SuccessTypes
In
Medical Education

A Program for Improving Academic Performance

Version1.1

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with
Bernell K. Dalley, Ph.D.

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pes anserinis illustration by Leslie A. Smith.

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Acknowledgments

If this book is at all readable, if it is interesting and useful, it is mainly due to the contributions of my wife, Mary Jane. I knew what I wanted to say, but she helped me say it better.

The many medical students at the Texas Tech University Health Sciences Center (TTUHSC) who let me know that they were helped by my counseling encouraged me far more than they could ever imagine. It was from their feedback that I learned what worked and what didn't. Also, the term "bubble diagrams[1]" was coined by the medical students in response to the diagrams' inclusion in my biochemistry lectures. I tried to use more sophisticated terms such as "concept diagrams," "network diagrams," and "Mindmapping™," but I continually heard comments like, "Dr. Pelley, I really like those *bubbles,"* or "Look how I bubbled this, Dr. Pelley," and even "Here comes Dr. *Bubbles!"* Thus, I relented and this is my opportunity to place the credit, or blame, where it is due.

Kae Hentges, director of the Achievement in Medical School (AIMS) affirmative action program at TTUHSC, made it possible for me to present a SuccessTypes workshop for the AIMS program during the early stages of this book. The feedback from the AIMS students, Emma, Michael, Sam, and Rene, was invaluable. Suzanne Logan has been a valued colleague. Her advice and support facilitated my writing greatly, and the chapter on stress was her idea. Chris Morris gently sanded, polished, and improved the original manuscript so that my imperfections as a writer would not be as visible. She possesses a perfect balance of productive criticism and supportive compliments. I am indebted to Debbie Nash for reading and commenting on early versions of the manuscript. Leslie Smith is responsible for the creative ideas in the layout and overall appearance of the book. The entire team at Texas Tech University Extended Studies has a nice balance of professionalism and a friendly, positive attitude. Gordon

[1] In writing the first edition, I was not aware of the term “concept mapping” coined by Joseph Novak. All subsequent versions of SuccessTypes will use the term “concept map” in place of “bubble diagram.”

Lawrence and Gerald Macdaid provided very valuable guidance and encouragement during the final revisions of the manuscript.

I am grateful to the Texas Tech University Fund 2005 program for its support of my SuccessTypes project. Inspiration Software, Inc., Portland, Oregon, provided software used to create the initial versions of most of the bubble diagrams used in this book. Additional information about Inspiration can be found in Appendix B.

To Vinson and Ina Pelley,
who had the good sense to have
an INTP as their first born.

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Preface To First Edition

Why was it written?

I wrote *SuccessTypes in Medical Education: A Program For Improving Academic Performance* to bring you a method of learning that will increase your chances of success in the first two years of the medical curriculum This method is especially valuable if you have been accepted to medical school but have not yet matriculated. Ideally, you should begin working in this book at the beginning of the summer prior to the start of classes. However, the SuccessTypes philosophy is useful and relevant to you throughout medical school.

Although I wrote this version of *SuccessTypes* for first- and second-year medical students, any student who wants to improve his or her academic performance can benefit from the examples and exercises in this book — including high school students, undergraduate science majors, and even resident physicians who are preparing for their specialty boards. Versions of this book adapted to pharmacy students, nursing students, undergraduate college students, and college teachers are either planned or in preparation.

I decided to write this book because I am no longer satisfied to help just one student at a time. My practical, workable approach evolved out of counseling sessions that became increasingly effective in helping failing medical students save their careers. I was brought into regular contact with these at-risk students over a 10-year period in my role as the Associate Dean for Academic Affairs at the Texas Tech University School of Medicine. I found that *early* identification and involvement with at-risk students was necessary in order to develop strategies to prevent further failing grades on examinations. I have chosen to write this book in first person to maintain the atmosphere of personal dialog that characterized the counseling origins of the SuccessTypes philosophy.

How is it organized?

I have written each chapter of this book to draw on earlier chapters. The chapters in **Part I** lay down the theoretical underpinnings for the SuccessTypes method; **Part II** provides both examples and exercises to help you develop the skills used by the SuccessType; and **Part III**

extends your understanding of psychological type into two other areas that should be of interest to all medical students, stress management, and personal growth.

The examples and exercises in **Part II** are drawn from the courses that are typically experienced early in the medical curriculum: biochemistry, histology, and gross anatomy. My co-author, Dr. Bernell K. Dalley, Course Director for Histology and for Gross Anatomy, has provided the examples and exercises for those courses.

How is it different?

This book is designed to train you in methods that will improve your academic performance. It is different from other study guides because it contains both theory arid practice. Its theoretical underpinnings are the psychological types that are identified by the Myers-Briggs Type Indicator® (MBTI®). But, rather than leave you to decide how to apply the theory, I have expanded my counseling method with examples and exercises similar to those that you will see in the first semester of medical school.

What this book isn't and what it is.

This book is not intended to be a substitute for the MBTI. The only reliable way to identify your type is through a qualified professional who can administer and interpret the results of the MBTI. Suggestions for where to take the MBTI are listed in Appendix B. The characteristics discussed in this book are intended only to inform you about the psychological types identified by the MBTI and to help you understand the learning style of your own type and that of others. While it may be tempting to try and determine your own type from the descriptions contained in this book, you should know that there are many factors that can cause you to bias your determination. The type descriptions in this book are much more valuable in helping you verify your type and in understanding the effect of type on learning style.

How is personality related to learning?

Unlike other learning style measurements, the MBTI was not originally developed to assess learning style. Instead, it was the result of research by Kathryn Briggs and Isabel Myers to determine if the psychological types proposed by Carl Jung could be used to improve communication and resolve conflict. The MBTI is indeed useful in this regard and is currently the most frequently used tool in marriage counseling, team-building, and leadership training.

Many of the barriers that interfere with our understanding of each other are lowered when we understand the mental habits that make up the different psychological types that are identified by the MBTI.

The mental functions that determine an individual's psychological type also describe how that person *prefers to process information* or, in other words, how he or she learns. These preferences make a student's learning style predictable and consistent. In fact, I would often get a reaction of amazement and curiosity from a student when I was able to correctly guess details of his or her study habits after only a brief interview that allowed me to guess at certain aspects of his or her type. I usually guessed correctly because predictability and consistency in mental habits are fundamental properties of type.

Becoming a SuccessType will get you off to a good start.

Getting off to a good start in medical school is not an easy task, and for many it is a difficult adjustment. Some educators try to scare or intimidate students into adjusting to the medical school environment, and others minimize its importance. Students are generally left to discover the mysteries of medical school either from second-year students or repeating students, or from just plain trial and error.

The MBTI opens up a window of insight into your own strengths and potential strengths (the MBTI doesn't identify weaknesses). It will put you in control of your own destiny in medical school by helping you adapt your learning style to become a SuccessType as is described in Chapter 2. The one central theme that permeates this entire book is that *when you use your knowledge of psychological type to develop your learning skills, you become a SuccessType* and improve your performance on medical school examinations.

Where do we go from here?

This book has been an opportunity for me to extend the counseling that I have provided to medical students at the Texas Tech University Health Sciences Center well beyond our walls. I did not seek perfection in this first edition, or it would never have been completed. However, I do seek excellence, and excellence is only attained by attending to both strengths and weaknesses. I invite those of you who have used this book to help me reach for excellence in the

second edition by returning the feedback form in the back of the book with what worked, what didn't, and what's missing. This will help me learn from you so that I can, in turn, help others. Those who follow in your steps will appreciate it.

[*Author's note: I have altered the title from the original "SuccessTypes For Medical Students." The original title was chosen to be the first volume in a set with each volume dedicated to other groups within healthcare education such as nursing, allied health, and pharmacy. An unanticipated large number of requests for student and faculty workshops about the SuccessTypes concept has led to the decision to not pursue any additional versions for students in other fields in the series. Thus, the other volumes were never completed making the original title awkward. Although the examples and subject material concern medical education, students in other health professions or even non-health studies can still apply the learning principles.*]

John W. Pelley, PhD
September l997

Preface to Version 1.1

Version 1.1?

Do books have versions? I think they do when they are available online because it represents the capacity to fine tune the existing document when it is available in electronic form. Now I can offer *updates*, like software updates, that correct spelling, grammar, and usage and provide minor clarifications. A new version, such as 2.0 would be an *upgrade* that would be more like a new edition in hardcopy form.

Over ten years have passed since SuccessTypes was published. There was no advertising budget since it was published locally by the Texas Tech Division of Extended Studies, but I had access to the TTUHSC web server to publish a website. I decided to publish the SuccessTypes Medical Education Webpage as a way of bringing attention to the book and soon some medical schools in addition to students took notice. It was a delicate situation to avoid the stigma of commercialism, so I devoted considerable space to provide free access to advice and information, and I carefully marked the links set up by Extended Studies for purchasing the book as commercial links. After the publication of both the book and the website, invitations to speak about SuccessTypes, at first to students, and eventually also to faculty began to grow in number. Now, after a decade of travel to institutions and education meetings, I have learned well beyond what was contained in the original book. I have included in version 1.1 some of that new information, but more will follow in the online version of a second edition, version 2.0. Here are some of the major changes for Version 1.1:

1) Substitution of the term "bubble diagram" with "concept map." There are many terms in use that amount to the same thing. Concept map, however, is the term most widely recognized.

2) [*Author's notes: Enclosed in brackets and italicized. These are some of the more important updates to provide readers right away. These will be carried over into the next version.*]

3) Minor re-wording designed to help clarity and completeness, including the title of the book. Blank pages are included to aid the appearance of a printed copy.

What's coming in Version 2.0:

1) Brain-based concepts that have extended and explained much of what I have taught.
2) Complexity and chaos concepts that affect medical education as seen from an institutional level as well as the individual level.
3) Conversion of concept maps from "center-out" to "top-down." I hadn't realized that the same inclination to proceed linearly through a reading assignment from "top-down" would also affect the construction of a concept map, but it does. A top-down map is just as "correct" as center-out so I now recommend the former. This enhances the ability of students to compare their maps and, thus, their thinking.
4) Addition of chapters for premedical students and for faculty.

I invite feedback from students, faculty, and others with an interest in helping medical education be more effective…and more fun! Let me know if there are topics that I should add or expand on and also give some guidance regarding any problems or criticisms, but please understand that opinions without the underlying rationale are only empty thoughts. Please let me hear your thinking. My email address is johnDOTpelleyATttuhscDOTcom (anti-spam modified).

[Web edition (Version 1.1): May, 2008]

John W. Pelley, PhD
May, 2008

Chapter 1
Getting off to a good start

Success in medical school is hard to predict.

During the period of time when I served both as the medical school admissions dean and as a teacher in the first-year medical curriculum (Medical Biochemistry) at the Texas Tech University Health Sciences Center, I noticed an unexpected phenomenon in the first-year medical students. The students who were at the top of the acceptance list weren't necessarily making the top grades in their courses. Since the admissions process is heavily weighted in favor of grades and MCAT scores, you might expect a strong correlation between rank on the admissions list and class rank. However, I noticed that some other unknown factor was entering the success equation to cause many students to perform at a lower level than entrance scores would predict.

You might enter medical school with the feeling that you will continue the strong performance you had as an undergraduate. The odds are in your favor that you will pass your courses, but you will find that once you begin your studies in the medical curriculum, you will want more than just a passing grade. For one thing, you will want to be competitive for your first choice of a residency position after you graduate. Also, you will want to know as much as possible before you start working with patients during the clinical clerkship training. However, my 35 years as a teacher and administrator have taught me that you could wind up surprised and disappointed in your grades.

The primary question:

First-year student, "Will I survive?"

Second-year student, "Will I know enough?"

Getting off to a good start is no small task.

The first year of medical school requires a rapid adjustment on your part to a very high volume of material. In addition to working harder, you must also work smarter to organize major facts and concepts and to develop the ability to draw inferences from this information on standardized tests. Medical students like yourself are intelligent, motivated, and well prepared in the sciences,

and yet, each year I see approximately 10 percent of you fail your exams, requiring remediation and/or repetition of course work. This often leads to repetition of an entire year of medical training.

Getting off to a good start is no small task, nor is it a predictable, straightforward adjustment to a new learning situation. Study strategies that were effective in the premedical educational environment may continue to work for you, but there is also a good chance that you will struggle. During the time in which I served as the academic affairs dean, I remember one student who came to my office with a smile on his face to tell me that he had finally found a study method that worked…after the sixth attempt! In many cases, you will only realize you have a problem with your study skills after failing the first round of examinations. At that point, panic sets in and it is difficult, if not impossible, to adopt new learning strategies. The situation is further complicated by the debilitating damage to your self-image and confidence.

Why were hard-working medical students failing?

The students who were coming to my office for help weren't just frustrated, they were also confused. The confusion was over the fact that their exams didn't show that they knew what they thought they knew. Often, I had to get the student past a cycle of blaming the exams for being tricky and unfair or, worse, blaming themselves for not being smart enough. I began to see a syndrome with the following symptoms: 1) up until 2:00 a.m. every night; 2) reading and rereading the text and notes intensely; and 3) certain that they knew more than other students who didn't work as hard, but who managed to do better than them on the exams. For many, the syndrome also included intensive writing and memorizing detailed outlines of their course notes.

As you can imagine, it wasn't much help to advise these students to keep working hard. And, it didn't take a rocket scientist to see that more than a pep-talk was needed. I needed to help them replace their current study method with something more effective.

At first I didn't know how to help.

Initially, I gave the best advice I knew. I began reading books and journal articles on memorization techniques, stress management, cognitive science, and learning theory. This helped me to provide some useful tips and advice, but something was still missing; there were still too many students who were struggling and failing. Then a psychologist on our staff suggested that I look into the psychological types that are identified by the Myers-Briggs Type Indicator (MBTI) as a way to diagnose learning problems. She pointed out that the MBTI reveals important aspects of *how people prefer to process information*. That got my attention because it sounded similar to the cognitive science I had been reading. I decided to evaluate the MBTI by attending a workshop on the educational applications of type.

I saw immediate applications for the MBTI.

I arrived at the MBTI workshop somewhat skeptical. I had already investigated numerous learning style tests and inventories and was never impressed. These psychological instruments seemed to have the ability to determine learning characteristics of students without telling them what to do about it. However, by the end of the first workshop session, I saw immediate applications. I deduced that the failing performance of medical students was only a symptom, not the real problem. The problem was the ineffective learning style of students who had certain psychological types. I learned that students who are "sensing types" usually test poorer than their *actual knowledge* on timed multiple choice tests and that students who are "intuitive types" usually test better than their actual knowledge. Interestingly, the performance of these two types is reversed when they are tested on the *application* of their knowledge. I had discovered that an important unknown factor in the success equation for medical school was the student's psychological type.

Are some types doomed?

Definitely not! While it was encouraging to discover that each type has unique strengths, I discovered something else that showed me how to provide better counseling for students. I learned that *each type can learn the skills of the other types*. That simple concept is so fundamental that it challenged me to develop methods to teach these skills to medical students.

Although some psychological types have more difficulty than others on multiple choice tests, studies on over 10,000 medical students have shown that all 16 types are represented in the medical profession. In other words, all types (including your type) can and do make it through the timed multiple choice tests that are used almost exclusively in the first two years of medical school. While psychological type theory doesn't predict if you will pass or fail, it does indicate when you are swimming with the current. This book explains how to take advantage of your type so that you are always swimming with the current. Those that swim with the current are what I call SuccessTypes.

To understand SuccessTypes you have to understand psychological types.

Type is a term used to describe how you *prefer* to think and communicate. Just as there are different preferences between people with regard to many aspects of their lives, there are different preferences in the way they see the world and in the way they react to it. As you will see in later chapters, there are 16 distinct ways that you and others can be grouped or typed. The Myers-Briggs Type Indicator is a psychological instrument that was developed as a reliable way to identify the type that most accurately describes you. You may be able to verify your own type by reading the descriptions in Chapter 3.

Part I of this book will help you:

- understand the dimensions of type
- assess your own learning style
- develop your learning style to become a SuccessType

Part II of this book contains descriptions of several methods to guide you into the SuccessTypes method of learning. Dr. Dalley and I have provided examples to illustrate these learning methods followed by exercises for you to complete. A suggested correct answer is provided for these exercises so that you can assess your progress. These examples were chosen from the material most likely to be seen early in medical school: biochemistry, gross anatomy, and histology.

Part III of this book contains some useful information on how your type reacts to stress with some suggested coping strategies and a final chapter on how an understanding of type can contribute to your personal growth.

Let's go over the main points:

1) Even if you performed well prior to coming to medical school, there is no guarantee that you will be just as successful in the medical curriculum.
2) The medical curriculum requires more than working hard; it also requires working smart.
3) The Myers-Briggs Type Indicator identifies learning styles that will point to ways for you to work smart.
4) Each psychological type that develops their learning style through an understanding of psychological type becomes a SuccessType.
5) All psychological types can learn the skills needed to become SuccessTypes.

Part I

The SuccessTypes Concept

Chapter 2
The SuccessTypes concept: Why is psychological type relevant?

Our thinking involves several different mental functions.

Whenever we learn something new, we process information by moving back and forth through four identifiable processes. As you will see in later chapters, different psychological types emphasize some of these processes more than others.

Our thinking proceeds through a sequence of four major processes or mental functions

The processes are:

1. We collect relevant observations and facts that we need to learn. This step provides us with the realities of the situation.

2. We associate the observations and facts with what we already know to discover patterns and possible new relationships. This step locks new information into long-term memory by fitting it into our current knowledge.

3. We analyze each of the new patterns and possibilities for logical flaws. This step assures that what we have learned is logically sound so that we can rely on it in our thinking.

4. We weigh the relevance of the new information to our own personal values and the values of others. This step provides us with an appreciation of the human consequences of what we are learning.

Psychological type theory helps us think about our thinking by separating it into these distinct mental functions. As a medical student, some of these mental functions are called upon more than others in the first two years of medical school. At first glance, the data collecting mental function seems to have the most obvious value considering the sea of information that must be navigated. However, my experience is that students who use the second mental function and spontaneously look for associations between facts and concepts tend to perform better on multiple choice exams.

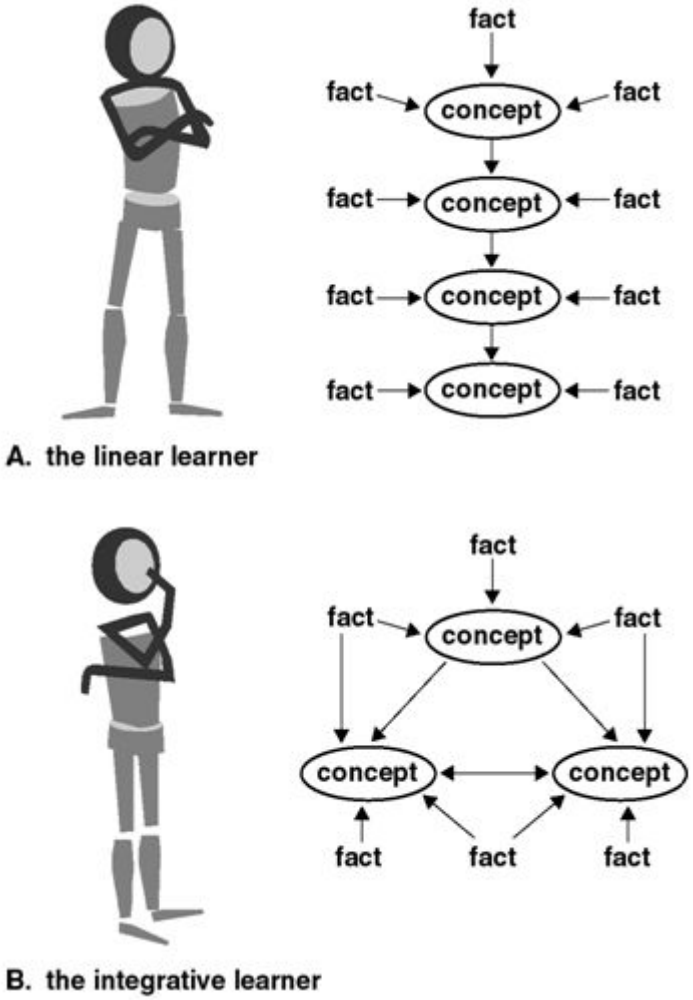

Figure 2.1 The linear learner connects concepts with their associated facts in sequence and doesn't look for associations between concepts unless they are also presented as a concept. The integrative learner spontaneously looks for connections between concepts and for facts that may apply to more than one concept.

I have noticed that the students who list and memorize facts tend to read and learn in a linear fashion, while students who look for fact and concept associations tend to read and learn in a more branched, integrative fashion (Figure 2.1).

Integrative learning results in "test-wise" students.

Test-wise students can perform better than their actual knowledge on tests because they have developed their ability to think deductively. Deductive reasoning is the process that applies general principles to a situation to determine specific conclusions. For example, I might ask you on an exam question to choose the most likely outcome if enzyme X were inactivated by a mutation. If I had not taught that outcome as a fact in lecture, you would have to deduce the correct answer from other general information that you had learned about enzyme X. This deductive thinking comes easily to integrative learners because they make associations between concepts and facts more easily. They spontaneously move their thinking from sensing into the second mental function, intuition, and begin to examine patterns and possibilities that they can analyze to decide on the correct answer. It is important to note that these students are not necessarily more intelligent, but they are better prepared mentally to use the information they have learned to deduce the correct answer to multiple choice questions.

> It's not what you know, it's how you think about what you know.
>
> J.W. Pelley

Linear learning puts students at a disadvantage.

Linear learning is particularly unsuited to the type of examinations that are used during the first two years of medical school and later on medical licensure examinations. If you were to analyze a typical medical school multiple choice examination, you would find that most of the questions are not testing recognition and recall of facts and concepts. Instead, you would find that to identify the correct answer,

> Concept: an abstract idea generalized from specific facts.
> Fact: reality determined from observation.

you would have to compare or contrast different concepts, or you might have to connect several related concepts to reach a conclusion - hard work for the linear learner, natural for the integrative learner.

Taken to the extreme, linear learners will remember facts and concepts but will only know the associations between concepts that are told to them. If it weren't for the fact that linear learners naturally form many associations as they study, regardless of their type, they would fail all of their exams miserably. The problem for the linear learner is not lack of intelligence or ability. The problem is that the integrative mental process that looks for associations does not come naturally to them, and they tend not to trust it. Because they don't trust integrative learning, they don't use it as often and rely on linear thinking.

Students with linear learning habits *can* become integrative learners.

One of the most important aspects of psychological type that makes it such an effective concept in education is that rather than confine you to a certain way of thinking, it frees you to develop your thinking. It is important to emphasize that you don't need to change your personality in order to develop your thinking skills. In fact, you couldn't change your personality if you wanted to. What you can do is acquire an understanding of the mental skills needed to succeed on multiple choice examinations, and learn how to incorporate those skills into your own thinking.

In my own experience, those students who have followed my SuccessTypes counseling exhibit less than half the failure rate of those who do not. By my own estimation, over 95% of the students who have come to me for academic counseling were linear learners.

How do you identify a person's type?

Psychological type is identified with the Myers-Briggs Type Indicator (MBTI), which consists of either 126 (form G) or 166 (form F) forced choice questions. "Forced-choice" means that you are asked to choose between two opposite situations, such as "Would you rather be considered as (a) a practical person, or (b) an imaginative person?" It is common for many choices to be difficult because your choice might be different depending on the circumstances. However, the MBTI is designed to help average the preferences in any one dimension to provide a reliable report of your type.

