand as much as possible and memorize no more than necessary. For example, let's say you must learn nine thousand facts, and five thousand of these can be predicted by learning the pathophysiology. You'll still have to memorize four thousand facts, but at least five thousand of them won't be subject to the vagaries of your memory.

My example is an arbitrary one, of course. In reality, the proportion of memorized facts to logically recallable facts depends on the subject matter, as evidenced in the two games above. In the first game, if you knew the solution to the puzzle, you could reproduce each letter precisely, with no memorization required. In the second game, if you understood the solution, you'd have only to memorize the fact that the first line was composed of the number one. There is, of course, the possibility of a game at the extreme end of the spectrum—for example, one in which you are asked to memorize pi to sixty decimal places. Since recalling the numbers cannot be done by using reason or logic, you'd obviously have to rely solely on memory.

Let's consider the biochemical subject of human metabolism, specifically the Krebs cycle, glycolysis, the urea cycle, and all that other lovely "garbage." You will have to learn and recall that citrate gets converted into isocitrate, at which point it loses a molecule of carbon dioxide and turns into alpha-ketoglutarate. Also, you'll need to know that NAD+ gains a hydrogen atom and turns into NADH. Every medical student needs to know these facts, and there is no way to reasonably figure out that citrate gets converted into isocitrate (or that succinate gets converted into fumarate). You'll have to memorize those facts, as well as nearly everything else you'll need to learn in biochemistry.

On the other end of the spectrum is cardiology. The human heart is essentially a complicated pump, and the human vasculature can be compared to complicated pipes. If you understand how the heart works (physiology) and what can go wrong with it (pathophysiology), you can logically recall a great deal of information. Being aware of which subjects require memorization and which do not will help you succeed.

Learning the pathophysiology won't just help you recall and remember knowledge. It also will provide insight and predictive power in many different situations because you will be able to connect different areas of knowledge. For instance, if you understand why a certain disease process happens, you may be able to predict the cause of disease in a situation that mimics those conditions. Pure memorization won't enable you to accomplish this kind of thinking.

It is worth asking why we don't use computer programs to diagnose and treat patients. Computers have an advantage over humans in memorization: once a fact is recorded in a computer's memory, it is there until someone decides to erase it (assuming no software or hardware problems interfere). But imagine a group of doctors and programmers developing a computer program designed to fill the shoes of a doctor. First the computer would ask the patient to provide his or her symptoms and medical history. The specific combination of symptoms and details from the history would generate differential diagnoses. Next, the computer would ask appropriate questions to narrow down the list of differential diagnoses. The computer would continue asking questions, attaining the results of a physical exam through robotic methods (use your imagination)—and order any necessary tests, the results of which could be uploaded into its memory. The computer would continue to gather information in this way until only one diagnosis remained. Last, the computer would generate a treatment plan. This seems like it could work.

But what happens if a patient has two unrelated problems? We could run the computer program twice and come up with two different treatment plans. But what if those treatment plans contradicted each other? What if the patient had two related problems that created one unusual complicated problem? Unless the programmers explicitly programmed that specific unusual complicated problem into the system, the computer would come up blank: No solution. And this is because a computer cannot resolve problems outside of whatever it has been programmed to do. Thus our medical computer could not handle novel situations because it hasn't the ability to reason or adapt to new and changing situations.

If you stick to your plan to memorize all the medical facts you can without learning the pathophysiology, you'll wind up no different from our imagined computer. When presented with a new situation, you won't know what to do because you won't have seen this specific situation before. You won't have developed the tools for thinking outside the box, for applying an understanding of concepts to a new presentation. In contrast, if you understand why certain disease processes happen, you'll learn how to make predictions about novel situations. In other words, you'll employ your insight, a gift computers do not have.

Of course, you still must memorize many facts, and to even the most motivated students, the number of facts to memorize may seem daunting at first. Don't be daunted. In chapter 2, "Study Efficiency," you'll learn how to cope with this task.

## Detail Worrying

Although conceptual learning is extremely important, some attention needs to be paid to the individual facts that the medical school faculty expect their medical students to know. Nearly every medical school lecture you attend will be riddled with details—all of which the faculty consider fair game for testing. It is, however, a mistake to think that every detail is created equal: some may end up saving a patient's life, while others will almost never be needed. Details can be divided into two categories: useful and useless.

Useful details are those that have at least some clinical importance. Whether that clinical importance is high or low will determine if the detail is of major or minor importance. Useless details are those that have almost no clinical importance, though you may be tested on such useless and superfluous details, which, from this point on, I'll refer to as *microdetails*.