You will notice that the instrument is not called the Myers-Briggs Type "test." There are no right or wrong answers, nor are there sick vs. well types, mature vs. immature types, nor smart vs. dumb types. You don't have a little or a lot of a type, nor are you a strong or weak type. Type is simply a statement about your own "either/or" thinking preferences. The rule of thumb is that psychological type is determined by an indicator, whereas psychological "traits," such as the need for achievement, are measured by various tests. In contrast to an indicator, tests do give a quantitative measure of the trait. Although the MBTI is not an aptitude test, your type can indicate an aptitude for certain medical specialties because it reflects your preferences. Chapter 3 will refer to different medical specialties to illustrate the different types.

The score that is reported for each of the dimensions of type is not a measurement of the strength of your type. It is only an indication of how certain you are of your preferences; remember that type is an either/or choice. An integral and indispensable step in type determination is the verification of the results of the MBTI, especially where your score indicates uncertainty for a particular preference. Verification is discussed in Chapter 4.

Understanding the nature of type is critical to learning the SuccessTypes strategies.

The integrative learning style of the SuccessType student is only one of four dimensions of the mental habits that favor high test performance. Before reading about the four dimensions of type in the following chapters, you need to keep in mind some of the more fundamental aspects of type. These will be emphasized throughout the book:

a) Your preferences for certain mental habits are a persistent part of your personality and do not change once they are established.
b) Each preference is part of a dimension that consists of two polar opposite ways of thinking. Each of these opposites are *useful and important* mental functions.
c) The skills of the polar opposites can be learned without requiring you to undergo a personality change.
d) Type does not measure psychopathology (normal vs. abnormal) but can be biased by psychopathology.
e) There are no good or bad types.
f) The MBTI is not an intelligence test.

Type is only one of the ways of describing the dimensions of an individual's personality. Obviously, there are many other descriptions of personality, none of which come close to a complete description of an individual.

Your type is the starting line, not the finish line.

The SuccessTypes program is based on the fact that a type description doesn't confine you to a given learning style. Type merely predicts the way you will learn if you have the freedom to choose. The problem is that different learning environments, different courses, different professors, and different types of evaluation all impose the need for you to learn in different ways. In the first two years, the traditional medical school curriculum demands that you process a large volume of facts and concepts on multiple choice exams.. .and always in a hurry. My experience indicates that *in this situation*, there are some learning skills that contribute to success more than others.

As you read the explanation of psychological type in Chapters 3 and 4 and begin to consider your own type, chances are that you will not have developed the use of all the mental functions to their full potential. I want to emphasize two important points about your type. First, you are about to learn valuable insights into the potential of your own type. Later on in your career, you will find that an understanding of your unique attributes will guide you in making better decisions. Second, you can learn and develop the skills needed to become a SuccessType in any of the type dimensions. This means that you can develop the skills that will make you a SuccessType in medical school by taking advantage of your actual type. If you are already doing well in medical school, the SuccessTypes program can help you develop your type more fully.

Your type has several potential strengths.

The SuccessTypes philosophy is that your type, as with all the 16 types, has existing strengths and potential strengths. You notice that I didn't phrase that as "strengths and weaknesses." Those mental habits that you do not prefer to use are not weaknesses. They are aspects of mental function that you can learn to develop.

It is not your individual type that is a strength. It is your decision to develop your type and balance it by learning the skills of your opposites that is a strength. What you should be

prepared for is that, while developing your own type is fun and natural, developing the skills of your opposite is hard work.

Pelley's Profundities: Your type tells you when you are working and when you are playing.

I have developed two definitions to help emphasize what to expect when you try to develop the SuccessTypes learning strategies that are taught in the second part of this book:

1. Performing in your type is play.
2. Performing in the opposite of your type is work.

I have phrased these definitions to make two points, that: 1) work is not defined by the effort exerted, and 2) play is not without effort. Most of us at one time or another have played to the point of exhaustion. How, then, do we recognize work and play, if not by effort? I predict you will always find that those circumstances that draw on your type will be perceived as play, and those circumstances that require you to function out of your type will be perceived as work. A colleague of mine is an extravert and, for her, giving a lecture is like play. She is so energized by extraverting during the lecture that when she teaches an evening course it takes her several hours after the lecture to wind down before she can even go to sleep. On the other hand, I am an introvert and giving a lecture is hard work for me. After two hours of lecture in the morning, I need some alone time to recuperate. In both cases, we both devote a lot of effort to the lecture, and our student evaluations indicate that we both do a good job, but only one of us is at play.

The insight that I want to provide here is that you can and do use all of your mental functions even though you may work harder at some compared to others. The important thing is not your ability to use skills outside your type, it is your willingness to exert the effort.

Now it is time to start finding out what type you are.

Let's go over the main points:

1) While integrative and linear approaches to learning are both valid, integrative learners tend to be better prepared for multiple choice exams.
2) Psychological type can reveal a preference for either the integrative or the linear learning style because it describes how you prefer to process information.

3) The MBTI determines your type by asking you to make a series of choices between two opposite ways of describing yourself.
4) Psychological type does not describe intelligence nor does it measure pathologic behavior.
5) Type doesn't describe limitations on your thinking, but it does tell you what kinds of learning will be harder for you and what types will be easier.
6) You can't change your type, but you can learn skills.

Chapter 3
Psychological Types:
Which of the preferences best describes you?

This chapter will help you to understand the characteristics of the mental functions that determine psychological type. It is not a substitute for the MBTI and you will only get a true picture of yourself by having the MBTI administered by a qualified professional who can help interpret the results. Suggestions for where to take the MBTI are listed in Appendix B.

I have chosen examples from everyday life, from the choice of medical specialty, and especially from learning situations to help describe each of the type dimensions. Four dimensions with their single letter abbreviations define your type: Extraversion (E) vs. Introversion (I), Sensing (S) vs. Intuition (N), Thinking (T) vs. Feeling (F), and Judging (J) vs. Perceiving (P).

Carl Jung laid much of the groundwork for Myers and Briggs.

Carl Jung published his theory of personality in *Psychological Types* in 1921. He was influenced by Pavlov's research on differences in how people respond to pain and stress and eventually correlated these differences with introversion and extraversion. Jung continued these studies to include the other personality types that correspond to Pavlov's stimulus-response model since perception is analogous to a stimulus and judgment is analogous to a response. He defined perception to include both a conscious *sensing* process and a relatively unconscious *intuitive* process. His definition of judgment included a rational *thinking* component and an emotional *feeling* component. Jung also found that extraversion describes the overall interest of a person in the outer world of events and people and that introversion describes the overall interest of a person in the inner world of concepts and ideas.

Isabel Myers and Katherine Briggs introduced a fourth dimension of personality by describing whether judging or perception predominates in the way people deal with the world around them.

The judging process predominates when a person emphasizes decisiveness, and the perceptive process predominates when a person emphasizes openness to new information.

As you read descriptions of the mental habits that describe each type, keep in mind that the demands of everyday living require everyone to use all of these mental processes all the time. What is different for each type is found in which of the processes they *most prefer*, that is, with which process they are most comfortable.

Ex*traversion (E) vs. Introversion* (I*)*: What is the source of your energy?

The terms *extravert* and *introvert* ought to sound familiar.

The psychological type dimension that is most familiar to the general public is the extravert vs. introvert dimension. Carl Jung originally derived these terms from Latin roots to represent extraversion as "outward-turning" and introversion as "inward-turning." Although these terms are familiar to most, their usage is usually just a substitute for describing a person as being either sociable and "people-oriented" (extraverts) or as being reserved and the "quiet type" (introverts). The extravert/introvert dimension affects your thinking and your learning in a far more important way than these generalizations lead us to believe, however. This dimension determines the source of the energy for your thinking.

Are your thoughts energized more by your outer world or your inner world?

Extraversion and introversion are descriptions of where your interests lie. If you are drawn to your outer world of people and events, the energy for your thinking will come from these external sources. On the other hand, if you are drawn to your inner world of facts and concepts, the energy for your thinking will come from reflection and contemplation. Therefore, the thinking of an extravert will be influenced more by events that occur around them, whereas the thinking of the introvert will be influenced by thoughts that occur within them.

> If you don't know what an extravert is thinking, you haven't been listening,
> but if you don't know what an introvert is thinking, you haven't asked!

People sometimes imply that introverts, unlike extraverts, are antisocial. It is more accurate to say that extraverts are energized by interacting with people as a part of their environment, whereas introverts are energized by interacting with people in their reading and in their thoughts. An interesting feature of the introvert is that he or she will be comfortable with one other person, but will tend to be less expressive with more than one other person.

Here's a quick check for your preference for extraversion vs. introversion.

Your preference for extraversion or introversion may be found in the way you like to recuperate after a long period of hard work. Extraverts will usually seek out friends and activities that put them in touch with their outer world. Introverts tend to seek out a book, some music, a walk in the park, or any other activity that gives them the solitude needed for getting in touch with their inner world.

Your preference for extraversion or introversion can also be found in the way you learn.

Extraverts tend to learn best by studying with several others, whereas introverts learn best by studying alone or with one other person. If you are an extravert, you probably like learning first through activity and trial-and-error, followed by contemplation. If you are an introvert, you probably like learning first through quiet contemplation. Extraverts tend to have shorter attention spans and introverts tend to have longer attention spans.

Extraverts and introverts tend to select medical specialties that match their type.

- Extraverts are attracted by specialties that offer high levels of interpersonal contact, such as pediatrics or clinical teaching, or by action-oriented specialties such as surgery or obstetrics.
- Introverts are attracted by specialties requiring sustained attention and more time working individually or in one-to-one interactions. Introverts are also attracted to postgraduate training and academic settings.

Sensing (S) vs. Intuitive (N): How do you see the world?

Jung used the terms *sensing* and *intuitive* to describe how people take in information.

This dimension describes how we prefer to perceive new information, and of the four type dimensions, it is the single *most important* for achievement on multiple choice examinations. Most of the methods in the second part of this book are aimed at developing intuitive skills. The distinction between sensing and intuitive preferences relates to which aspect of new information you would rather give the greatest attention. If you prefer to focus on what's happening now, what you can touch or manipulate, and what is real and factual, then you likely have sensing preferences. If, on the other hand, you prefer to use your imagination to relate new information to other concepts that you already know and to see patterns and possibilities, then you likely have intuitive preferences. The sensing type is usually more comfortable thinking in the "here-and-now" present while the intuitive type can't resist thinking in the "what-if" future.

> Sensing types prefer to see a big picture as one more fact, but intuitive types only give their attention to the facts in their big picture…and ignore the rest!

If you are a sensing type, you are usually able to write down all of the information in a lecture and it is generally organized exactly the way it was presented. If you are an intuitive type, you usually miss some of the lecture because everything that is new and interesting takes your attention away to the world of associations and possibilities. Instructors who frequently repeat what they just said are a blessing to the intuitive type student. Sensing type students thrive on handouts and other aids that give a visible structure to the lecture, and they are dismayed when the instructor wanders off of the main path with examples or anecdotes, attempting to try and clarify or explain a concept. Intuitive type students are bored with handouts and lists of facts, and they are interested and attentive when the instructor wanders off the main point with examples or anecdotes that clarify or explain a concept.

Here is a quick check to determine your preference for sensing vs. intuition.

Your preference for sensing or intuition may be found in the way you would go about building a cabinet. If you are a sensing type, you would be concerned with having a proper set of instructions, and you would take great pains that they were followed exactly. Your sensing preferences would cause you to focus on the selection of the proper wood to get the right texture and making the exact measurements and cuts to ensure precise fit. You would take pride in

doing a good job of sanding and finishing so that the final result was exactly the way it was intended. You would look forward to doing the next cabinet even better.

If you are an intuitive type, you would rather design the cabinet. In fact, you would rather design several cabinets in case there might be a need for different cabinets under different circumstances. You would be tempted to try to figure out how the parts fit together before reading the instructions, referring to them only when necessary. Less care would be taken with measurements and with sanding and finishing because you could always find a clever way to cover up a mistake. Instead of looking forward to building the next cabinet better, you wonder what it would be like to build a chair.

Your preference for sensing or intuition can also be found in the way you learn.

Your preference for sensing or intuition may be found in the way you study a chapter assignment or lecture notes. If you always begin at the beginning and read through the material in sequence, never going on to the next section until the current section has been covered satisfactorily, then you are likely to be a sensing type. If you find yourself scoring lower on exams even though you have memorized massive amounts of information, you are probably a sensing type. Sensing types are often dismayed that other students who don't seem to be able to recall as many facts tend to achieve higher scores than they do.

If, on the other hand, you tend to jump around in the book or lecture notes looking for the more interesting sections to study first, never content to simply start at the beginning like everybody else, then you are likely to be an intuitive type. If you always seem to be able to figure out the correct answers on exams even though you can't seem to memorize enough information, you are probably an intuitive type. Intuitive types are often dismayed by other students who seem to be able to memorize more than them, although they make up for this by quickly developing an understanding of the material. Their tendency to be distracted while they are studying gives intuitive types the feeling that they are not working hard enough.

Sensing types will tend to score lower than intuitive types on multiple choice tests but will tend to equal intuitive types when tested by actual performance in real life situations. In terms of the medical curriculum, intuitive types have the edge in the first two years where the predominant

mode of evaluation is by multiple choice examinations, but this edge is equalized in the more "hands-on" clinical training of the third and fourth years.

Sensing and intuitive types tend to select medical specialties that match their type.

- Sensing types are attracted to specialties that involve medical procedures requiring sensory awareness, such as surgery, and they take pride in consistency in following established practices. Their preference for practical attention to day-to-day events and consistency in routine office procedures also attracts many sensing types to family practice. The main difference between surgeons and family practitioners is not in the sensing preference that they both share in common, but in the way they handle complexity. Surgeons train for many years, repeating complex surgical procedures until they know exactly what to expect. Family practitioners don't train to manage complexity, they just refer it to a specialist!
- Intuitive types are attracted to specialties such as internal medicine that involve diagnosis and treatment of diseases, and they take pride in being able to solve complicated problems. The variety of complex clinical problems presented to the internist fits their natural instinct to identify relationships among symptoms and to develop the educated guesses that constitute a clinical diagnosis. The routine medical procedures that satisfy the preferences of most family practitioners or surgeons would eventually drive the internist right up the wall.

Thinking (T) vs. Feeling (F): What's your reaction?

Jung used the terms *thinking* and *feeling* to describe how people react to new information.

If you tend to respond to new information in terms of its logical basis and you tend to form your evaluations objectively, then you are a thinking type. If, on the other hand, you tend to respond to new information in terms of its human consequences and you tend to form your evaluations subjectively, then you probably are a feeling type. Thinking types need to remember that the feelings of others are facts that should be taken into account in their decisions, and feeling types should remember that thinking types have feelings, too; they just don't trust them in making decisions.

If you are a feeling type, you will have a difficult time relating to the objective aspects of science courses like biochemistry and physiology; but whenever clinical correlations relate the material to actual human conditions, your motivation for learning the information will increase dramatically. If you are a thinking type, you will appreciate instructors who are well-prepared and whose lectures are logically consistent. Thinking type students appreciate a lecturer who actually answers the question they asked, and feeling type students appreciate a lecturer who thanks them for asking such a helpful question.

Here is a quick check to determine your preference for thinking vs. feeling.

Your preference for thinking or feeling may be found in the way you see a sick patient. If you focus first on the disease and then you see how it is affecting the patient, you are likely a thinking type. On the other hand, if you are a feeling type, you will focus first on how the disease is affecting the patient and then you will turn your attention to the disease.

Your preference for thinking or feeling can also be found in the way you learn.

If you are a thinking type, you will learn best when you are given clear and relevant study objectives. If you are a feeling type, you will learn best when you are given personal encouragement. You will begin studying first the material that needs to be learned if you are a thinking type, but if you are a feeling type, you will begin studying first the material that you value personally. The thinking vs. feeling dimension, then, is more of a motivational issue than one of learning and using information. Of the four dimensions, thinking vs. feeling is probably the least important in determining success in the first two years of medical school. This dimension emerges with a more dominant role in learning in the last two years of clinical training where feeling types have a natural inclination toward involvement with, and communication with, patients.

> Thinking types need to remember that *feelings are also facts*, which must be taken into account in their logic, but feeling types need to remember that thinking types have feelings too!

Thinking and feeling types tend to select medical specialties that match their type.

- Thinking types are attracted to specialties requiring technical skill and tough-minded objectivity, such as pathology or medical research.
- Feeling types are attracted to specialties in which they can give care and understanding through direct patient contact, such as pediatrics, internal medicine, or psychiatry.
- Thinking types usually need more training in communication skills than feeling types.

It is important here to reiterate one of the general cautions about psychological type. None of the dimensions of type are good or bad. All people react in both the thinking and the feeling dimensions; it's just that some people trust logic more than feelings and others trust feelings more than logic. Medicine has a need for both types.

Judging (J) vs. Perceiving (P): How organized are you?

Myers and Briggs developed the *judging* vs. *perceiving* dimension to describe how people structure their lifestyles.

This dimension describes how much discipline we prefer in our lifestyle, and of the four type dimensions, it is the second most important for achievement in the first two years of medical school. Some of the methods presented in the second part of this book are aimed at developing the judging skills that are described in this section. The distinction between judging and perception relates to our preference either for the decisiveness that comes with the judging process or for the openness that comes from the perception process. If you prefer to live an orderly, planned lifestyle, then you have judging preferences. If, on the other hand, you prefer to live a spontaneous, adaptive lifestyle, then you have perceiving preferences.

> Judging types end their verbs with "-ed" while perceptive types end their verbs with "-ing,"
> …finished vs. finishing!

Judging types emphasize their thinking or feeling judgment in the way they structure their lifestyle. If you are a judging type, your emphasis on decisiveness motivates you to meet deadlines and to set up goals with schedules to ensure that you meet those goals. Compared to the perceiving types, you will generally be more dependable and responsible, but extra energy is required to be adaptable.

Perceiving types emphasize their sensing or intuitive perception in the way they structure their lifestyle, if you could call it structured. If you tend to be late for appointments, to miss deadlines for term papers, and to always drift away from a schedule, you are probably a perceiving type. Compared to the judging types, you will generally be more open to new information, but extra energy is required to be responsible and dependable.

Here is a quick check to determine your preference for judging or perceiving.

Your preference for judging or perceiving may be found in the way you take a vacation. You may be like a friend of mine who arranges everything in advance so that she knows exactly where she is going to stay and she knows exactly what route she will have to travel. Also, she knows what she is going to do when she gets there, how much it will cost her, and what she will need to wear for each specific activity. If you tend to plan a vacation that way, then you are likely to be a judging type. On the other hand, you may be more like me. I'm more interested in determining the best place to stay after I get there because I might find something better, and I'm always willing to change my route if I discover something interesting on the way. If possible, I'll wait to figure out what to do when I get there because that way I can size the situation up a little better, and I'm not worried about how much it will cost because I'll adjust my budget as I go. My wardrobe is always mix-and-match, so I can pack less and still be able to dress for a variety of events. Sound familiar? If so, then you are likely to be a perceptive type.

Your preference for judging or perceiving can also be found in the way you learn.

Your preference for judging or perceiving can be found in your study schedule. If you always complete assignments as soon as possible and you do your best work when you have a schedule to follow, you are likely to be a judging type. If you tend to delay completion of assignments until you are certain that you have taken everything into account and you find schedules confining, then you are likely to be a perceptive type.

Judging types don't rest very easily if they are denied closure, whereas perceptive types don't rest very easily if they are denied access to additional information. It is easy, but not correct, to stereotype the judging type as compulsive and the perceptive type as an unmotivated

procrastinator. However, the skills of the judging type bring discipline to learning and the skills of the perceptive type bring an openness to new information.

Judging and feeling types tend to select medical specialties that match their type.

- Judging types are attracted to medical specialties where situations involving systematic procedures and order are important.
- Perceptive types are attracted to medical specialties that require constant adaptability to changing demands.

Let's go over the main points:

1) Extraversion and introversion describe where the energy for your thinking comes from.
   - If you are an extravert, people and events get most of your attention.
   - If you are an introvert, thought and reflection get most of your attention.
2) Sensing and intuition describe how you focus on new information.
   - If you are a sensing type, you focus on what is real and tangible and in the present.
   - If you are an intuitive type, you focus on what is possible and in the future.
3) Thinking and feeling describe how you react to new information.
   - If you are a thinking type, you react logically and you don't trust your feelings to make decisions.
   - If you are a feeling type, you react to what you value personally and you don't trust logic in making your decisions.
4) Judgment and perception describe how much you need discipline in your everyday life.
   - If you are a judging type, you prefer a more orderly, planned lifestyle.
   - If you are a perceiving type, you prefer a more spontaneous, adaptive lifestyle.

Chapter 4
Putting it all together: Your type is greater than the sum of its parts

Your type is represented by a combination of four letters.

By combining the single letter abbreviations for your preferences in each type dimension, the MBTI provides a four-letter representation that describes you. A description of all 16 types can be found in Appendix A. Keep in mind as you evaluate your type description that your type is not a pigeonhole, but a way *you* have chosen to describe yourself. It is as natural as saying, "I really prefer jazz to country music." That statement doesn't confine you to listen only to jazz or restrict you from listening to country music. It does say something, however, about where you are most likely to be found at a music festival.

Table 4.1 demonstrates the consistency among people of the same type. This table shows the results of a study by Isabel Myers where medical students with each of the 16 types selected certain specialties at a statistically higher ratio than would have been predicted by their representation in the overall student population. This demonstrates that medical students with the same type tend to group according to the specialties that are attractive to their particular type. If psychological type were not a consistent part of our behavior, no single specialty would show up on this table as being preferred by any one type. You will notice, however, that *specific* specialties not only show up as preferences, but the *type* of specialty preferred matches the characteristics of the psychological type. For example, the intuitive types (the "N's") tend to like the diagnostic problem-solving found in areas like internal medicine, pediatrics, and psychiatry, while the sensing types (the "S's") tend to like subjects involving medical procedures or routine care such as surgery or family practice. What is not shown in Table 4.1 is that all of the types selected into all of the specialties, although not at a statistically significant rate. Thus, many students select into all specialties regardless of their type, probably because type is not the only

factor in choosing a specialty. One interesting exception to the influence of type is that sensing types demonstrated a negative correlation (i.e. avoidance) with psychiatry!

People with the same type will also have many differences.

Psychological type is not a stereotype. People with the same type may share similar preferences in their overall mental habits, but they do not behave identically. For example, intuitive types can have interests in such diverse fields as either art or science. What the intuitive artist and the intuitive scientist have in common is the use of their preference for insight and creativity. Similarly, sensing types are not restricted from either art or science. Their preference for what is real and practical will cause the sensing artist to focus more on the practical aspects of art through craftsmanship and realistic representation, while the sensing scientist will focus on the application of scientific principles. In other words, your type indicates how you will tend to act and react according to your individual life experiences, but it does not compel you into exactly

ISTJ Dermatology OB/Gynecology Family Practice	**ISFJ** Anesthesiology Family Practice Ophthalmology	**INFJ** Internal Medicine Child Psychiatry	**INTJ** Child Psychiatry Internal Medicine Pathology
ISTP Anesthesiology OB/Gynecology Radiology	**ISFP** Anesthesiology Family Practice Urology	**INFP** Psychiatry Cardiovascular Diseases	**INTP** Neurology Psychiatry Pathology
ESTP Orthopedic Surgery Dermatology Family Practice	**ESFP** OB/Gynecology Thoracic Surgery Ophthalmology	**ENFP** Psychiatry Child Psychiatry Dermatology	**ENTP** Otolaryngology Psychiatry Radiology
ESTJ OB/Gynecology General Surgery Orthopedic Surgery	**ESFJ** Pediatrics Orthopedic Surgery Otolaryngology	**ENFJ** Psychiatry Thoracic Surgery Public Health	**ENTJ** Neurology Internal Medicine Cardiovascular Diseases

Data from the Specialty Choice Tables, pages 7- 10, in The Myers-Briggs Type Indicator in Medical Career Planning by Mary H. McCaulley, 1980. Gainesville, FL: Center for Applications of Psychological Type.

Table 4.1: Medical specialties statistically significantly preferred by each type.

the same lifestyle as others with your type. Otherwise, there would only be 16 different types of jobs, 16 different types of hobbies, 16 different types of homes, 16 different... well, you get the point.

You use one of the mental functions more than the others.

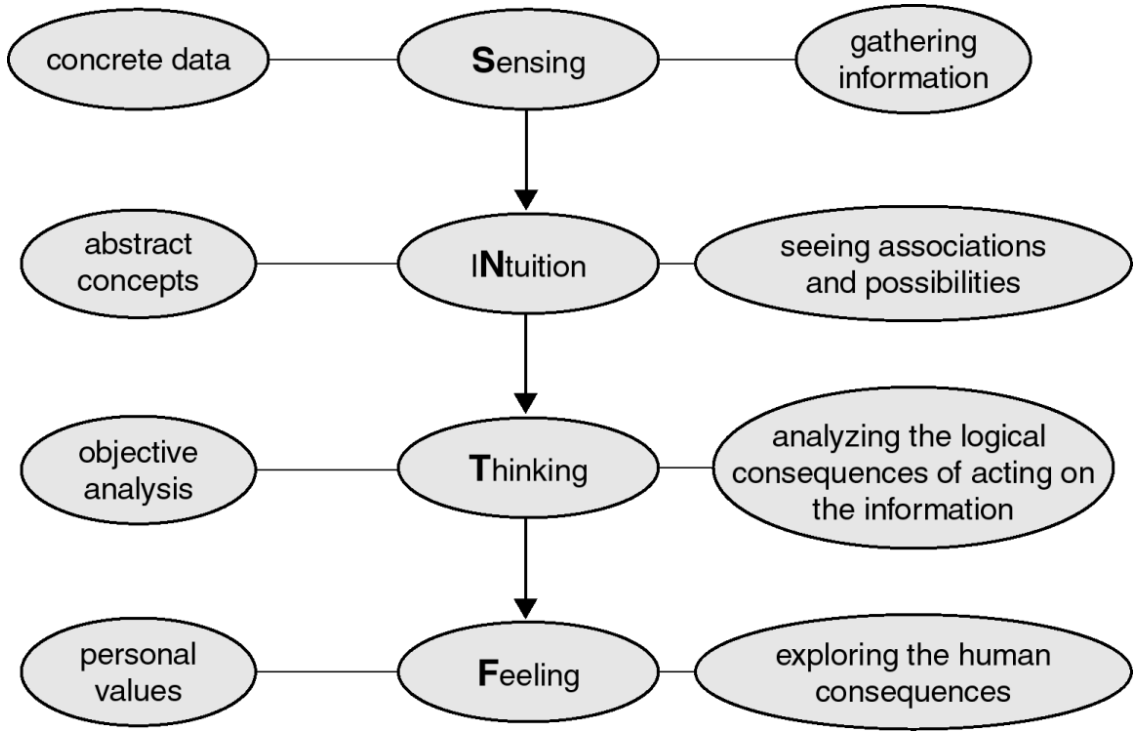

Figure 4.1: Table Use of the mental functions in information processing. Different types prefer to emphasize each step differently.

Personality is not determined by the simple addition of the four dimensions of type but by the way they interact. For example, when you learn something new, you use all of the mental functions, but not with equal emphasis (Figure 4.1). You first gather information with the sensing function followed by associating that information with new possibilities. You then proceed to determine the logical consequences of the new information, and then you react emotionally to the human consequences. Each psychological type emphasizes the use of one of the four functions over the others. This function, called the dominant function, is the one that develops first during childhood, and, because it is the most used, it becomes the best developed.

You can find your dominant function in Table 4.2. As you might expect, your dominant function will play a dominant role in your overall learning style.

Type	Dominant Function	Inferior Function
ESTP, ESFP ISTJ, ISFJ	Sensing	Intuition
ENTP, INFP INTJ, INFJ	Intuition	Sensing
ESTJ, ENTJ ISTP, INTP	Thinking	Feeling
ESFJ, ENFJ ISFP, INFP	Feeling	Thinking

Table 4.2: Each type has a dominant function that is most used and best developed. There is a corresponding inferior function for each type that is the least used and least developed.

Your least used function shows up when you least expect it.

Table 4.2 also lists your least used function, which Carl Jung called the inferior function. Because this function is used the least, it develops much later in life. The inferior function is an important concept because it reveals much about how you tend to deal with stress. This topic is important enough to your academic success that I have devoted a whole chapter to it in Part III.

Verification is needed to identify your type more accurately.

Whenever an individual takes the MBTI, it is crucial to verify that the correct type has been identified. That's because it's easy to bias the MBTI. The MBTI is like a mirror and bias is like a mask. If you wear a mask and look into the mirror, you will see the mask. If you look into the mirror with no mask, you see yourself. All you have to do is claim to have preferences that aren't really true for you, and you have put on a mask. If you mask your true type, you will not

only get an incorrect picture of yourself, but little if any of the discussion about becoming a SuccessType will be relevant to you.

So, why would anybody bias their type determination? For the same reason that actors wear makeup - it helps them look the way they think they ought to look. If you choose a response that reflects what you think you should be rather than what you truly are, you have introduced bias. An introvert who wishes she was more outgoing might represent herself as preferring to go to parties, and a perceptive type who wishes he was more organized might represent himself as preferring to use a daily planner to get things done. Clearly, introverts can stay late at parties and perceptive types may use daily planners, but that doesn't mean they prefer it. Factors such as peer pressure and parental expectations, a period of crisis or major transition, the demands of your career, and untreated psychopathology can bias type determination by causing uncertainty in preferences. All of these factors interfere with self acceptance, a crucial requirement for avoiding bias.

Students and physicians frequently comment that when they hear my description of type, they seem to have one preference, but when they look at what they actually do, they seem to have the opposite. One physician, for example, said that my description of a person who prefers to live a more adaptive and less orderly life style described him very well. When he showed me the schedule in his daily planner, however, it seemed to indicate that he lived a very structured, orderly life. I asked him if he used his planner when he went home for the evening, and he replied "Heavens, no! At home, I'm free to do what I choose"...and suddenly he understood. This was a good opportunity to illustrate that type does not confine an individual to a way of behaving or performing, it simply tells you how you behave naturally. This physician was clearly functioning the way his job required.

Are you interested in learning more about yourself?

This SuccessTypes book is focused on performance in medical school and does not involve elaborating on many of the other useful concepts of type. However, there are several type concepts that can be important for anyone interested in understanding themselves and others better. In particular, psychological type is useful in strengthening relationships and improving communication skills because it fosters an understanding of both the validity and the mutual

usefulness of different ways of thinking. You can find out more about type in communications, career strategies, team building, leadership, and religion from the recommended reading listed in Appendix B. Also, if you really get hooked on type, you can join the Association for Psychological Type International (APT*i*) that will keep you up to date on research into the theory and applications of type. Their address is also in Appendix B.

Let's go over the main points:

1) Your type is a combination of four letters that represent each of your preferences.
2) Type is more than the sum of its parts.
3) Everybody with the same type is not exactly alike.
4) Everybody has one mental activity, the dominant function, that they prefer and use more than the others.
5) The least used function, the inferior function, is the opposite of the dominant, and it provides important insights into stress behavior.
6) The MBTI can be biased by factors that interfere with self acceptance.
7) There's more for you to learn about the usefulness of type in communication and relationships.

Chapter 5
Type and test performance: What does psychological type teach us about learning style?

This chapter and the next will introduce you to the learning strategies taught in Part 2. This chapter elaborates more thoroughly on the role each of the type dimensions plays in the achievement of high test scores, and Chapter 6 explains some basic learning principles that are also important in improving your performance on multiple choice examinations.

It is important to distinguish between preference and ability.

Your type preferences may lead to an aptitude in certain activities, but they don't limit your ability. Aptitude is tied in some measure to the various interests that are due to your psychological type preferences. You will naturally develop a skill or strength in those interests. Likewise, your type preferences will naturally lead to a learning style that is most comfortable for you. But it is important for you to know that whatever your type preferences are, they don't place a limit on learning skills that you decide you want to develop. Instead, your type preferences can contribute to the further development of your learning skills.

Table 5.1 has examples of how all of the dimensions of psychological type are represented in the ways we learn. As I have emphasized earlier, any type can learn the skills involved in any of these dimensions. Remember, though, if you are developing learning skills that don't match your type preference, it will require more effort than developing skills that more naturally suit your type preferences.

Table 5.1

EXTRAVERSION	INTROVERSION
Learn best with others.	Learn best alone or with individual attention.
Like learning through activity and experience. Shorter attention span.	Like quiet for study without interruption of concentration. Longer attention span.
Employ trial and error to see what works and what doesn't.	Anticipate problems before plunging in too quickly.
Go from doing to considering and then back to doing.	Go from considering to doing and then back to considering.
Good at initiating.	Good at reacting.
Put learning into action before the idea gets stale.	Pause to understand clearly before putting learning into action.
Communicate learning best through demonstrating.	Communicate learning best through describing.
SENSORY PERCEPTION	**INTUITIVE PERCEPTION**
Patient with routine or detailed material.	Patient with abstract or complex material.
Errors of fact are rarely risked or encountered.	Errors of fact are considered natural to learning.
Annoyed when a part of communication is left to the imagination.	Bored when communication is too explicit.
Observant at the expense of imagination.	Imaginative at the expense of observation.
Enjoy using what's already learned.	Enjoy learning new things.
Value soundness and usefulness of understanding.	Value quickness and originality of understanding.
Re-examine answers to test questions to be certain.	Trust first hunches about answers to test questions.

Like the chance to be precise on untimed tests.	Like the challenge of timed tests.
Seek understanding of new symbols in a careful and deliberate way. Work from present experience.	Seek understanding of new symbols through unconscious impressions and hunches. Work in intuitive leaps.
Work steady, step-by-step.	Work in bursts of energy.
THINKING JUDGMENT	**FEELING JUDGMENT**
Learn best when given a clear and objective rationale.	Learn best when given personal encouragement.
Like giving and receiving a critical analysis.	Criticisms are often taken personally.
Solve problems according to "right vs. wrong" principles.	Solve problems through determining what's most important to the people involved.
Begin studying first that which should be learned.	Begin studying first that which is more valued personally.
Good at weighing the logical consequences of alternative courses of study.	Good at deciding what would be most rewarding among alternative courses of study.
JUDGING	**PERCEIVING**
Complete tasks on time or early.	Postpone unpleasant tasks.
Often overachieving.	Often underachieving.
Structure things now to avoid unexpected emergencies later.	Comfortable dealing with the unexpected when it arises.
Give answers due to valuing decisiveness. Orderly use of information.	Seek information due to valuing inquisitiveness. Pick up more information.
Finish one task before starting another one.	Start many tasks and delay finishing most.

From table on learning preference in *People Types and Tiger Stripes* (3rd ed., pp. 43-46) by Gordon D. Lawrence, 1995. Gainesville, FL: Center for Applications of Psychological Type.

Introverting skills for extraverts: Effective learning takes a little patience.

If you are an introvert, you usually pause to understand a concept clearly before trying to use it. Introversion predisposes you to think deeply, giving you the time and patience to construct associations and correlations in your mind. This patience also predisposes you to focus on the material you are studying and absorb more information. For externally oriented extraverts, patience is hard work because of their preference for moving quickly from topic to topic and their desire for frequent interaction with other people. However, if extraversion isn't balanced with introverting skills, it will lead to superficial learning and will neglect the integrative learning that is needed to think about multiple choice questions.

As described throughout Part II, your natural introverting skills can be developed by gradually increasing the time intervals that you spend actively summarizing your learning assignments.

Extraverting skills for introverts: Thinking out loud can refine your thinking.

The preference of the extravert to think out loud and work in groups helps to refine what has been learned and provides a verification that one understands the material. It's a little difficult to carry on a conversation about something you don't understand. Also, the extravert is predisposed to consider the breadth of a subject, helping to ensure that important topics are not left out.

As described in Chapter 9, your natural extraverting skills can be developed by joining a weekly group study session.

Intuitive skills for sensing types: What are the rules for seeing relationships?

If you are an intuitive type, you have a tendency to organize material in a way that makes recall easy and deduction possible. Your intuition encourages you to seek understanding through an almost unconscious process that occurs in bursts of energy, causing your learning to progress in leaps and spurts. Because of this process, you tend to trust your first guesses on multiple choice exams. The use of imagination that is required to work in this integrative mode is hard work for the more concrete and practical sensing type who thinks more in the present moment. However,

if literal, linear learning is not balanced with an understanding of the relationships between facts, the preparation for multiple choice examinations will be incomplete.

> Noticing what *actually* is needs to be balanced by noticing what *might* be.

Your natural intuitive skills can be developed by practicing the concept mapping method along with the other methods in Part II that support concept mapping. Sensing type students consistently report to me that they develop the ability to "see" the material differently after just a few days. They have a lot of uncertainty at first, and then a light goes on and they are able to discover relationships they never saw before.

Sensing skills for intuitive types: You need to ensure that *all* of the material is studied.

The preference of the sensing type to focus on pertinent facts and to proceed in a step-by-step fashion helps to ensure that the topics to be learned are covered completely. This type of patience enables you to keep track of important details that you might overlook if you have intuitive preferences. If you have sensing preferences, you will also be able to help your intuitive friends understand the practical application of the concepts they are learning.

Your natural sensing skills can be developed very effectively by paying close attention to the expansion steps in concept mapping (Chapter 7). Intuitive students have told me that they have developed the ability to see more relevant details by looking for everything in the learning assignment that needs to be "hung" on their maps. They also consider using concept maps a great memory technique because they can visualize where the details fit in the overall picture.

Thinking skills for feeling types: Do I have to give up my sense of humanity?

If you are a thinking type, you organize and structure information so that relationships are logical. Thinking skills help you to see cause-and-effect relationships that are a major component of multiple choice exams. These skills, incidentally, are also very helpful in learning diagnostic skills in the clinical years. A logical approach leads to efficient study by focusing your attention on those things that should be studied first. For the feeling type, learning the

material from basic science courses may be hard work when the human implications of the material are not readily apparent. However, if the feeling preference isn't balanced with the logic and organization of the thinking preference, it will lead to uneven learning with a weakness in any area that does not fit the student's personal values.

Your natural thinking skills can be developed in group study or in one-on-one study when you carry out the verification process described in Chapter 10. When you have to explain what you know to someone else, you develop your ability to think logically.

Feeling skills for thinking types: You can bring more enthusiasm to learning.

The preference of the feeling type to persuade and reach conciliation can contribute to group study by minimizing interpersonal conflict. Also, the importance of personal values to the feeling type leads to an enthusiasm for learning by making it relevant to human outcomes. If you are a feeling type, your spontaneous concern for determining what is most important for your patients will lead to very positive evaluations in your clinical training. Your natural feeling skills can be developed by a method that I and other thinking types use. You should consider feelings as important facts to take into account in any particular situation. Chapter 11 on stress also has some suggestions for developing your feeling skills, as well as your sensing, intuitive, and thinking skills. The rudder that is manned by the thinking type is of little value without the wind in the sails provided by the feeling type.

The rudder that is manned by the thinking type is of little value without the wind in the sails provided by the feeling type.

Judging skills for perceiving types: Just how organized do I need to be?

If you are a judging type, you have a plan for study and you complete it on time. Your judging preferences contribute to both effective and efficient learning by ensuring that the material to be learned is covered in depth. In medical school you must make good decisions about what to study and also have the discipline to get the job done. Unless you are already a medical student, the idea that there may not be enough time to study all of the material in depth for an exam is

probably a new concept to you. This lack of enough time to master all of the material presented is a major shock to every new medical student. This means that you can no longer catch up on the weekend if you fall behind, and it means that you can't pull off a good grade with an all-nighter. That just doesn't work in medical school – trust me on this. The discipline required for following a study schedule is hard work for the adaptive, open-minded attitude of the perceptive type. If you are a perceptive type, you will notice a tendency in yourself to postpone any serious attempt at learning until you're sure that you've collected all the information. However, if your flexible approach to learning is not balanced with the organized mentality of the judging type, you won't have time to organize the information you have to learn.

> Without a study schedule, you will run out of time before you run out of material.

Your natural judging skills can be developed by following the time management system described in Chapter 10.

Perceptive skills for judging types: Flexibility can bring new opportunities for learning.

The preference of the perceptive type to remain open to new information and to adapt to new situations helps to bring flexibility to learning. Not all subjects or topics can be learned at the same pace and in the same way, and sometimes the plan needs to be changed. A schedule can protect you from falling behind in your learning, but it can also prevent you from taking advantage of new opportunities for learning. This could happen, for example, when you decline an opportunity to participate in a spontaneous group review session because it is not in your study schedule.

Your natural perceptive skills can be developed in group study as described in Chapter 9. Hearing new versions of the same material will help you see the advantages to remaining open to new information. Also, since groups by their very nature become spontaneous, you can develop your ability to take advantage of any new learning opportunity that appears as the group switches between subjects.

SuccessTypes develop the skills in each type dimension in order to improve their learning style.

It is clear that some of the type skills contribute to your learning more than others depending on the performance measure. When that performance measure is a timed multiple choice examination, the logical skills of the thinking type will be called upon more than the people skills of the feeling type. However, the sensitivity of the feeling type will called upon more than the objectivity of the thinking type when the performance measure involves patient communication.

In my experience, the development of intuitive skills will help all types of students develop the integrative learning style that is so important to thinking deductively on multiple choice exams. The goal of this book is to help you develop an integrative learning style while taking advantage of the opportunity to develop other type skills to make you a more effective student.

Let's go over the main points:

1) Your type preferences can contribute to the development of your learning style, rather that place a limit on them.
2) The skills for each type preference can be learned by the other types.
3) Introversion brings periods of reflection and contemplation needed for seeing associations and relationships between facts and concepts.
4) Extraversion brings an opportunity to verify learning.
5) Intuitive skills bring an awareness of the connections between facts and concepts and allow deductive reasoning.
6) Sensing skills help to provide enough facts to think with.
7) Thinking skills bring a logical order to facts and concepts, thus aiding memory.
8) Feeling skills can provide motivation by helping you maintain a long range perspective about why the learning is important to you.
9) Judging skills bring the discipline and organization needed for efficient time management.
10) Perceiving skills keep you open to new potentially valuable information.
11) Different performance criteria will draw more on some type skills than others.

Chapter 6
Basic requirements for success on MCQs: Is your mind in gear?

In this chapter, we will focus on a number of relevant general learning principles. In the same way that your personality is not completely described by your psychological type, your learning is not completely explained by your type preferences. In order to help you understand additional learning principles that are important to becoming a SuccessType, I will draw on the fields of cognitive science, time management, and artificial intelligence. Where possible, I will relate these learning principles to what you have already learned about type.

The principles described here are employed in Part II, which has examples and exercises designed to help you develop the skills of the SuccessType.

You can't memorize understanding.

The German language has two separate verbs that refer to " knowing": wissen and verstehen. If you want to refer to knowing by memorizing a fact or remembering an event, you use wissen. However, if you want to refer to knowing as understanding something, you use verstehen. The existence of these two separate verbs illustrates how attitudes toward "knowing" something can be quite different. The fact orientation of the sensing type would tend to favor the use of wissen, while the concept orientation of the intuitive type would tend to favor the use of verstehen. Thus, the sensing type and the intuitive type will approach learning the same material in different ways.

While the memorization of facts will serve you well in some of your learning, the majority of exam questions will require you to think in a more integrated mode. This is equally true on laboratory practical exams as well as multiple choice examinations. Practical exams are conducted in the laboratory, testing material that is taught during the laboratory sessions. This "hands-on" type of testing requires more than mere identification of structures, however, because interpretation of function is also tested. Similarly, on multiple choice exams you will not recognize the answer choices word-for-word from your textbook or notes. The biggest mistake

sensing types make when studying for a multiple choice test is to assume that they will recognize the correct answer when they see it. As a result, their primary test-taking strategy is to try to find an answer that looks the way it appears in their notes. If a question requires making an association or a relationship between concepts, the sensing type also expects to have memorized that association as a fact. By comparison, the intuitive type learns in a way that instinctively develops concept relationships whether or not those relationships were taught. Instead of always looking for the correct answer on an exam, the intuitive type tends to begin eliminating incorrect answers in order to enhance the probability of a correct response. You could say that intuitive types tend to answer with a higher degree of certainty than sensing types because their leaning style is more effective.

What is the difference between efficiency and effectiveness?

> Efficiency is doing things right ;effectiveness is doing the right things.

Efficiency and effectiveness are time management concepts. Efficiency concerns the best way of doing a task. Efficiency becomes one of your primary concerns when you have more to learn than time allows. In fact, the need to be efficient can so dominate your learning style that you overlook the more important concept of effectiveness. Effectiveness refers to whether you make the best use of your time by accomplishing the most important tasks. For example, efficiency is being able to read a book at 5,000 words per minute. Effectiveness is determining that you only need to read Chapter Two.

Effective learning in the SuccessTypes program is based on four general principles:

- *Keep your mind actively involved*: Activity requires thinking at higher levels.
- *Attempt to visualize new information*: All high-level learning is visual; it is important to be able to see relationships.
- *Follow study periods with verification*: Unclear or incomplete learning can block other learning.
- *Employ vocal methods*: Paraphrasing what you are trying to learn promotes active learning and provides verification.

All learning is active learning; passive learning is an oxymoron.

> Effective learners are automatically efficient because they work on the right thing at the right time

The concept of active learning is the single most important thing you can know about learning. Active learning stands out above all the other general principles of learning. Turn back to Figure 4.1 for a moment and observe how each of the four mental functions - sensing, intuition, thinking, and feeling - all contribute to information processing. Active learning involves using all of these processes, but many students spend most of their time on only the first process by just looking at their notes over and over. Just because you are looking at something doesn't mean that you understand it or that you can use it. Concentrating harder and longer is not active learning.

One of my favorite examples of active learning comes from the concept of *active reading* in *How to Read a Book*, by Mortimer Adler. He uses pitching a baseball as a metaphor for active reading. At first glance, you may think that the only active behavior is on the part of the pitcher. The ball is gripped, raised, and released by the pitcher in the same way that thoughts are considered, organized, and written by the author. However, further observation shows that the catcher is also quite active. The trajectory and velocity of the ball are analyzed by the catcher and the catcher's mitt is extended to catch the ball in the same way that the reader must view, interpret, and evaluate the words of the author. The moment that your study becomes inactive, learning stops and you drop the ball.

The effectiveness of active learning is illustrated by a study in which students learned a list of sentences in one of two ways (Bjork, 1979). One group was presented with the sentences in their original form with 10 seconds to memorize and rehearse each sentence. The other group was presented with the same sentences except that the words were scrambled. The students still had only 10 seconds per sentence and had to use part of that time to unscramble the sentence before committing it to memory. The students who were forced to use part of their time to unscramble each sentence had better recall than those who simply read them. In other words, the extra mental activity required for unscrambling the words improved their ability to recall information. Put more succinctly, activity improves memory.