Microdetails have a tendency to occupy a proportionally large percentage of many medical students' study time. They usually show up in one of two ways: contained in a vast chart or list or verbally stated by the professor. During one lecture on cardiac contractility, for example, the professor mentioned that the cardiac myocyte was ideally contracted when its length was two millimeters. Not surprisingly, this fact failed to appear on any lecture slide, class test (although it could have), or board exam I encountered, and it's a fact that is entirely useless to a practicing physician. So why did the professor include this in his lecture? He is a research physician and thought it was worth noting that a cardiac myocyte is ideally contracted to a length of two millimeters. And if you were researching cardiac myocytes, you'd probably want to know the optimum length of contractility. But not one of us listening to that lecture was researching cardiac myocytes at the time, and none of us planned to in the future. The fact was useless to everybody except the professor.

Most medical students react with disdain to being held responsible for knowing extra useless facts, and this one was placed on top of a mountain of medical knowledge under which we were all being buried. But instead of reacting with anger, I imagined this professor working passionately every day, discovering previously unknown facts. I know that when one discovers something new and exciting, that person wants to tell others about it. I'm sure the professor had told his peers about his discovery, but likely few others in his life cared to hear it, and there he was, giving a lecture on his area of expertise and brimming with the excitement of what that knowledge meant to him. Now it's true that some lectures in medical school quickly degenerate into a detailed accounting of the professor's research findings. I know if I'd been doing cardiac research for years on end and someone asked me to present a lecture on the basics of cardiac contractility, I'd have trouble resisting the desire to throw in my own research. You'll want to be aware that these microdetails will, in this way, creep into the lectures you hear. But don't react in anger. Simply understanding their origins will help you avoid that wasted energy.

Microdetails also can arise from a perfectionist professor's desire to cover every aspect of every detail of his or her subject. While some will be useful, microdetails tend to take up residence in long lists, and unfortunately, medical school faculty hold their students responsible for every word on every lecture slide. This means that even the microdetails that show up in long lists are fair game for testing. Worse, faculty might also hold you responsible for the microdetails they mention in class but never include on a lecture slide.

The good news is that microdetails usually compose just 10 to 15 percent of a test, and you can do well without explicitly studying them (see chapter 3, "Diminishing Returns"). You probably wonder how you can tell if a detail is useful or useless. The following list offers you a few ways to recognize microdetails when you come upon them:

- *Microdetails normally do not show up in lecture slides but are verbally stated.* When they are in a slide, they usually are part of a comprehensive chart or list.
- *Professors usually discuss microdetails for a short amount of time.* Since a microdetail is normally a single inconsequential fact, there isn't a whole lot to say about it, so often it's simply mentioned quickly.
- *Microdetails are sometimes off topic.* Such microdetails are normally introduced when a professor has gone off on a tangent talking about his or her research or maybe offering an interesting tidbit of historical information. Regardless, if a detail is off topic, it's probably a microdetail.
- *Microdetails have no clinical consequence.* The human body is a complicated machine with complicated problems, and taking care of a patient is a complicated subject. Clinical care envelops a large body of knowledge that contains many important nuances and details; by definition, microdetails are clinically worthless.
- *Microdetails aren't known with certainty because they concern areas still under active research.* A vast amount of medically related research takes place every day, which means our knowledge of medicine is constantly evolving. The material covered in medical school is always subject to change as a result; in fact, the medicine taught in school is almost always a few years behind the current state of medicine. It takes a while for textbooks, standardized tests, and medical school curricula to incorporate recent discoveries. Sometimes a professor will include the newest medical knowledge in a lecture, but if a professor starts a

sentence with "We think that" or "We aren't really sure, but" or ends it with "but no one really knows for sure," you've probably encountered a microdetail.

You need not memorize every microdetail to succeed in medical school, but some students are likely perfectionists and will strive to do so to get the top grade on a test. Since most microdetails are spoken in passing, catching every one can be challenging. Even if you have taken perfect notes and can rewatch each lecture, you may find yourself spending vast amounts of valuable study time on microdetails, and the time spent studying the microdetails can easily eclipse the time spent learning the concepts and important details. Is the extra study time spent learning the answers to 10 to 15 percent of your average medical school test worthwhile? For the perfectionist student, the answer is clearly yes. For most students, however, the answer may not be so straightforward. In chapter 3, "Diminishing Returns," you'll read more about how the nonperfectionist might choose to proceed.

## Summary

Learning the concepts and pathophysiology of a topic is extremely important for building a knowledge base that will help you recall information rather than having to memorize it. After learning the concepts and the pathophysiology of a topic, you'll need to memorize any leftover important details. Also, learn to recognize and watch out for the microdetails, the mostly useless details that can, if you're not careful, occupy too large a percentage of your study time.