The examples and exercises in Part II are designed to train you to develop the most effective active learning skills.

Your mind sees all.

There is ample evidence in the fields of cognitive science and artificial intelligence to suggest that everything you learn - and, therefore, everything you know - is converted into a visual metaphor. I also think it is likely that, even if you are an auditory learner, you convert what you hear into visual representations. The creation of visual representations occurs at every level of learning, even with rote memorization. Inspection of any book on memory techniques (see suggested reading for Chapter 6 in Appendix B) will show that a visual structure must be built before the facts to be memorized can be "attached" to the structure. The loci method has you mentally place objects to be remembered in different rooms of your house or dwelling, the peg system has familiar objects attached to each peg, and the exaggeration system has you visualize objects with odd sizes and strange relationships to each other.

Visualization performs two functions at all levels of your learning. It provides a structure for you to store new information, and it provides a way for you to retrieve information that has been stored. In the storage of new information, visualization helps you assimilate what you are learning into a preexisting familiar structure (Bransford and Johnson, 1972). For example, consider the following passage:

> *The procedure is fairly straightforward. First you put things into different stacks depending on their composition. Only one stack may be needed if the quantity is not large. If you don't have the proper facilities, then you will have to go somewhere else; otherwise, you may get started right away. Remember that it is better to do too few things than too many. A mistake can be expensive...*

If you are not aware as you begin reading that the passage is about washing clothes, it will be confusing and hard to recall. However, reading and remembering the passage is quicker when you can visualize stacking clothes or going to a laundromat.

Visualization gives your mind an organized way of retrieving the information it needs on an exam by providing a structure for retrieval. If, for example, you were asked to recall as many examples of "joints" as you could, your efforts would likely be haphazard and incomplete. You would likely begin with the more familiar, such as the joints in the human body, and then

continue with other possibilities, such as dovetail joints used in cabinet making or a joint where you go to hear your favorite music. You would have no consistent visual structure to refer to as you searched through your memory. If, on the other hand, you were asked to name all the joints of the human body, you could organize your recall according to the regions of the body by naming the joints of the arm, then the joints of the leg, and so forth. Your memory would be aided by constructing a visual image that would allow you to systematically retrieve the names of the joints contained in each major region of the body.

The examples and exercises in Part II are designed to train you to develop a visual retrieval structure, both anatomical and conceptual, in your learning.

How do you know when you know enough?

One of the greatest time management problems for students, medical or otherwise, is the ability to know when they have actually learned a concept. While the moment of truth for most students is usually saved for the exam, you can and should develop the ability to verify what you know ahead of time. Verification of learning is important for several reasons. It promotes effective study by confirming that you have achieved understanding, and also it promotes efficient study because unclear or incomplete learning of one topic can interfere with learning another. Students frequently find gaps in their knowledge of a topic after they think they have learned it.

Verification of learning also promotes efficiency by preventing you from spending time studying things you already know. It is normal for you to pay more attention to material that is familiar to you because it is less threatening than the material that you haven't learned. More challenging material is more intimidating because it is a barrier to your future success. The best way to confront such a threat to your learning is to use a time management system that helps you confront difficult material systematically. The time management system described in Chapter 10 will help you maximize the effectiveness of your study.

You should hear what you're thinking.

In order to say something intelligible, you have to make a decision about what to say and about how to say it, and that is not something that you can do passively. Expressing what you are learning improves your effectiveness and accomplishes several very important objectives.

1) **Verification of Learning**. Most professors will tell you that the first time they really understood something was after they had to teach it. Because explanations and descriptions don't initially flow out of the mind with ease, professors spend a considerable amount of time thinking about the material to be taught. Likewise, vocal paraphrasing will aid your thinking by allowing trial-and-error rephrasing until you can make what you are learning understandable. Once you can verbalize a concept clearly and completely, preferably to someone else, you have verified that you know it.

2) **Improved Memory Recall**. Memory recall is improved by using verbal paraphrasing because it introduces another method for encoding information into memory. Studies have shown that if you use different methods to review the same material (called variable encoding), you will recall the information more easily than using just one method (Bjork, 1979). That is why reading and rereading is not only inefficient, it is also ineffective.

3) **Development of Intuitive Skills**. In order to develop an explanation of a concept, you must look at the material differently than you would otherwise. It requires more than just remembering facts or reciting definitions. Your mind has to reach back into what you already know in order to devise the examples and metaphors needed for a verbal explanation of what you are learning. In the same way that this skill is the mark of an excellent teacher, it also becomes the mark of an excellent student. You will actively develop the intuitive skills of the SuccessType when you strive for clear and understandable verbal explanations.

Let's go over the main points:

1) In order to perform well on multiple choice examinations, you have to be able to think about what you know; effective learning helps to develop this ability.
2) Effective learning involves studying the right material the right way at the right time.
3) Efficiency is accomplishing many things; effectiveness is accomplishing the right things.
4) Effective learning is active, visual, verifiable, and audible.
5) Active learning uses all of the mental processes to promote effective learning.
6) Visualization provides a structure that is needed for learning new information and for recalling it.
7) Verification of learning leads to a better use of study time.
8) Vocalizing your learning verifies your understanding of the material and contributes to better recall.

Part II

Integrative Strategies, Examples, and Exercises

Chapter 7
Concept maps develop both intuitive skills and sensing skills.

Chapter 6 emphasized that for a study method to be effective, it had to be active, visual, verifiable, and audible. This chapter will teach you to use a study method, concept mapping, that meets all of these requirements and more (Figure 7.1). In order to help you learn by doing, examples and exercises taken from actual first-year medical school courses are included at the end of the chapter. It also would be very helpful for you to explain or demonstrate this method to someone else. [*Author's note: Over the past ten years it has become very clear that most sensing types are more comfortable with concept maps that are "top-down" (see Figure 7.1a below) where the primary bubble is at the top and the rest of the map extends downward. An example is shown below. The next version of SuccessTypes will have all maps converted to "top-down" style since intuitive types are comfortable viewing them from any perspective.*]

There's more to concept mapping than meets the eye.

When you create concept maps, you engage in learning that is active, visual, verifiable, and audible. Using concept maps as a learning tool offers several important advantages.

1) They serve as a way of organizing what you are learning.
2) They provide an easy way to verify what you are learning.
3) They serve as very effective review notes for examinations.
4) They contribute to effective reading by giving you a question to answer.

Reading without a question to answer is a waste of time.

If you will think back to the last time you read about something that interested you, like a favorite hobby or a sport, you were looking for answers to questions, such as, "What do I need to do to get started?" or "How can I get better at doing this?" Because you were looking for answers to your questions rather than just reading an assignment, the chances are quite good that

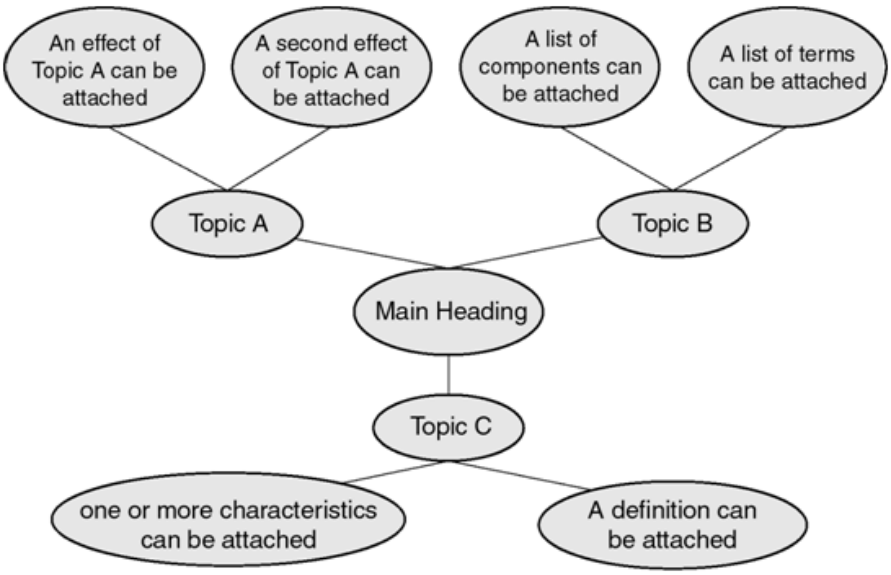

Figure 7-1: Sample concept map. An outline can be made more visual by spreading out information such as concepts, components, cause-and-effect relationships, characteristics, or definitions. Specific applications are described in Figures 7.2 through 7.10.

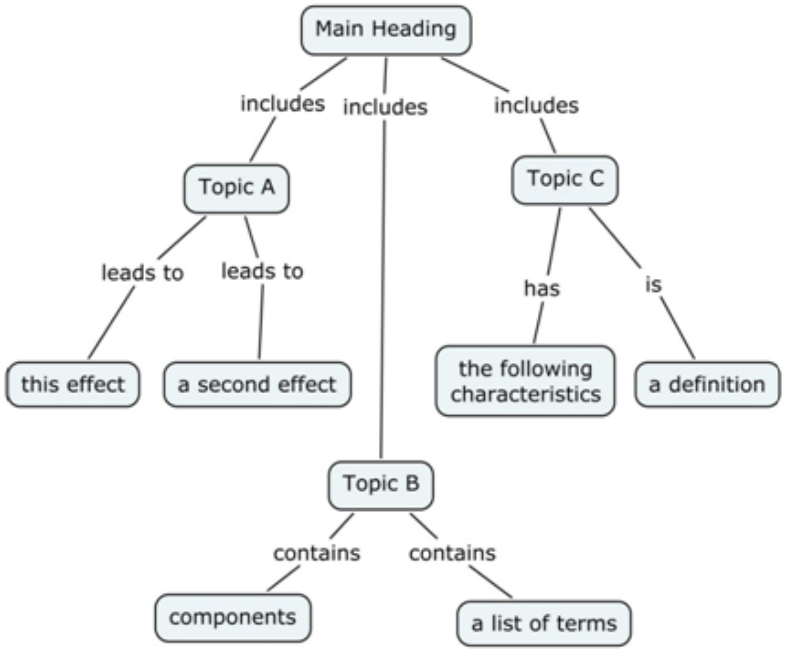

Figure 7.1a: "Top-down" version of Figure 7.1

you remembered much if not all of what you read. The effectiveness of this kind of reading is especially evident when you consider how well informed you or your friends are about subjects that interest you. Similarly, completing a concept map requires you to actively seek out answers to questions, such as, "What are the major concepts that will be included in this diagram?" or "How should these concepts be linked together?"

Reading with a question in mind is important because it keeps you focused. You don't necessarily have this focus when you are studying to fulfill a course requirement because you may be learning it for the professor, not for yourself. Learning for the professor and not for yourself, without questions to answer, is robotic, passive, ineffective, and a waste of your time.

Reading without writing is a bigger waste of time.

The interference theory of learning proposes that all information in our short-term memory is volatile and will be erased, or interfered with, by new information being learned. No matter how well you think you have learned something by just looking at it, if you haven't had a chance to actively integrate it into your long-term memory, it is likely to be lost as you continue to study other topics. If you have a system for actively recording meaningful notes as you go, you will take an important step toward committing the material to long-term memory. You can't write about something without making a decision about it and this requires active thought. Please note that verbatim recopying from notes or a book doesn't require active thought and, therefore, doesn't qualify as writing. Real writing involves composing. Writing about what you are learning creates a visual summary and, when it takes the form of concept maps, it can be assembled quickly. The visual feedback that occurs as you see your thoughts take shape on the page will often reveal aspects of the topic that you wouldn't have seen from reading alone. This is especially important if you are a sensing type because it will reduce your dependence on others to point out important relationships between concepts.

> Writing provides a moment of truth for the mind.

Sensing types can follow rules for intuitive thinking.

If you are a sensing type, concept maps will balance your tendency to organize your learning in a linear sequence by developing visual connections between related terms and concepts. However, they can be assembled in a step-by-step manner that is preferred by the sensing type. In effect, you will continue to use your sensing preferences that you trust, but you will do it in a way that develops the less trusted intuitive skills that you need to become a SuccessType. By actively looking for the terms and concepts to include in the concept map and determining the most meaningful way to connect, you will elicit an unconscious intuitive process of discovery and attaching meaning to specific facts. When this becomes a part of your daily routine, your intuitive skills will develop naturally.

Intuitive types need a place to hang all those elusive details.

Even the intuitive type has an Achilles heel when it comes to including and memorizing details. If you are an intuitive type, concept maps will balance your tendency to overlook details by giving you a place to attach them. The construction of visual relationships between concepts and factual details takes advantage of your natural tendency to see patterns. You will simultaneously develop your ability to remember details by creating a visual relationship that makes them easier to recall. Although exam questions that require a certain amount of rote memorization are usually in the minority, you can improve your scores if your study routine helps to prepare you for them.

The steps in concept mapping proceed in an orderly fashion.

Concept maps are a special type of outlining that places key concepts and brief descriptive passages within nodes or "bubbles." The bubbles are then connected in a two-dimensional pattern to show relationships among concepts. In the same way that writing is composing, the thought that goes into arranging the key concepts and connecting the bubbles is also composing. As you work through the steps below, keep in mind that you want the diagram to make enough

sense so that you can verbalize complete thoughts without referring to your text or lecture notes. This method can be used to summarize virtually any kind of material you are trying to learn.

The steps in the process are subdivided into three main stages: 1) main heading maps; 2) topic maps; and 3) expansion maps. These are followed by a list of general considerations.

Creation of Main Heading Concept Maps

An overview diagram is important for keeping your perspective. It defines the overall territory for a major topic and it gives you an immediate visual feel for how material is subdivided. When you are able to visualize the major divisions of a subject without the distraction of all the details, you acquire a sense of control that cannot be obtained when you look at the detailed expanse of the material.

Step 1: Main heading bubble. Identify the most general heading you can find. This will usually be a chapter title or a section heading in your lecture syllabus. Put the heading in a bubble at the center (or at the top) of the page (Figure 7.2). To easily identify this page and to keep your notes neat and organized, also write the main heading in the upper right-hand corner of the page.

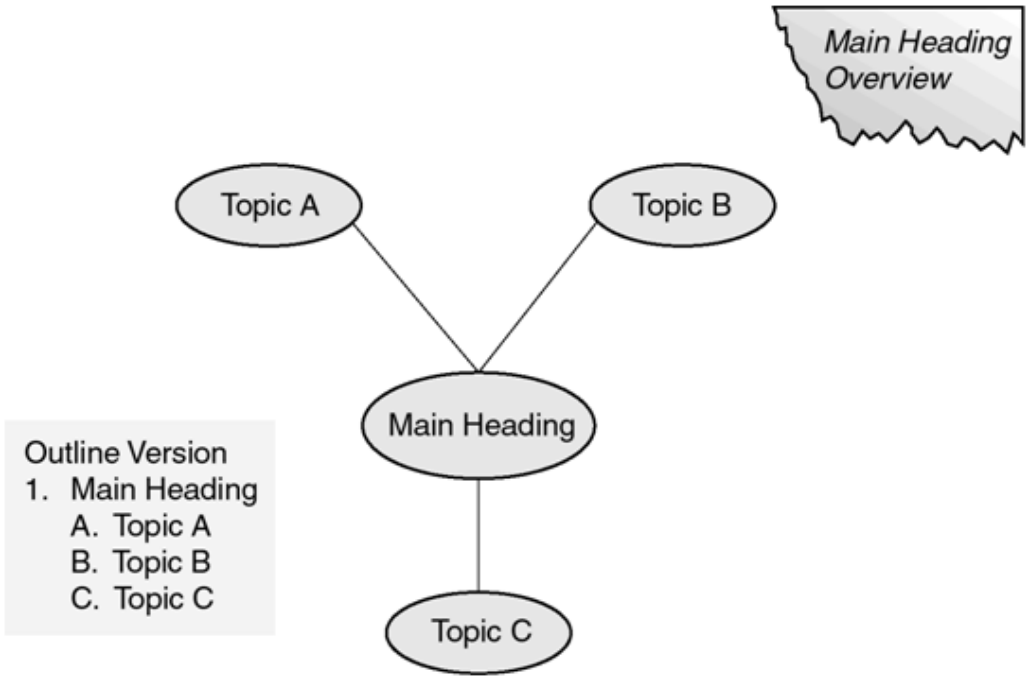

Figure 7-2: Construction of an overview map. Outline version is included for comparison.

Step 2: Topic bubbles. Begin the overview map by finding the major topics within that section or chapter. Very often, this is done or you in outline form, but you can also determine it for yourself. Most major headings will not have more than half a dozen main topics and sometimes as few as two. Add these to the map in a symmetrical fashion.

Creation of Topic Concept Maps

The creation of topic maps requires you to visually organize the material by selecting those terms and concepts that are important subtopics. As you decide how to arrange the connections in the diagram, you will automatically push your thinking to a higher level. Your long-term memory will be improved because you tend to remember that which you have created better than that which was created for you. There is also a psychological benefit due to the sense of control you acquire over the material as you give it a visual perspective.

Step 3: Topic bubble. Place each topic from the overview map in a bubble at the center (or at the top) of a new page. As you gain experience, you will find that you will need to start some concept maps near the top of the page. In the upper right corner of each page, identify the main heading and, beneath that, the topic.

Step 4: Subtopic bubbles. Look in your notes or textbook for the terms and concepts that divide the topic into subtopics. Examples of subtopics are:

a) categories (each category is a subtopic, Figure 7.3),
b) lists of components (each component is a subtopic, Figure 7.4),
c) steps in a process (each step is a subtopic, Figure 7.5),
d) characteristics (each characteristic is a subtopic, Figure 7.6), and
e) cause and effect (each cause and effect is a subtopic, Figure 7.7).

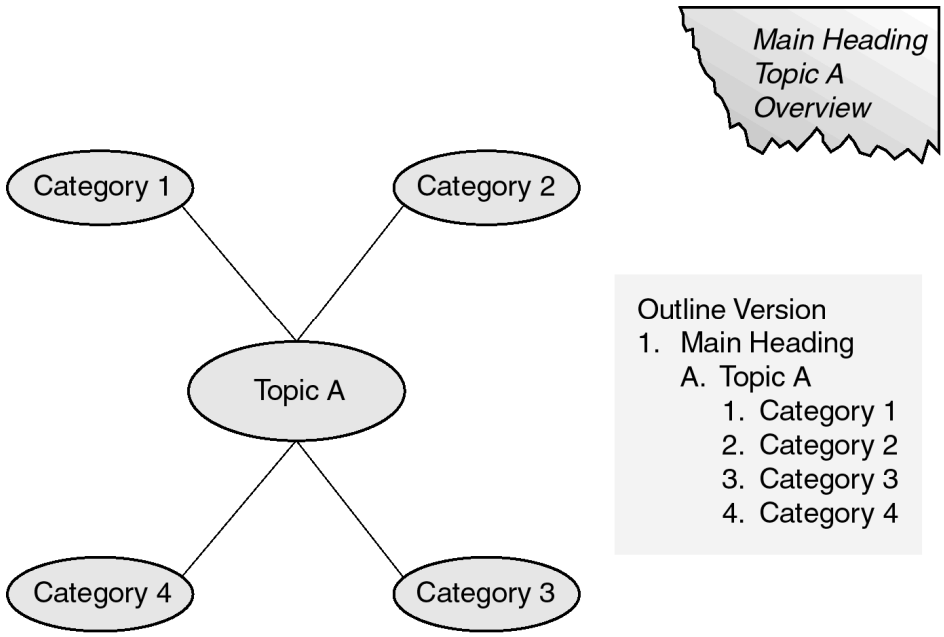

Figure 7- 3: Concept map of Topic A which has four categories. Outline version is included for comparison.

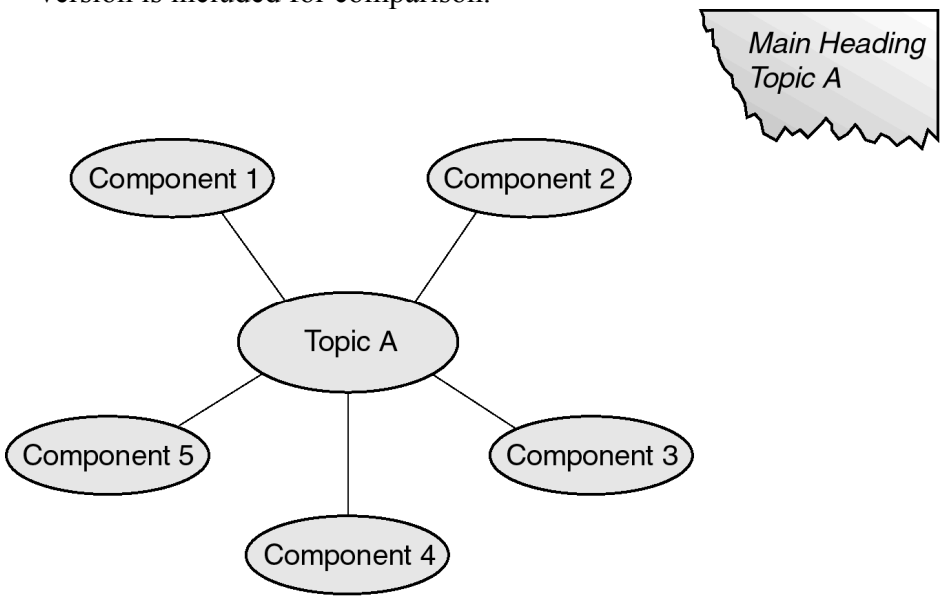

Figure 7- 4: Concept map of Topic A which has five components.

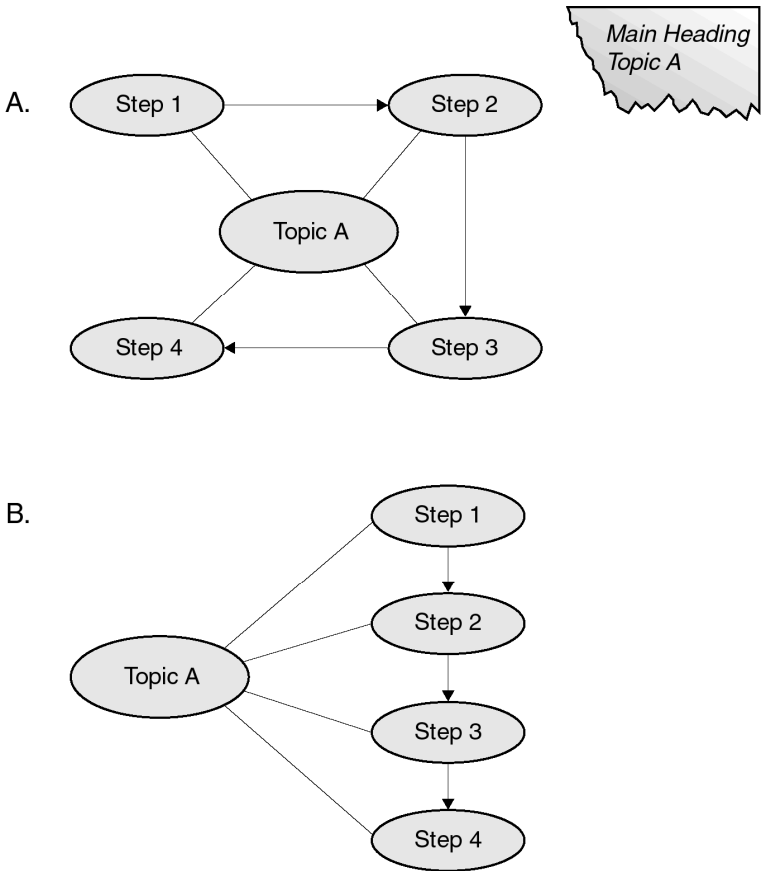

Figure 7-5: Concept map of Topic A which has four steps. A) circular form that is used to represent a cycle; B) linear form that is used to represent a process.

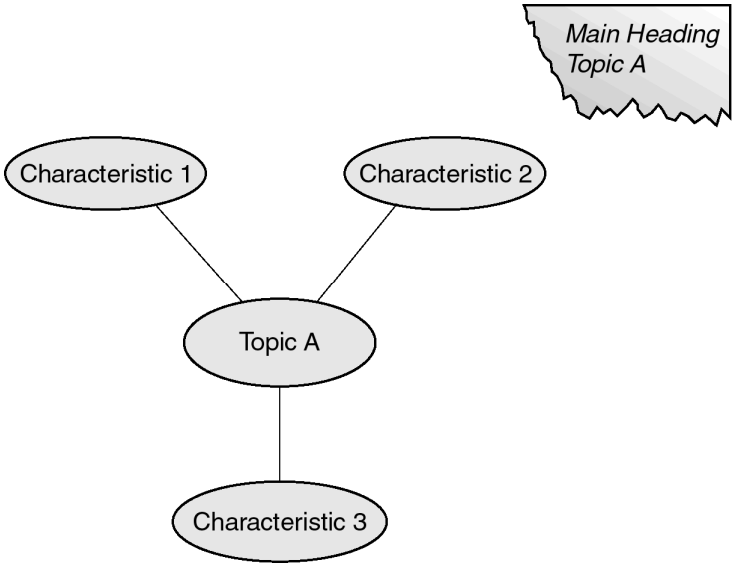

Figure 7-6: Concept map of Topic A which has three characteristics.

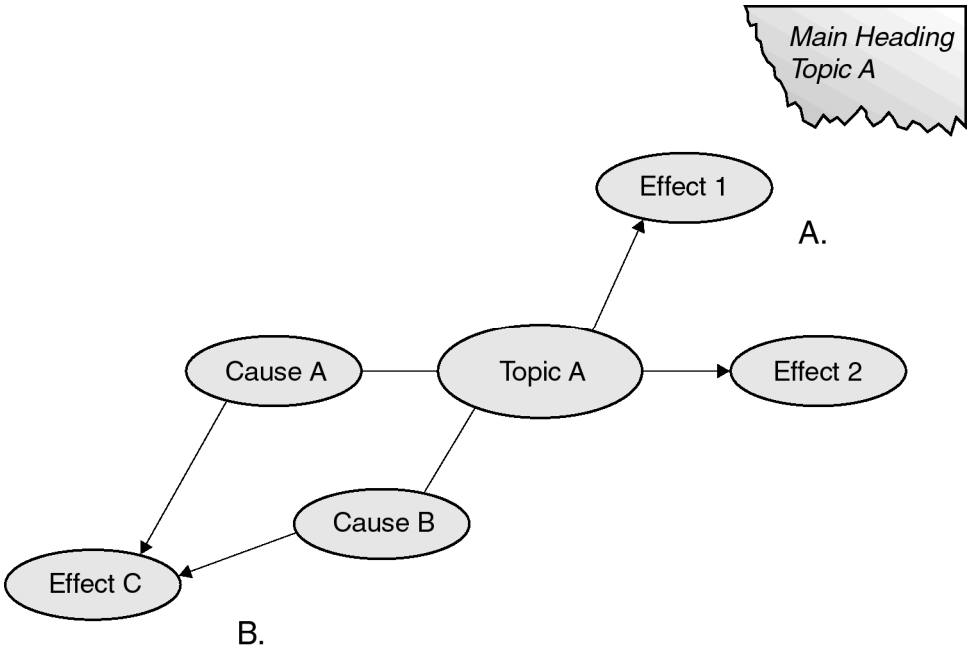

Figure 7-7: Concept map of Topic A. A) Topic A is the cause of two different effects; B) Two causes that are related to Topic A that lead to the same effect.

Step 5: Details. Taking each subtopic in turn, look for important facts, definitions, descriptions, other important details and attach those in separate bubbles. You may begin to discover as you do this that there are relationships between components of the diagram that you hadn't seen before. Draw any extra connections that will help you to remember similarities and differences between subtopics and their components. The sample overview diagram in Figure 7.8 shows that Subtopic 1 and Subtopic 2 have Characteristic C in common. Chapter 9 discusses the use of similarities and differences in greater depth.

Creation of Expansion Diagrams

You can expand beyond the space available on the topic diagram when it becomes too crowded to visualize effectively. You simply create a new page for the subtopic which needs additional branching and follow similar steps to those above. Expansion diagrams give you the flexibility to continue to build layer upon layer of visual connections, providing you with a feeling of confidence that you have paid attention to all of the material. As mentioned above, the ability to

branch additional information for individual topics gives intuitive types a place to "hang" those otherwise elusive details.

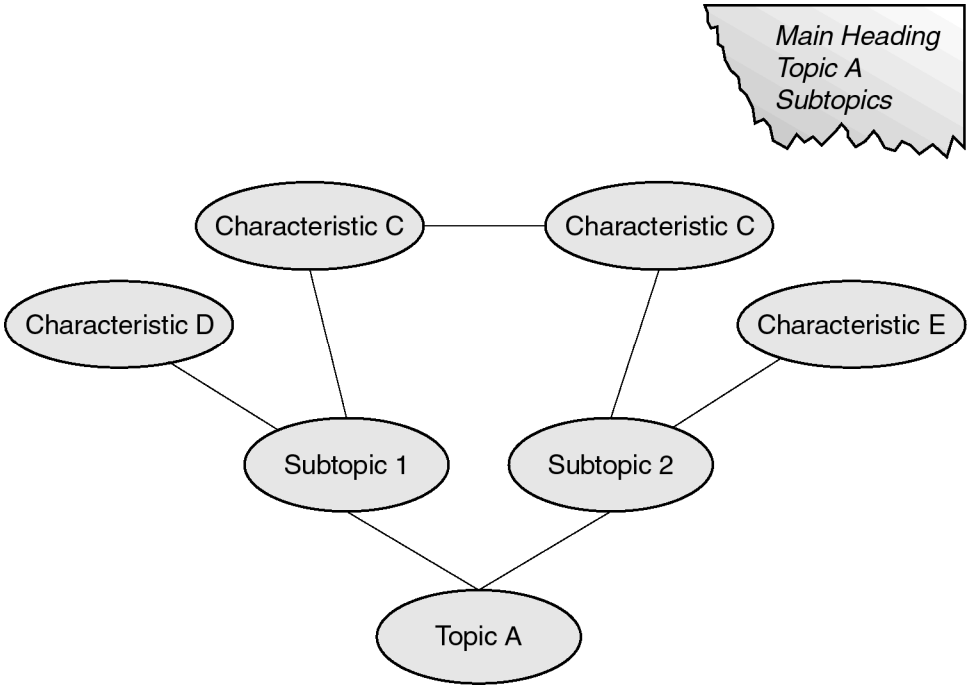

Figure 7-8: Addition of additional details (subtopics and characteristics of each subtopic) to Topic A.

Step 6: Expansion subtopic bubble. On the topic diagram, find the subtopic you want to expand and attach a bubble to that subtopic, including the word "expanded" (Figure 7.9).

Step 7: Expansion details. Start a new page with the subtopic at the center of the page. Search for the words or phrases to include or, better yet, paraphrase into your own words or phrases and attach them in bubbles. You can use the same kind of criteria as above, such as characteristics, definitions, and components. Add the expansion subtopic to the page heading in the upper right hand corner.

Observe the following general considerations in creating concept maps:

1. **Consider doing a rough draft and a final draft**. One of your most profound learning experiences when you begin the process of constructing concept maps will be the discovery of relationships between topics and subtopics that are not explicitly stated. Intuitive types as well

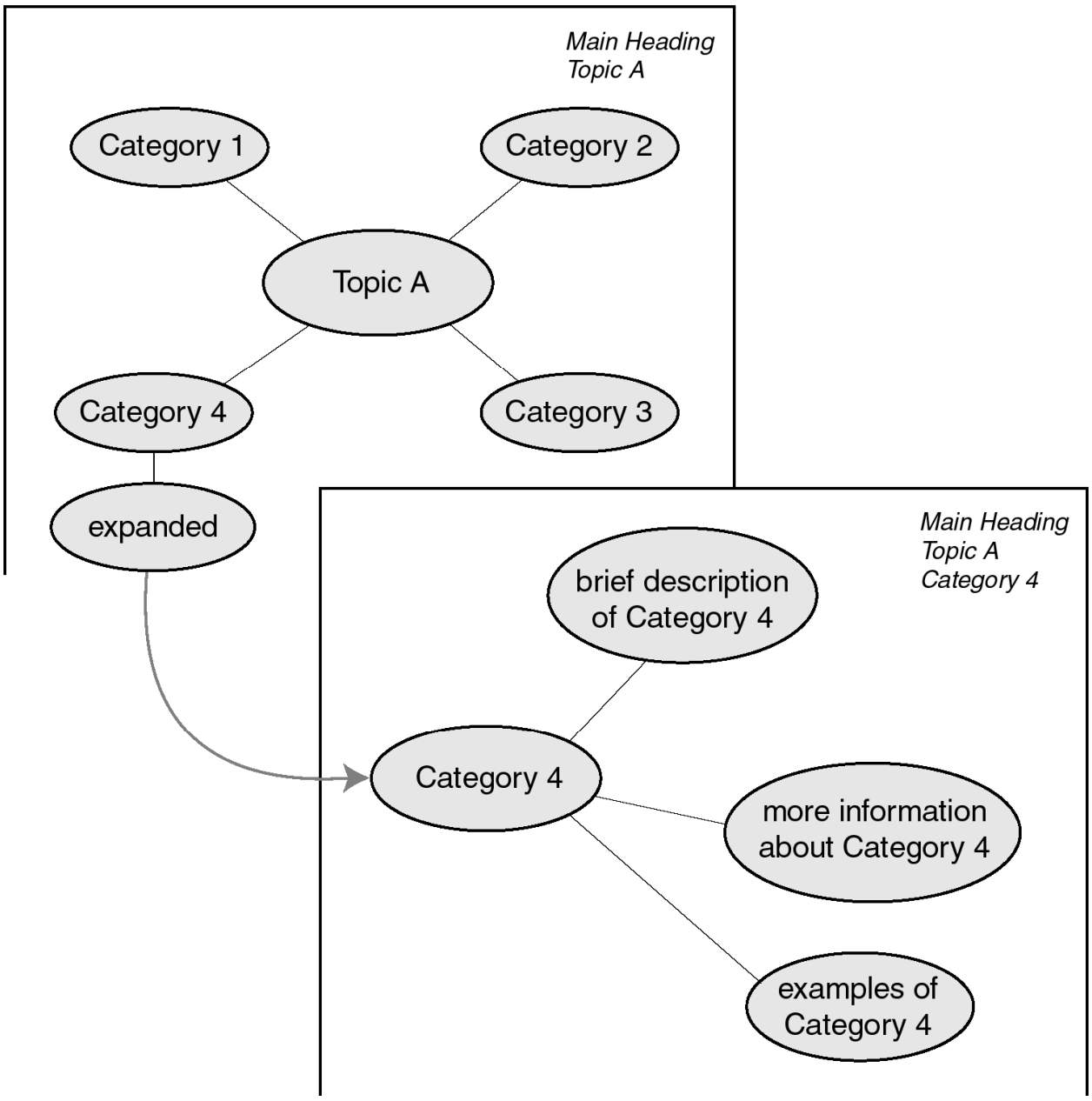

Figure 7- 9: Expansion of Category 4 as the central bubble in a new concept map.

as sensing types will acquire an improved view of the material. As an intuitive type, I have rarely been satisfied with the first version of any of my concept maps because I can always see ways to improve them as they are being developed. This process of discovery results in the integrative type of learning that uses and develops intuitive skills.

2. **Use color**. You can enhance the visual impact of your diagrams and improve your memory through the creative use of color. Start simply by highlighting the main topic on each page. Continue to develop the use of color by using different colors for different hierarchies of topics. Try to create your own coding system, but avoid the overuse of color. The goal is to make your diagram as easy to look at as possible.

3. **Take charge**. Don't be inhibited by the possibility that there may be a better way to compose a given concept map. There may be several correct ways of organizing the material, but as long as your facts are accurately represented, yours will be the best for you. The fact that it is your own composition will help you remember it your way ...and remember, if you see two equally good ways to develop a concept map, you can always do both versions.

4. **Look for connections**. You will discover many bubbled terms and phrases at the ends of branches in your diagrams that have logical connections with other parts of the diagram (Figure 7.8). Pay attention to these connections because they will help you understand the subtle differences between many correct and incorrect answers on multiple choice questions.

5. **Use multiple strategies**. Chapters 8 and 9 provide several approaches to help you discover and evaluate important topics and subtopics for inclusion in a diagram. You can quickly overcome a mental block by trying more than one strategy to aid your organization of a diagram.

Let's go over the main points:

5) Concept maps are a method of spatial outlining that helps you organize, verify, and review what you are learning.
6) Reading with a question in mind is essential to active learning.
7) Writing about what you read helps to build long-term memory.
8) Sensing types can develop intuitive skills in a step-by-step manner as they construct concept maps.
9) Intuitive types can use concept maps to build the sensing skills needed for memorizing details.
10) An overview concept map should precede the more detailed topic diagrams.
11) Topic diagrams describe all the important terms and concepts and include categories, components, steps, characteristics, and effects.

12) Expansion diagrams continue the diagramming connections for a topic diagram on a new page.
13) If you make two drafts for each concept map, you can take advantage of discoveries you make in the process.
14) You can enhance your visual learning through the creative and judicious use of color.
15) Many concepts can be organized in several different ways. Your way will be best for you.
16) If you see more than one way to diagram a topic, you may want to do both.
17) Look for connections between bubbles that help you to see potentially important relationships between topics.
18) You can overcome mental blocks by using different strategies for organizing a concept map.

Examples and Exercises in Medical Biochemistry

All of the examples and exercises in this section are based [on] excerpts from *Biochemistry: Mosby's USMLE Step I Reviews*[1] used with permission from Mosby—Year Book, Inc. The following steps will help you make best use of the examples and exercises:

1) Study the following examples to see how the terms and concepts from the excerpts might be represented in concept maps.

2) To complete the exercises that follow the examples, refer to the excerpts provided and try your hand at summarizing the material in concept maps. Blank pages labeled with appropriate page headings are provided for this purpose. [*Author's note: These blank pages have been intentionally retained in this web-version of SuccessTypes*.] You may want to refer to the steps for creating concept maps that begin on page 57.

3) Compare your concept maps with the "solution" concept maps, keeping in mind that yours may also be correct but not compare exactly. Sensing types very frequently have a concern about the "correctness" of their maps. This concern is greatly diminished after some experience is gained and it can be a great help to compare your finished map with one done by another student.

[1] See Appendix B for complete reference. The material from "board review" books was selected for these examples and exercises because this material is more representative of medical school course notes than a textbook.

Biochemistry Example 1: Secondary structure of proteins. The example below contains both an excerpt and concept maps designed to illustrate how to summarize the topic of "secondary structure" of proteins. The excerpt is taken from Chapter 2, "Protein Structure and Properties." Figure 7.10 provides an overview concept map, and Figures 7.11-7.13 show a concept map of the excerpt.

■ Secondary Structure Gives the Polypeptide Chain Well-organized Twists and Turns.

Secondary structure is regular structure stabilized by hydrogen bonding between peptide bonds.

- Produces either an **α-helix** or **β-structure**
- Side chains not involved in the hydrogen bonding but help to determine the stability and type of secondary structure

- **α-Helix conformation** An α-helix is right-handed, with peptide bonds toward the inside and side chains extending outward.
  - An α-helix is stabilized by regular formation of hydrogen bonds parallel to the axis of the helix. They form between the amino and the carbonyl of every fourth peptide bond.
  - Proline has no free hydrogen to contribute to helix stability; it is called a helix breaker.
  - Formation is favored by glu, met, ala, and leu side chains.
  - The α-helix occurs in some fibrous proteins (e.g., **α-keratin**) and most globular proteins.
- **β-Structure conformation** β-Structure is formed by extended regions of the peptide sequence, with hydrogen bonding between the peptide bonds of adjacent side-by-side extended sequences.
  - The direction of adjacent regions can be the same (**parallel**) or opposite (**antiparallel**).
  - Formation is favored by the side chains of val, ile, and tyr.
  - β-Structure occurs in 80% of all globular proteins and in silk fibroin.

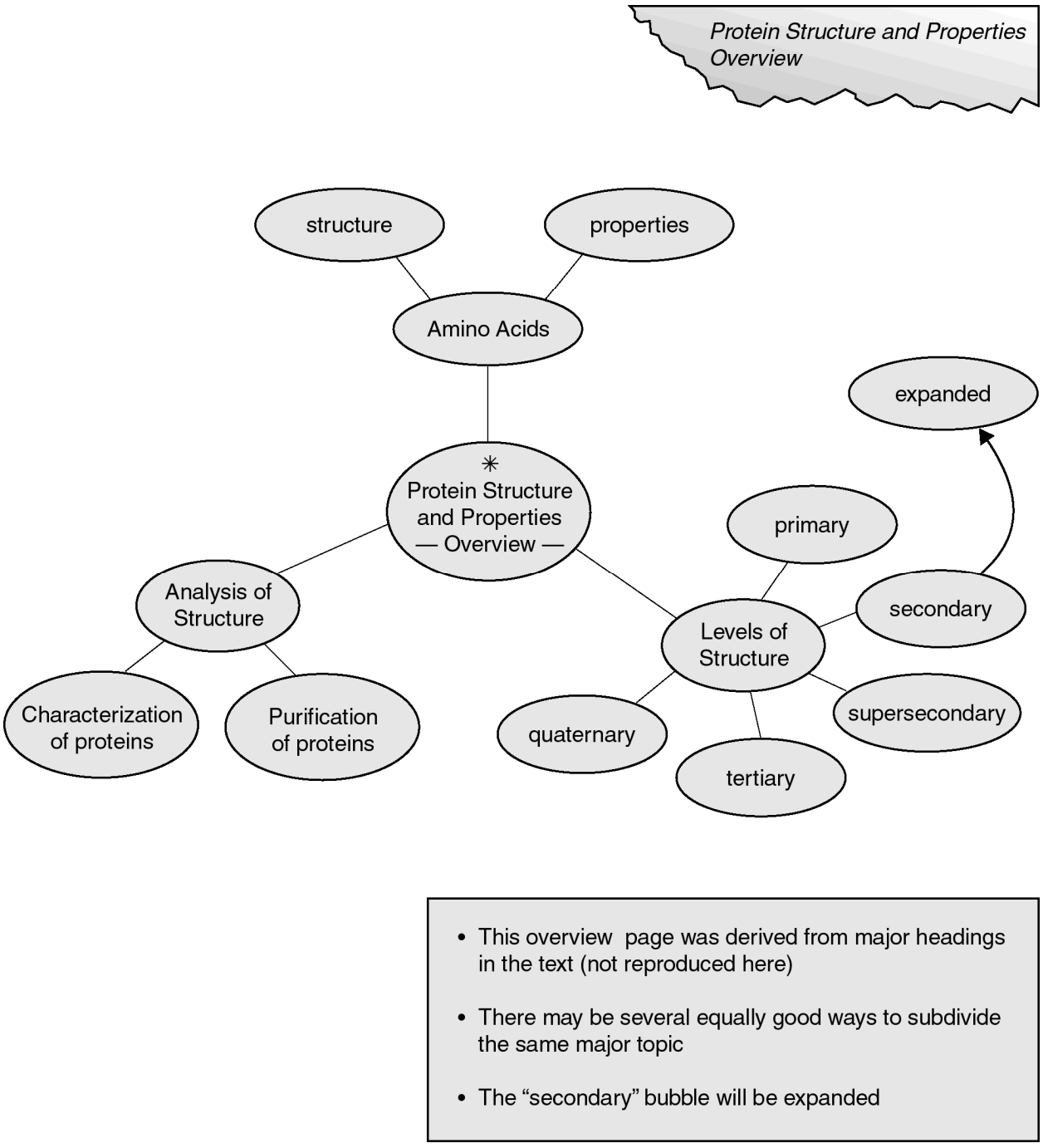

Figure 7-10: Overview of protein structure and properties.

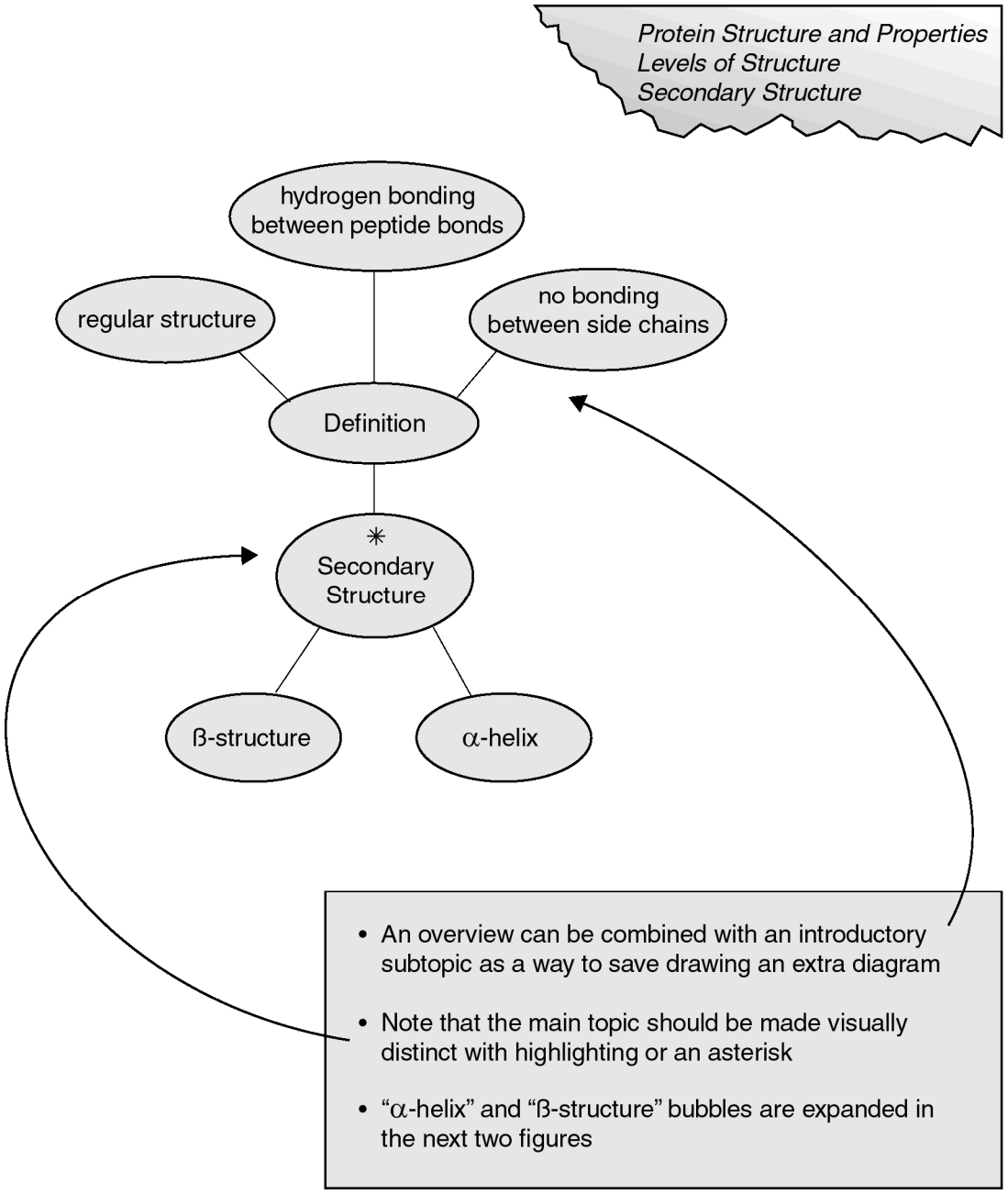

Figure 7-11: Secondary structure of proteins. Expanded from Figure 7-10.

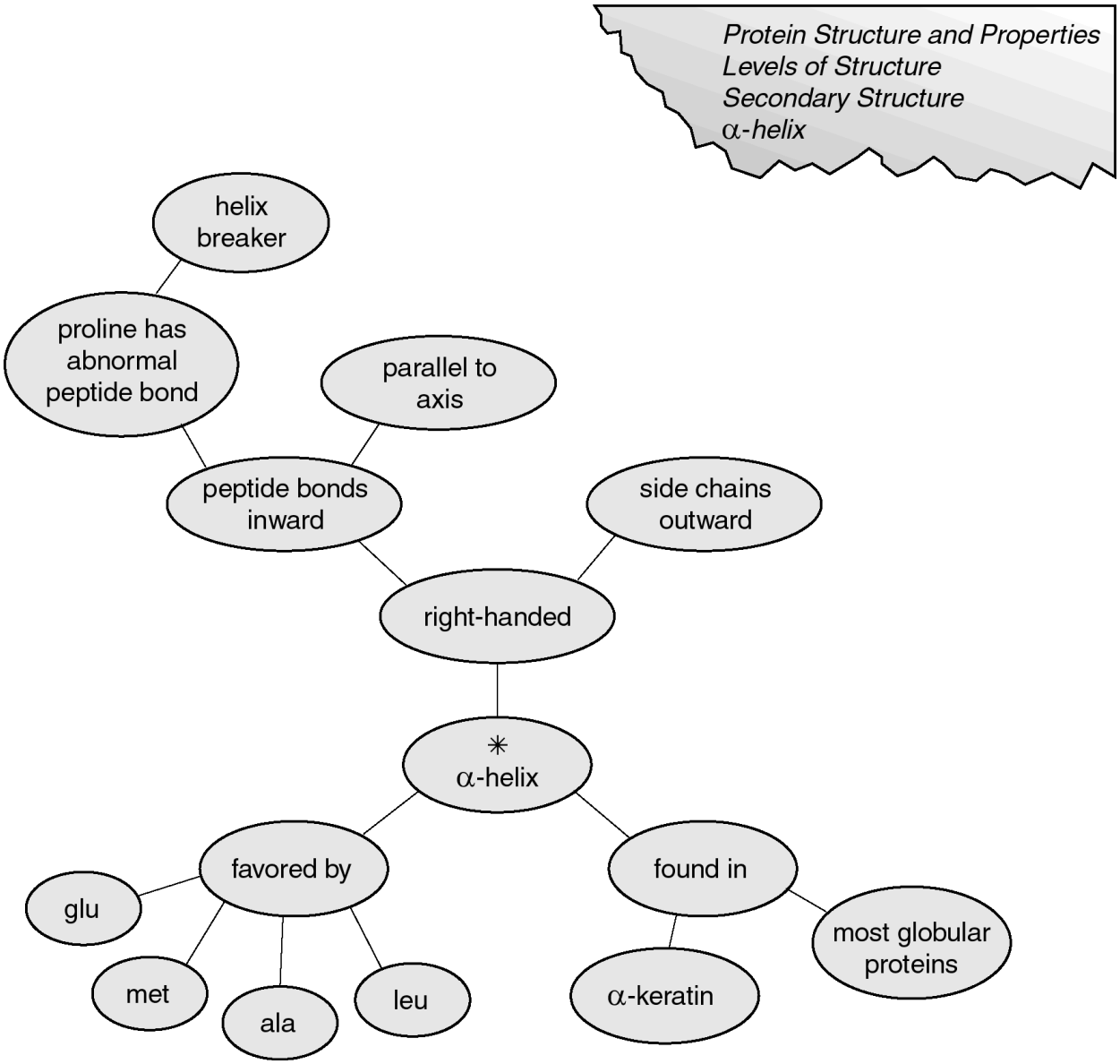

Figure 7-12: Properties of the α-helix. Expanded from Figure 7-11.

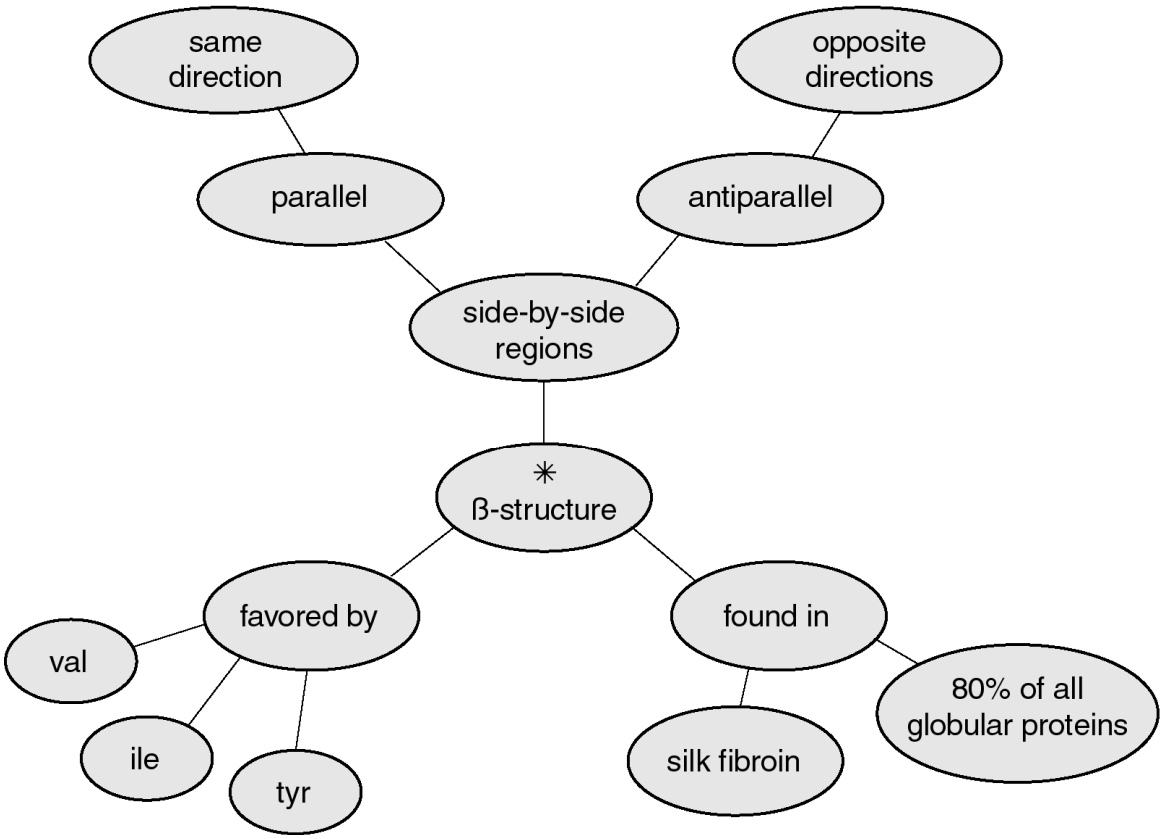

Figure 7-13: Properties of β-structure. Expanded from Figure 7-11.

Biochemistry Example 2: The Urea Cycle. The example below illustrates how to summarize the material concerning the generation of urea in the sequence of reactions known as the urea cycle. In the interest of brevity, the concept maps for this example are limited to summarizing the *reactions* of the urea cycle. The excerpt is taken from Chapter 18, "Amino Acids and Heme Metabolism."

■ Two Mitochondrial Enzymes Begin the Urea Cycle by Incorporating Free Ammonium Ions into Citrulline.

The urea cycle begins in the mitochondrial matrix with two of its five reactions. The major products of these reactions are carbamoyl phosphate and citrulline.

Reaction 1. **Carbamoyl phosphate synthetase** (CPS). Ammonium ions react with carbon dioxide and ATP to produce **carbamoyl phosphate** (Fig. 18.4). This mitochondrial form of CPS requires a positive allosteric effector, **N-acetylglutamate**, for activity.

- The cytosolic form of CPS, which is part of the pyrimidine synthetic pathway, does not require acetylglutamate and uses glutamine as the nitrogen donor for carbamoyl phosphate synthesis.

Reaction 2. **Ornithine transcarbamoylase.** Carbamoyl phosphate and **ornithine** are condensed to form **citrulline**. Both ornithine and citrulline have specific membrane transport carriers in the mitochondrial membrane.

■ The Remaining Three Steps of the Urea Cycle Are Catalyzed by Cytosolic Enzymes.

The major products of the cytosolic reactions are argininosuccinate, arginine, fumarate, ornithine, and urea.

Reaction 3. **Argininosuccinic acid synthetase.** Citrulline and aspartic acid are condensed to form **argininosuccinic acid**. This reaction is driven by cleavage of ATP to form adenosine monophosphate (AMP) and pyrophosphate. Combined with the two high-energy bonds needed for synthesis of carbamoyl phosphate, this brings the total cost of making one molecule of urea to four high energy bonds.

Reaction 4. **Argininosuccinase.** Argininosuccinic acid is cleaved to form fumaric acid and arginine.

Reaction 5. **Arginase.** Arginine is cleaved to release urea and regenerate ornithine.

■ The Urea Cycle Is under Both Long-term and Short-term Control.

- During extensive starvation, when muscle proteins are broken down to amino acids to be oxidized for energy, increased levels of ammonia result in activation of genes for urea cycle enzymes.

- Immediately after a high-protein meal, concentrations of N-acetylglutamate in the liver are increased. This allosteric activator is synthesized from acetyl coenzyme A and glutamate.

■ The Urea Cycle and the Citric Acid Cycle Have Some Common Intermediates.

Fumarate is produced by the urea cycle, linking it to the citric acid cycle as a mechanism for regenerating aspartic acid. The conversion of fumarate to oxaloacetate (OAA) allows for aspartate to be regenerated by transamination.

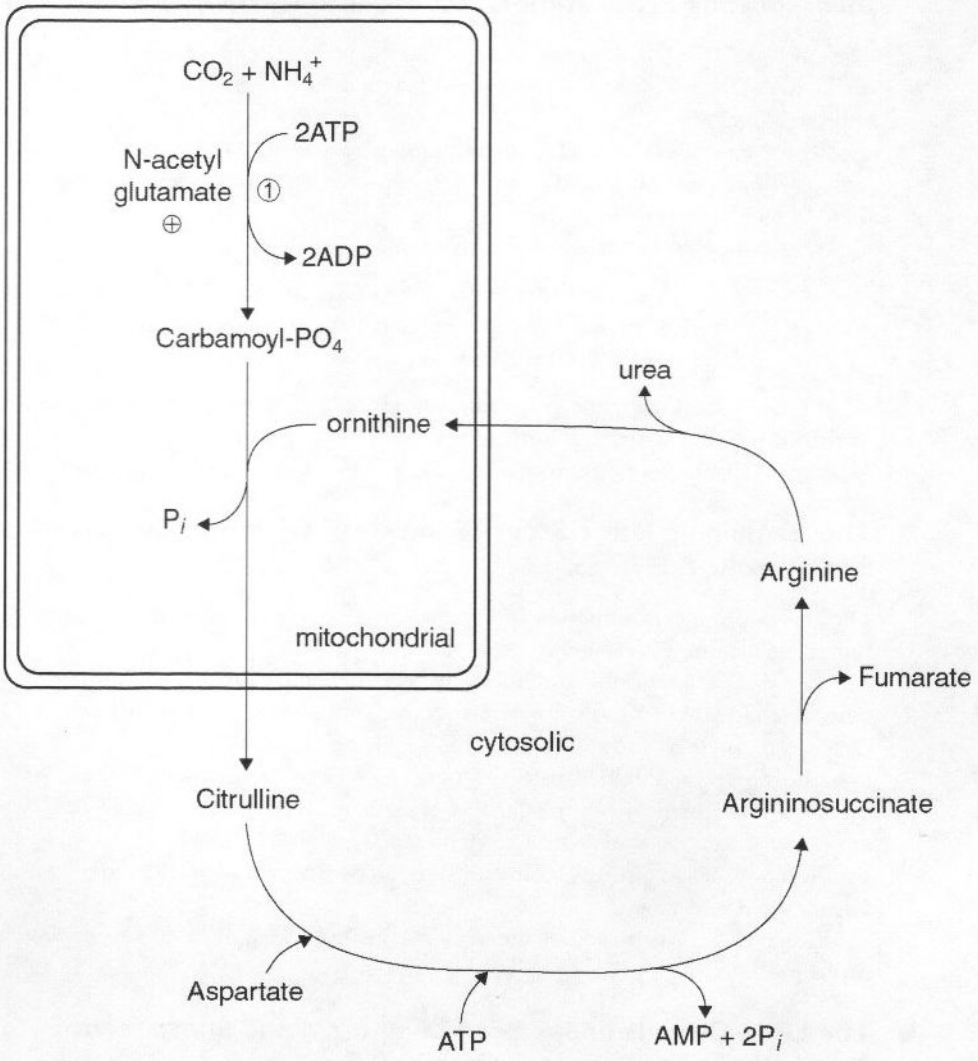

Figure 18.4: The urea cycle. From *Biochemistry: Mosby's USMLE Step I Reviews* by J. Pelley, 1997, St. Louis: Mosby–Yearbook, Inc. Copyright 1997 by Mosby–Yearbook, Inc. Adapted with permission.

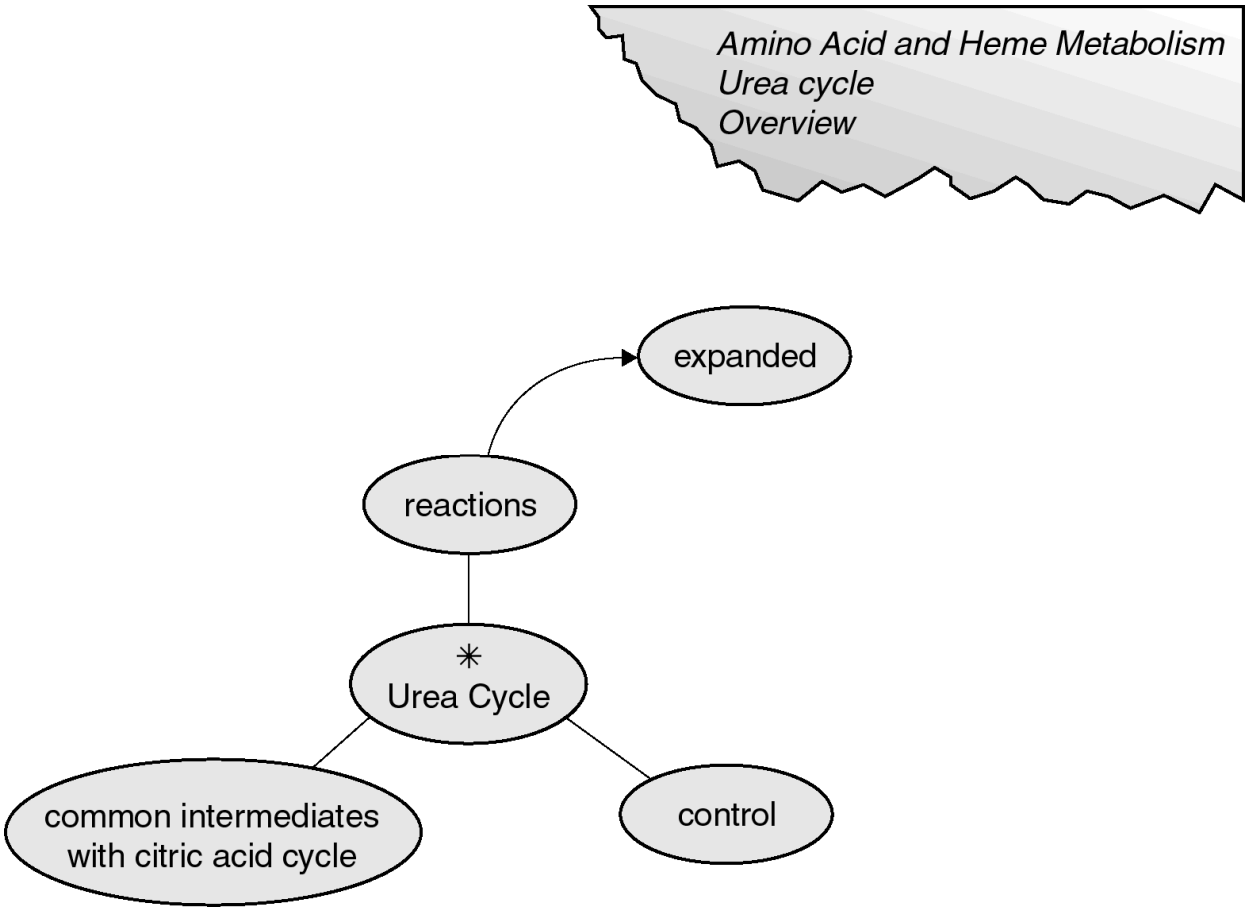

Figure 7-14: Overview of urea cycle.

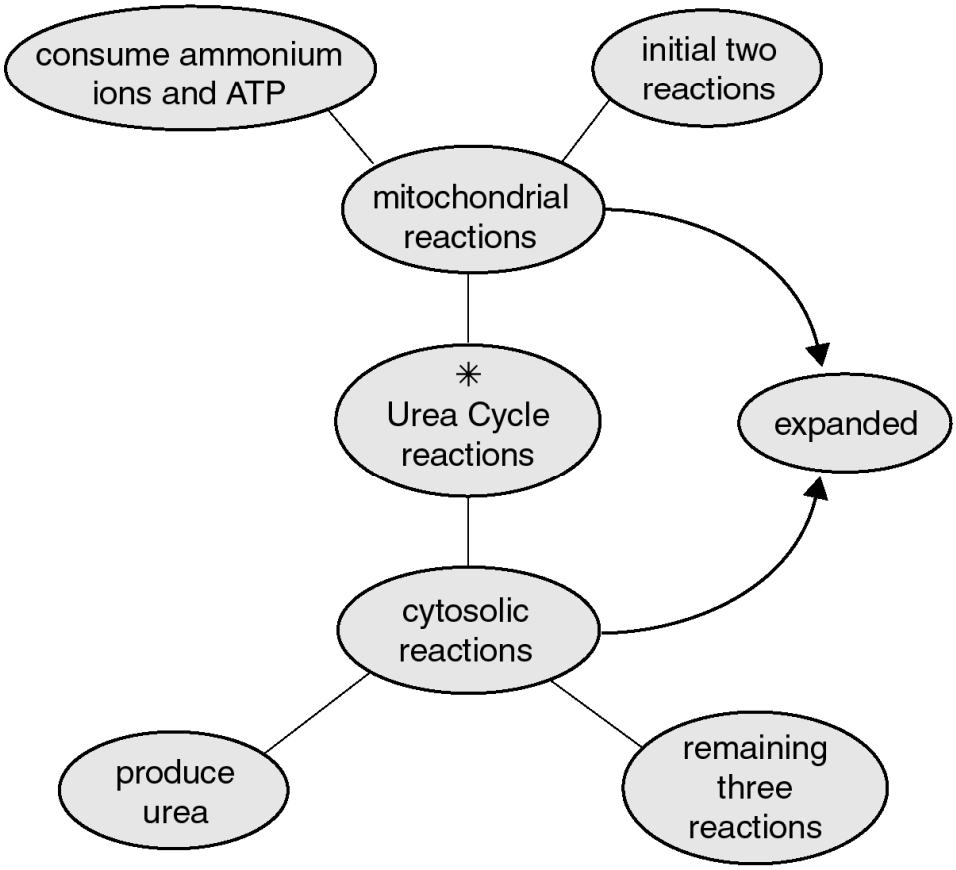

Figure 7-15: General features of the urea cycle reactions. Expanded from Figure 7-14.

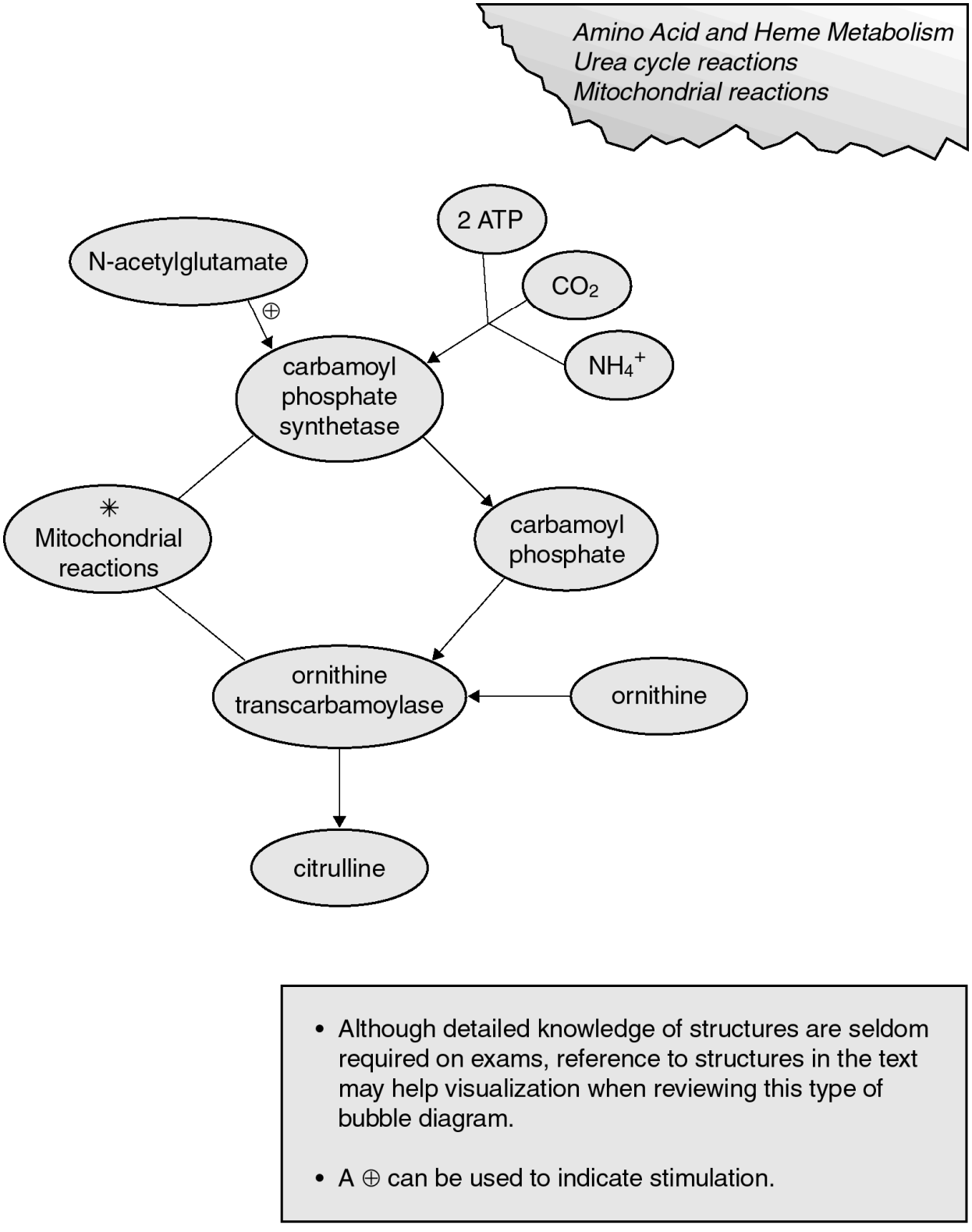

Figure 7-16: Mitochondrial reactions of the urea cycle. Expanded from Figure 7-15.

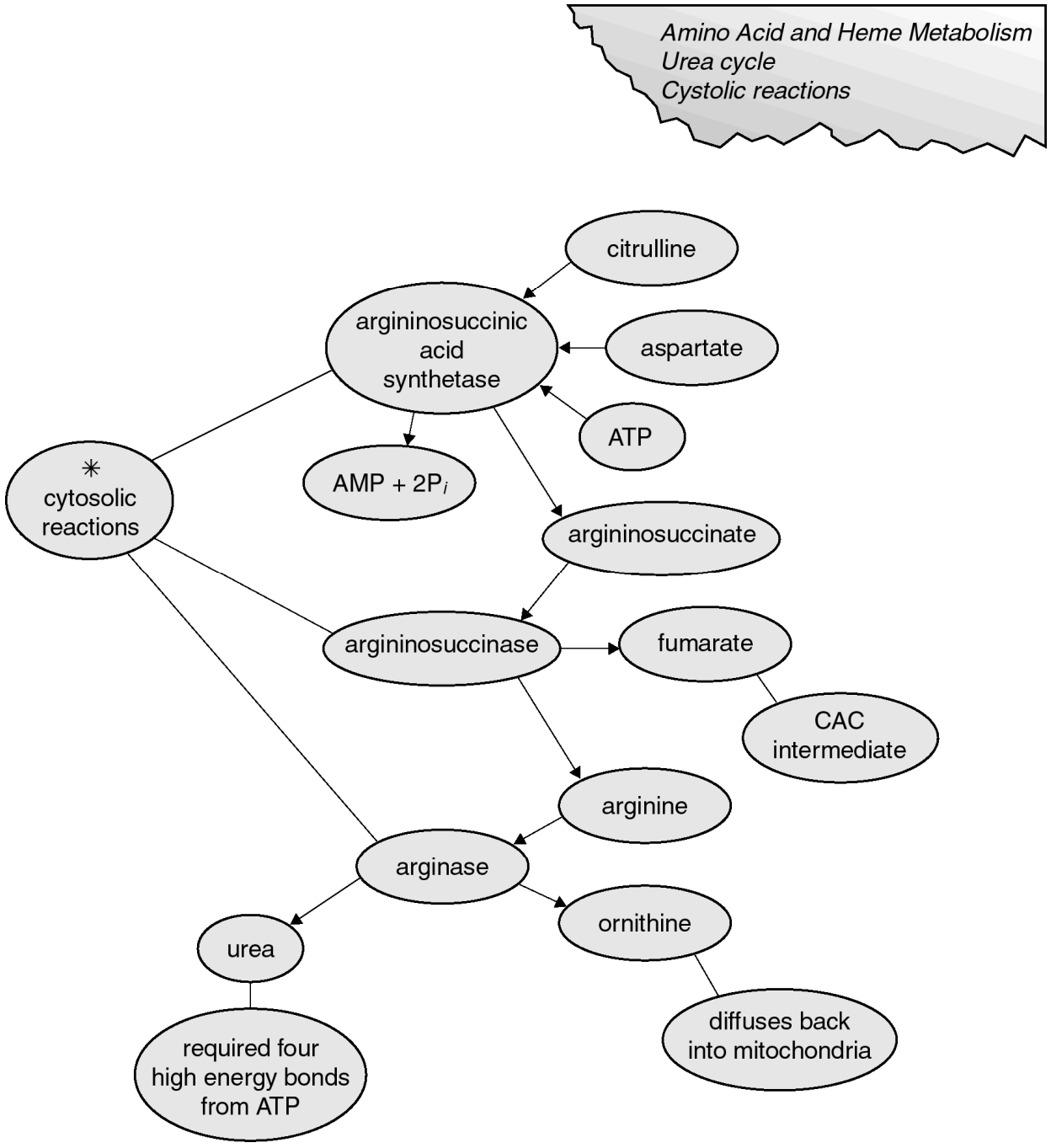

Figure 7-17: Cytosolic reactions of the urea cycle. Expanded from Figure 7-15.

Biochemistry Exercise 1: Supersecondary Structure of Proteins. Try to concept map the material concerning the supersecondary structure of proteins from the excerpt below. If you are a sensing type, it may help you to get started if you first construct a linear outline of all the major headings and descriptions. Follow this by fitting everything from the outline into your concept map. Remember, if you do a first draft and then revise it, you will continue to learn from the thinking that goes into decisions for reorganization.

■ Supersecondary Structures Bridge the Gap between the Regularity of Secondary Structure and the Variability of Tertiary Structure.

Supersecondary structures, or **motifs**, are combinations of secondary structure 10 to 40 residues in length that are found in numerous proteins.

- The **four-helix bundle motif** is a common pattern in globular proteins. This structure flares at one end, providing a cavity where prosthetic groups or cofactors can bind.
- The **ß-Barrel motif** is formed from a staggered β-pleated sheet that spontaneously folds around into a cylindrical barrel-like structure. The interior of the barrel can bind hydrophobic molecules such as retinol.
- The **saddle motif** is formed from a staggered ß-pleated sheet that spontaneously forms a saddle shape.
- Several motifs are mixtures of both α- and ß-structures.
- If they don't have a specific ligand binding function, motifs contribute to the structure of domains.

Domains are subdivisions of the primary structure about 25 to 300 residues in length; they fold independently into a stable configuration.

- Each domain is coded by a separate **exon** in the **structural gene** of the protein.
- Domains consist of one or more secondary structure motifs.
- Domains work together to provide the complete function of the protein. They contribute to the three-dimensional structure of the protein but do not describe its complete structure.

Protein Structure and Properties
Levels of Structure
Supersecondary Structure
Examples and Domains

Biochemistry Exercise 1 Solution. One possible representation of the excerpt is given in the following concept maps. If yours are different, they may still be accurate representations since many topics can be organized in several different ways. You can check the "correctness" of your map by repeating it aloud to see if you can present it as a meaningful lesson to someone else.

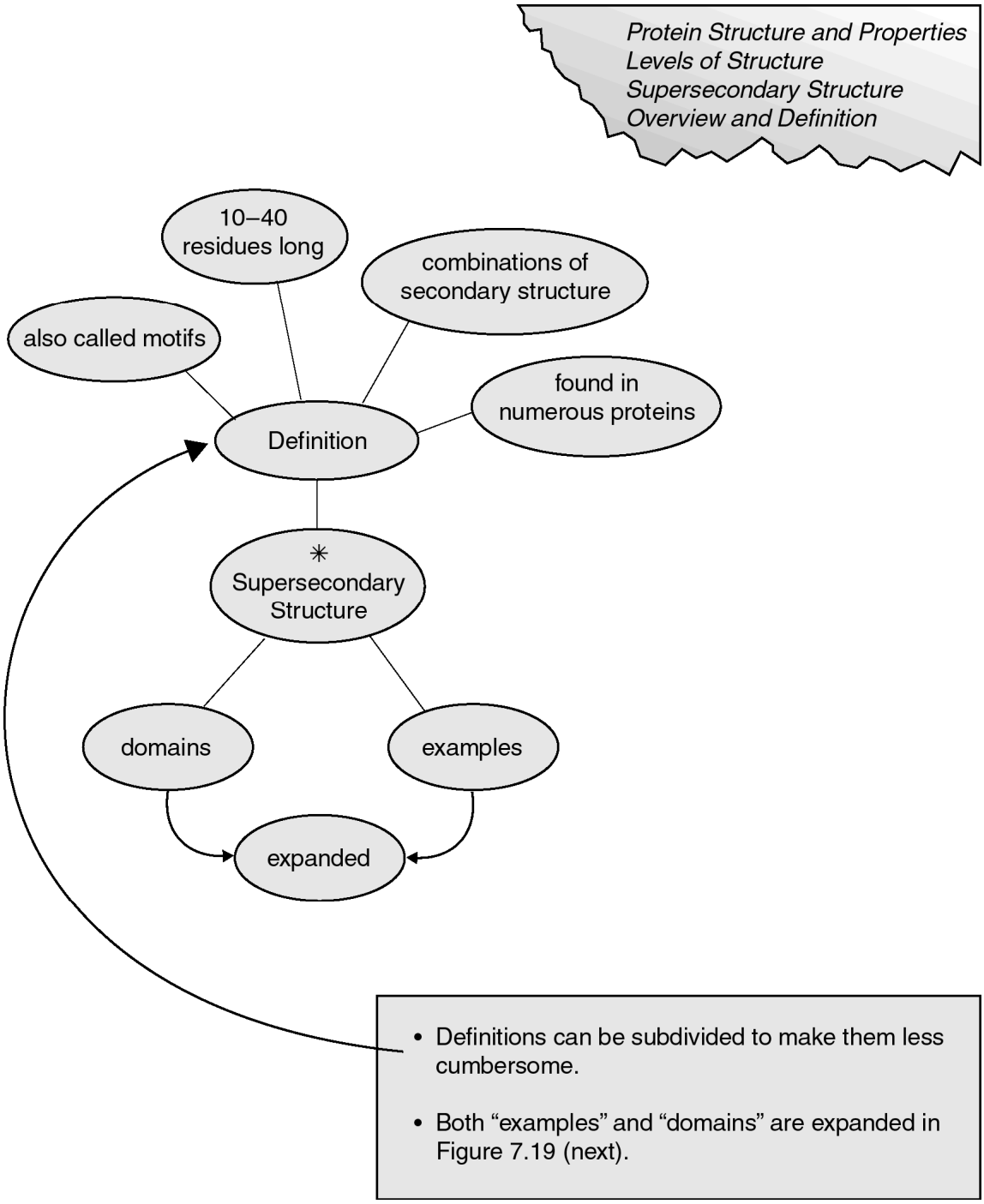

Figure 7-18: Overview and definition of supersecondary protein structure.

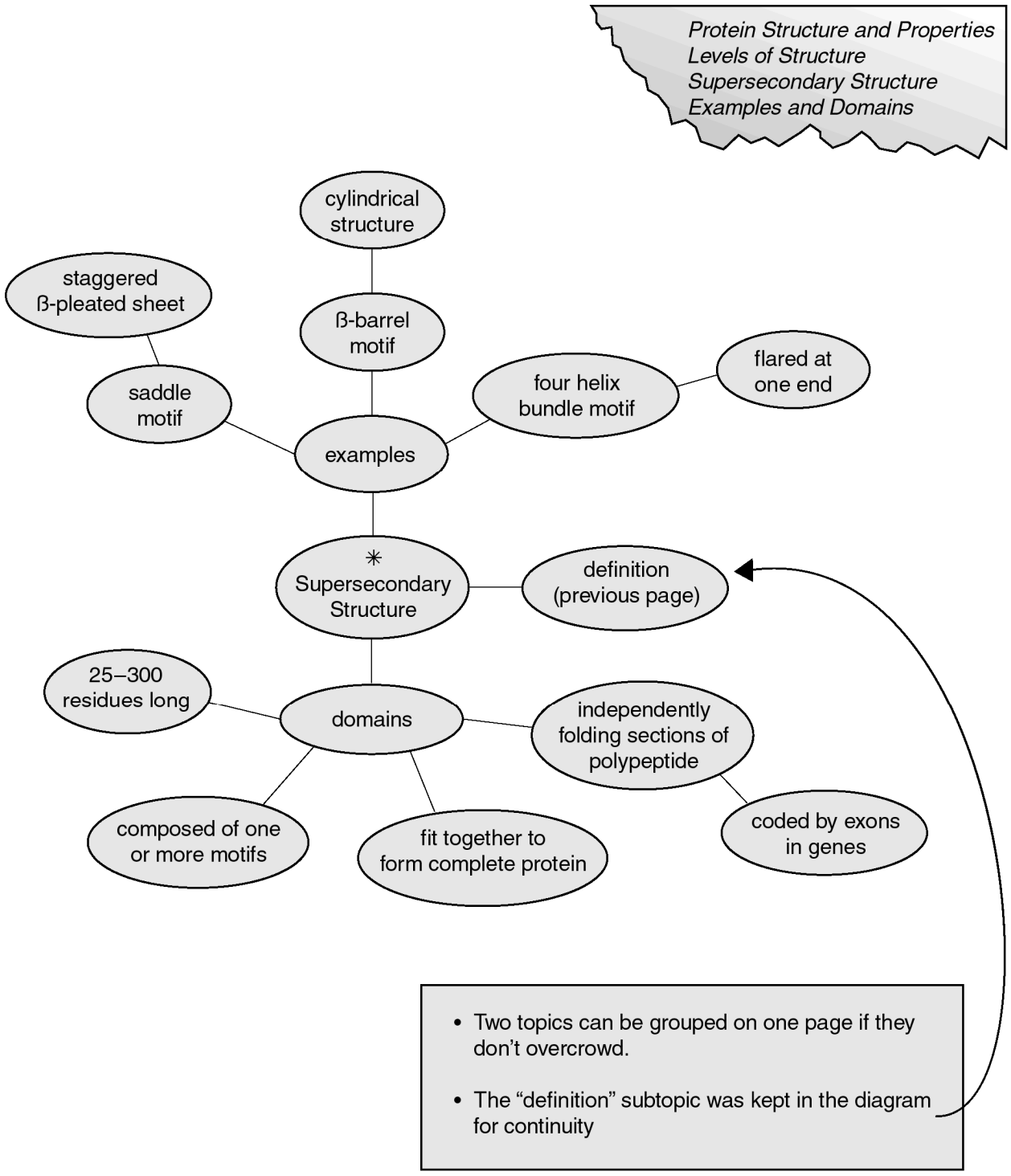

Figure 7-19: Examples and domains of supersecondary structure. Expanded from Figure 7-18.

Biochemistry Exercise 2: Vitamin D Metabolism. Try to concept map the material concerning the metabolism of Vitamin D from the excerpt below. Two overview concept maps (Figure 7.20, 7.21) that are not in the excerpt are provided to serve as a frame of reference.

- **Vitamin D** Vitamin D is obtained either as preformed **cholecalciferol** from **ergocalciferol** in the diet or from **7-dehydrocholesterol** in skin exposed to sunlight. Cholecalciferol is converted into what is effectively a steroid hormone by two sequential hydroxylation reactions (Fig. 28.6).
  - **1,25-Dihydroxycholecalciferol** (1,25-DHC, or **calcitriol**) maintains adequate levels of calcium in the serum. Depending on the physiologic state, this is done by bone resorption, calcium uptake from the gut, or absorption of calcium from the glomerular filtrate of the kidney.
  - Calcitriol binds to a cytoplasmic receptor in intestinal mucosal cells and activates a gene for a **calcium-binding protein** that acts to absorb calcium from the gut.
  - Calcitriol stimulates mobilization of calcium and phosphate from bone when **parathyroid hormone** is present. When calcium is elevated in the serum, the hormone calcitonin prevents mobilization of calcium from bone.
  - Parathyroid hormone stimulates the production of calcitriol when serum calcium levels are low.

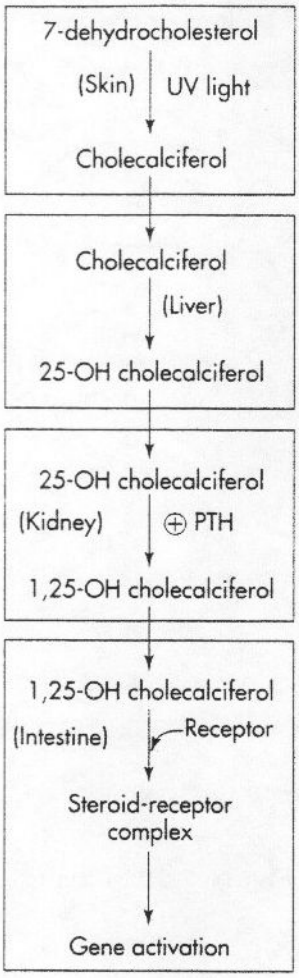

Figure 28.6: Conversion of cholecalciferol to the active form, calcitriol (1,25-OH cholecalciferol). After conversion of 7-dehydrocholesterol to cholecalciferol in the skin, it is transferred to the liver, where synthesis of 25-OH cholecalciferol takes place. 25-OH cholecalciferol is transported to the kidney, where it is converted to calcitriol. Calcitriol combines with a cytoplasmic receptor in the intestinal mucosa to activate a gene for a calcium-binding protein.

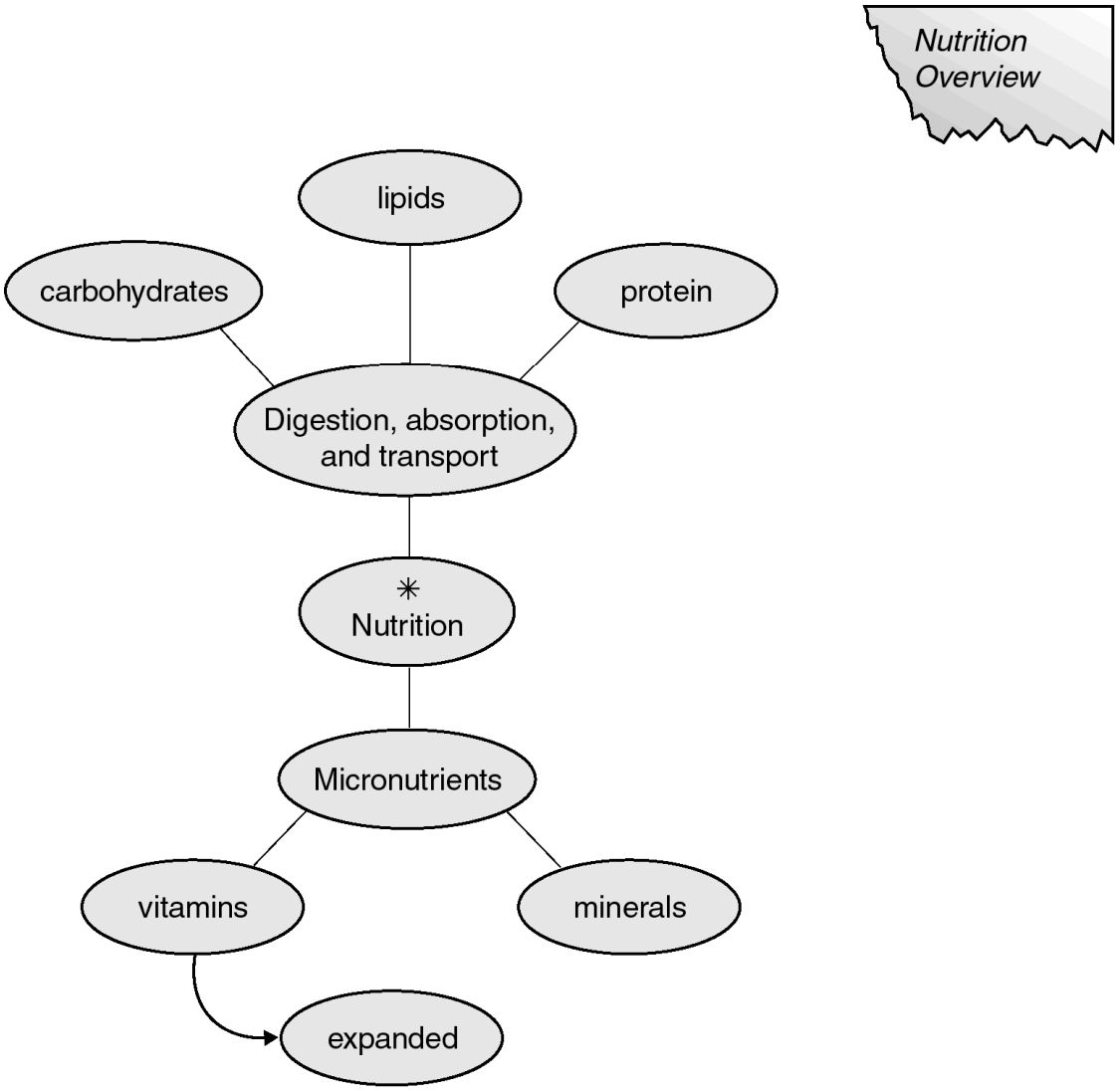

Figure 7-20: Overview of nutrition.

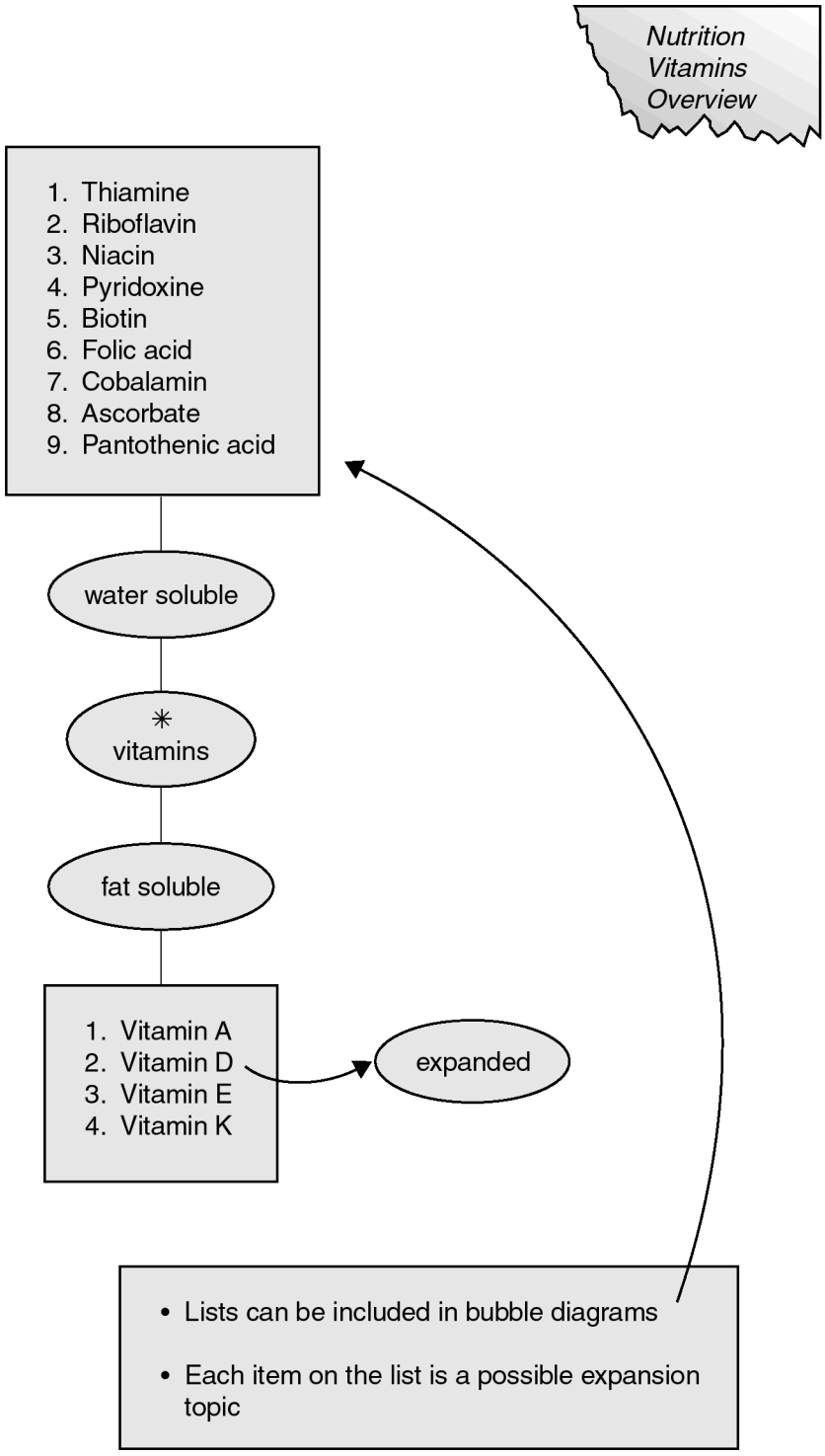

Figure 7-21: Overview of vitamins. Expanded from Figure 7-20.

Nutrition
Vitamins
Vitamin D

Biochemistry Exercise 2 Solution. One possible representation of the excerpt is given in the following concept maps. If yours are different, they may still be correct representations. You can check your accuracy by verbalizing the links to recreate a story or an explanation. This type of verification is rarely done by students and is extremely valuable in detecting whether you understand the material in addition to being familiar with it.

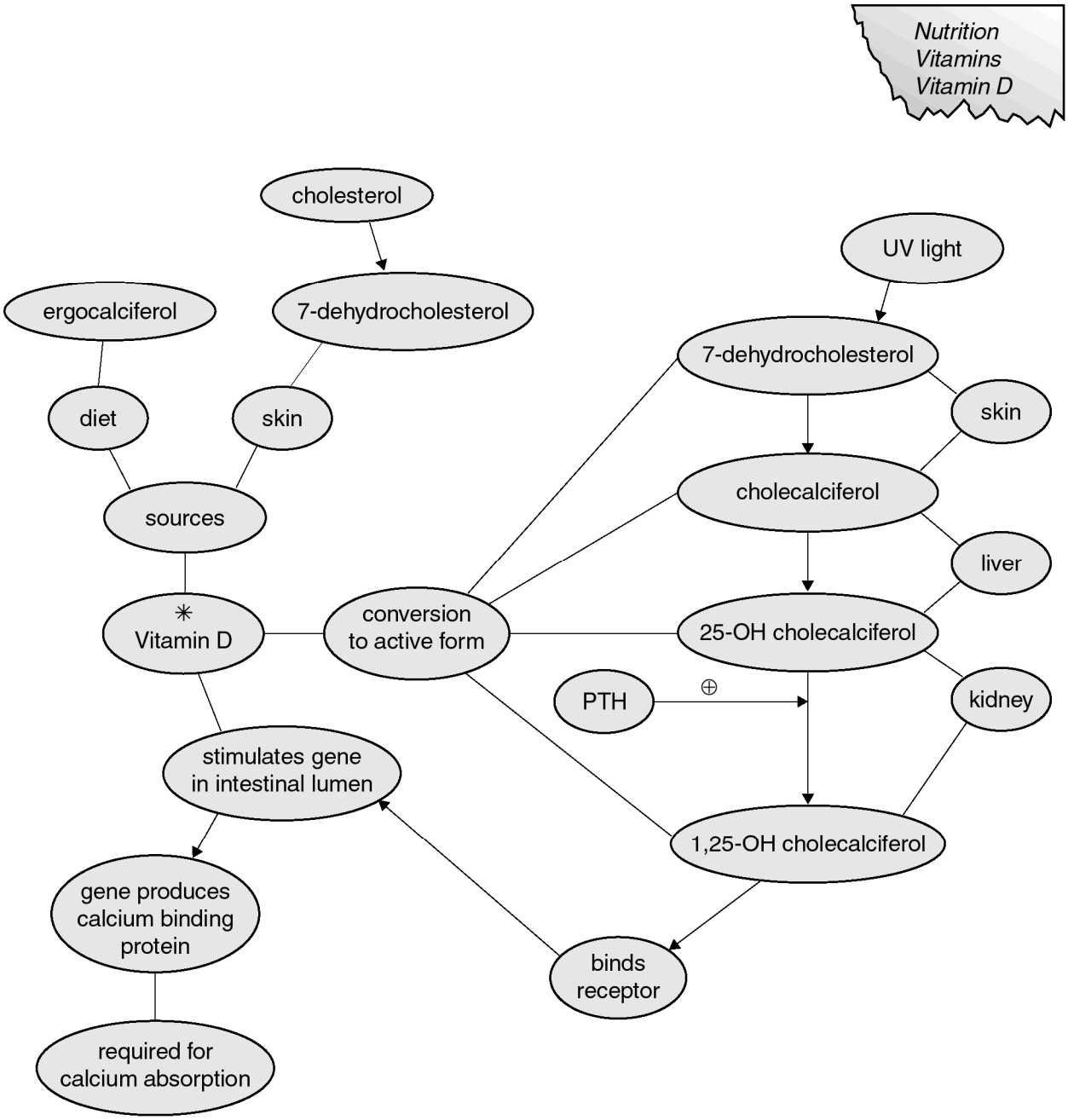

Figure 7-22: Vitamin D function and metabolism.

Examples and Exercises in Human Gross Anatomy

All of the examples and exercises in this section are based on excerpts from *Anatomy: Mosby's USMLE Step I Reviews*[2] used with permission from Mosby-Year Book, Inc. The following steps will help you make best use of the examples and exercises:

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3) Compare your concept maps with the "solution" concept maps, keeping in mind that yours may also be correct but not compare exactly. Sensing types very frequently have a concern about the "correctness" of their maps. This concern is greatly diminished after some experience is gained and it can be a great help to compare your finished map with one done by another student.

[2] See Appendix B for complete reference. The material from "board review" books was selected for these examples and exercises because this material is more representative of medical school course notes than a textbook.

Gross Anatomy Example 1: The Rotator Cuff. The example below illustrates how to summarize the material concerning the characteristics of the supraspinatus, one of the muscles of the rotator cuff in the shoulder region. The excerpt is taken from Chapter 2, "The Upper Extremity." Two overview concept maps (Figure 7.23, 7.24), which are not covered by the excerpt, are also included as a general frame of reference.

- **Muscles of the pectoral girdle and shoulder**
  - The **muscles that move the shoulder girdle** are shown in **Table 2.1** *[not included here]*.
  - The **muscles of the rotator cuff** are shown in **Table 2.2**.
  - The **other muscles that move the humerus** are shown in **Table 2.3** *[not included here]*.
  - — ***Rotator (musculotendinous) cuff (see Table 2.2)***
    - Is the **major stabilizing factor for the shoulder joint** holding the head of the humerus firmly in the glenoid fossa
    - Is formed by the tendons of the **supraspinatus**, **infraspinatus**, **teres minor**, and **subscapularis** muscles as they fuse with the capsule
    - **Reinforces the joint** on all sides **except inferiorly** where dislocation is most likely
    - Has several **bursae**, which provide a **lubricating** mechanism for tendons during movements of the shoulder
      - — **Subdeltoid bursa** lies between the tendon of the supraspinatus below and the deltoid muscle and coracoacromial arch above

Table 2.2: *Rotator Cuff Muscles*

Name	Origin	Insertion	Action	Innervation
Supraspinatus	Supraspinous fossa of scapula	Highest facet of greater tubercle of humerus	Abducts arm; stabilizes shoulder joint	Suprascapular nerve
Infraspinatus	Infraspinous fossa	Middle facet of greater tubercle of humerus	Rotates arm laterally; stabilizes shoulder joint	Suprascapular nerve
Teres minor	Upper two thirds of lateral border of scapula	Lowest facet of the greater tubercle of humerus	Rotates arm laterally; stabilizes shoulder joint	Axillary nerve
Subscapularis	Subscapular fossa	Lesser tubercle of humerus	Rotates arm medially; stabilizes shoulder joint	Upper and lower subscapular nerves

— **Subacromial bursa** is a continuation of the subdeltoid bursa deep to the acromion

— **Subscapular bursa** lies between the subscapularis tendon and the neck of the scapula and commonly communicates with the joint cavity through an anterior defect in the capsule

Quadrangular and triangular spaces

- **Quadrangular space**
  - — Is bounded by the **surgical neck of the humerus** laterally, the **long head of the triceps brachii** medially, the **teres minor and subscapularis** superiorly and the **teres major** inferiorly
  - — Transmits the **axillary nerve** and the **posterior humeral circumflex artery**
- **Triangular space**
  - — Lies adjacent to the scapula
  - — Is bounded by the **long head of the triceps brachii** laterally, the **teres minor and subscapularis** superiorly, and the **teres major** inferiorly
  - — Transmits the **scapular circumflex artery**
- Second **triangular space** (or interval)
  - — Lies adjacent to the humerus
  - — Is bounded by the **long head of the triceps brachii** medially, the **shaft of the humerus** laterally, and the **teres major** superiorly
  - — Transmits the **radial nerve** and the **profunda brachii artery**

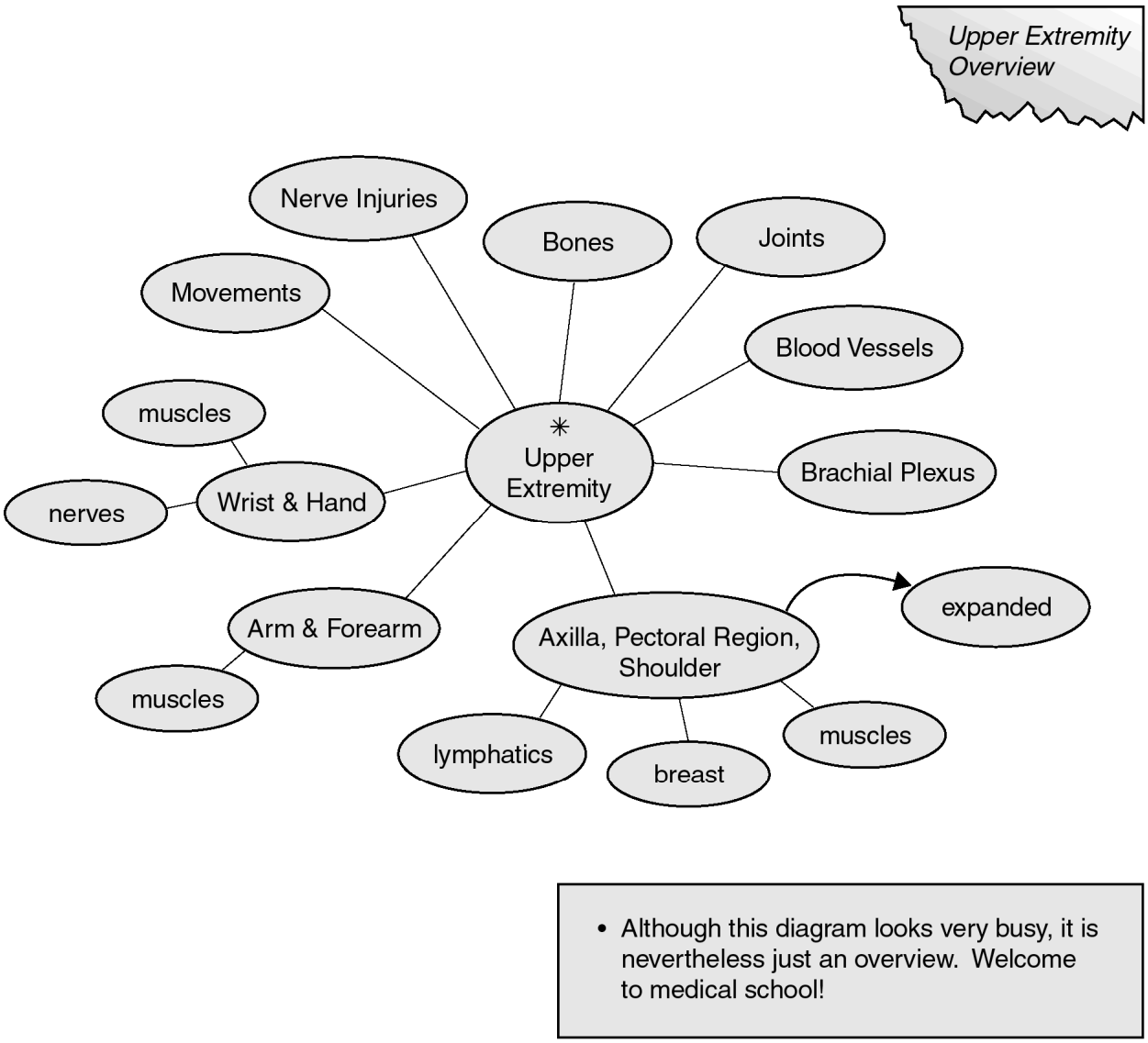

Figure 7-23: Overview of upper extremity.

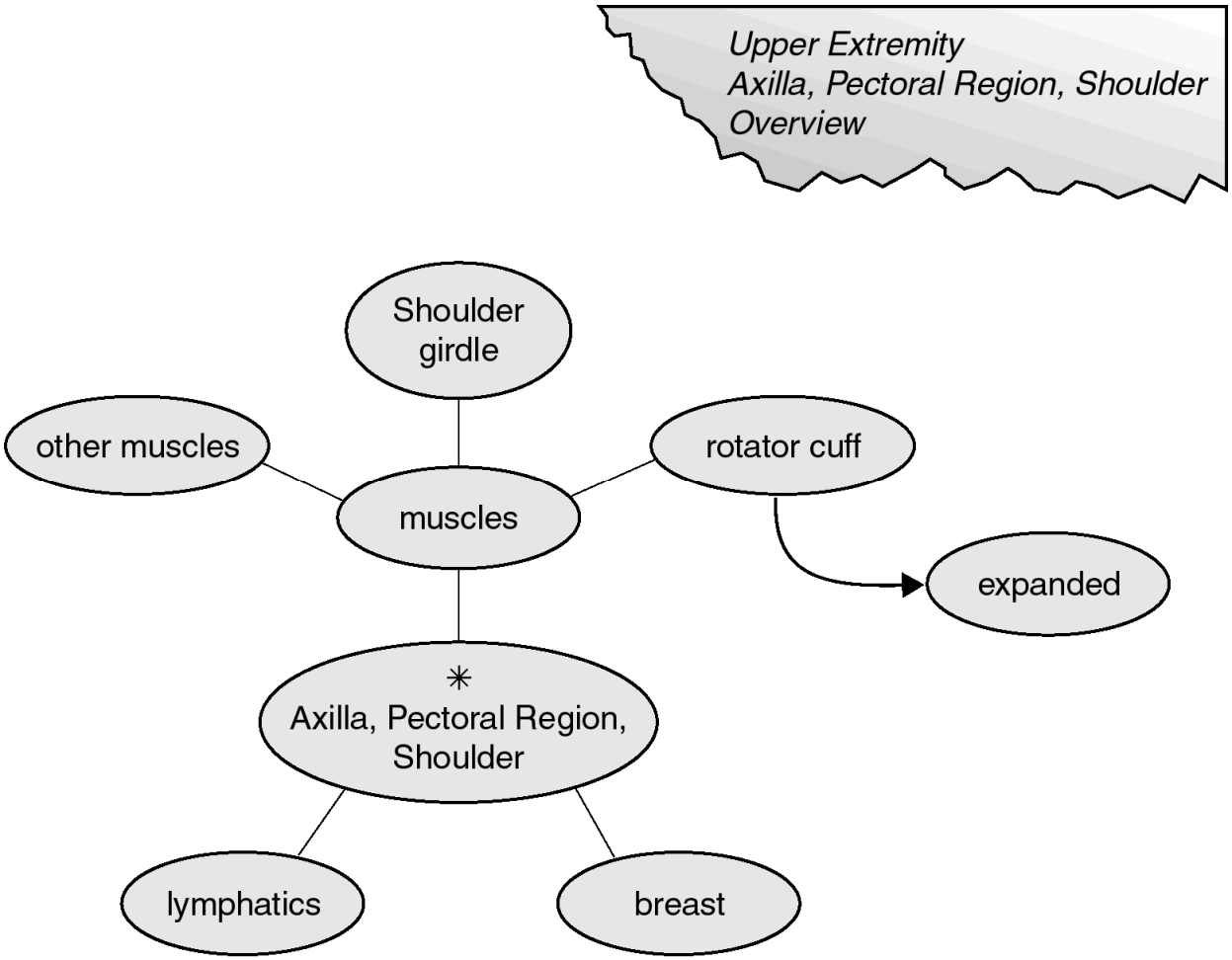

Figure 7-24: Overview of the axilla, pectoral region, and shoulder. Expanded from Figure 7-23.

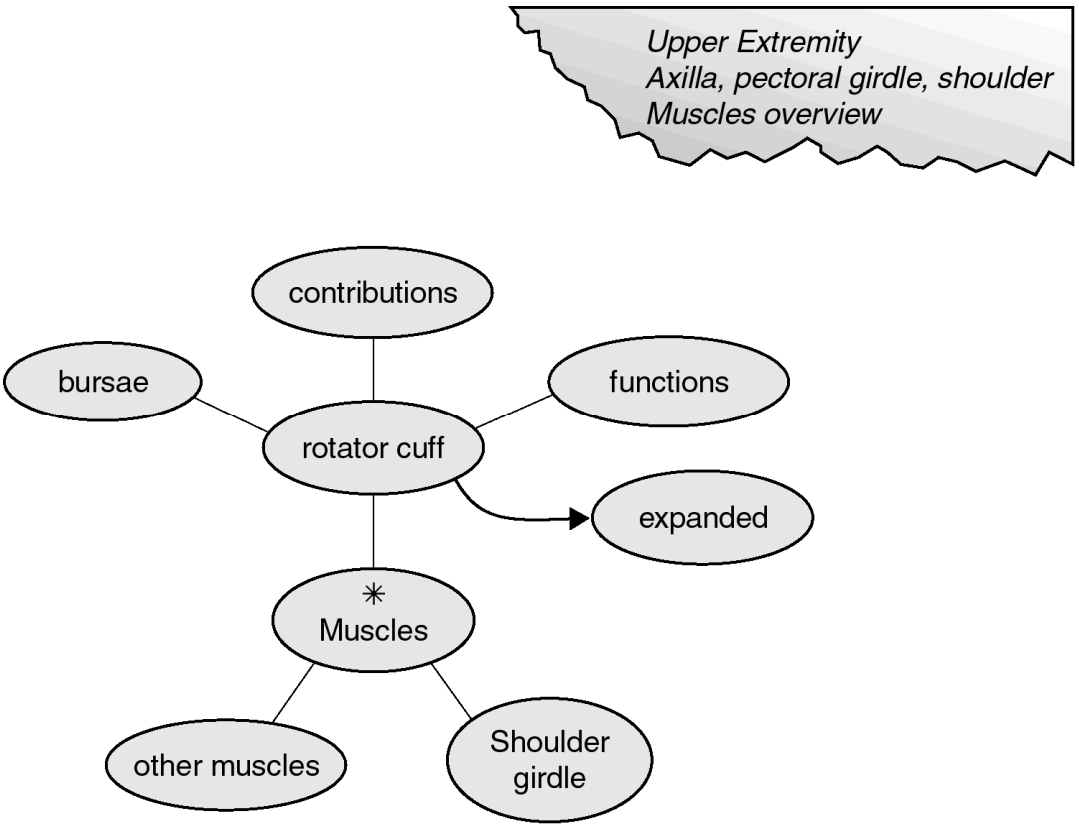

Figure 7-25: Overview of the muscles of the axilla, pectoral region, and shoulder. Expanded from Figure 7-24.

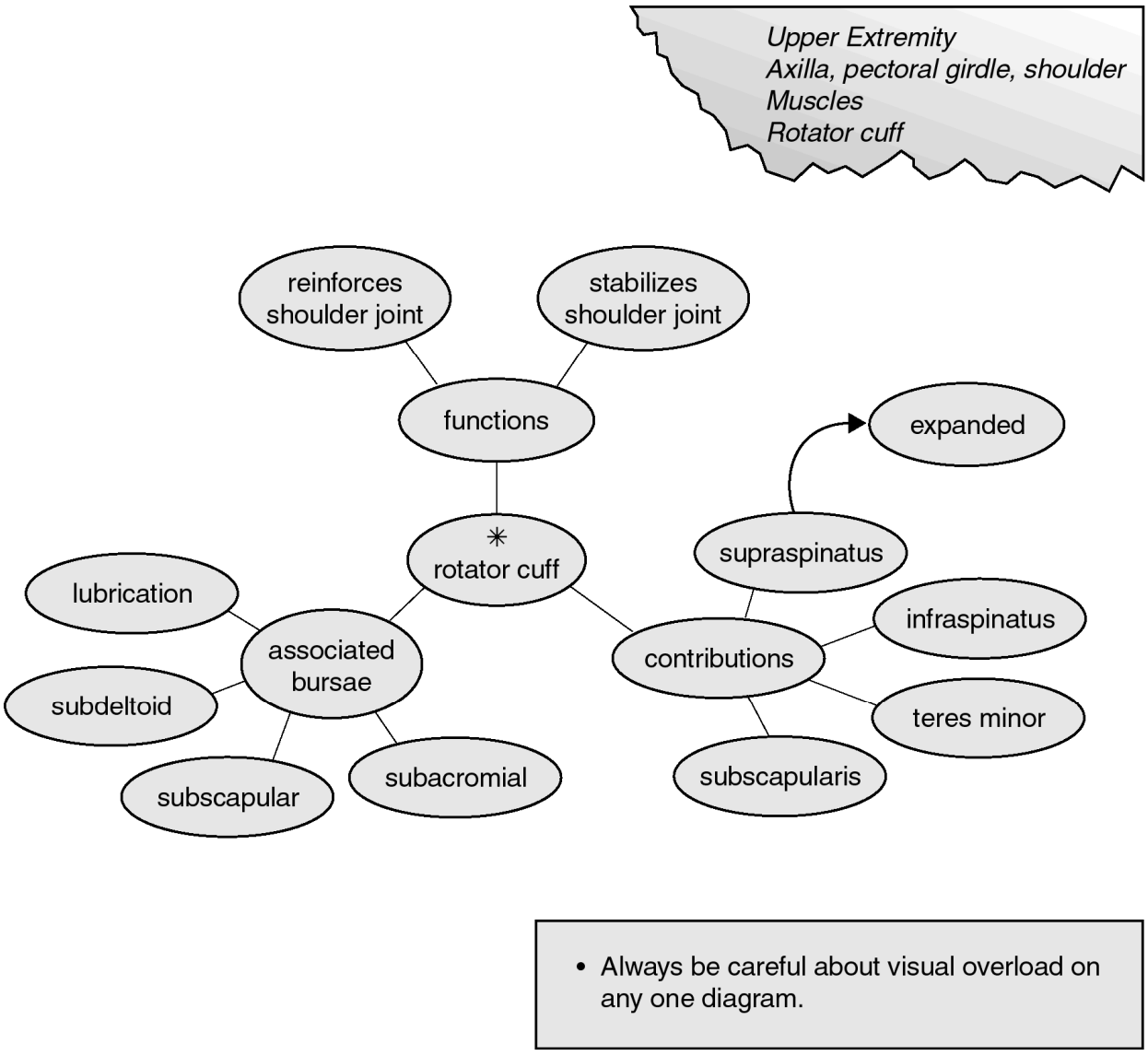

Figure 7-26: Muscles of the rotator cuff. Expanded from Figure 7-25.

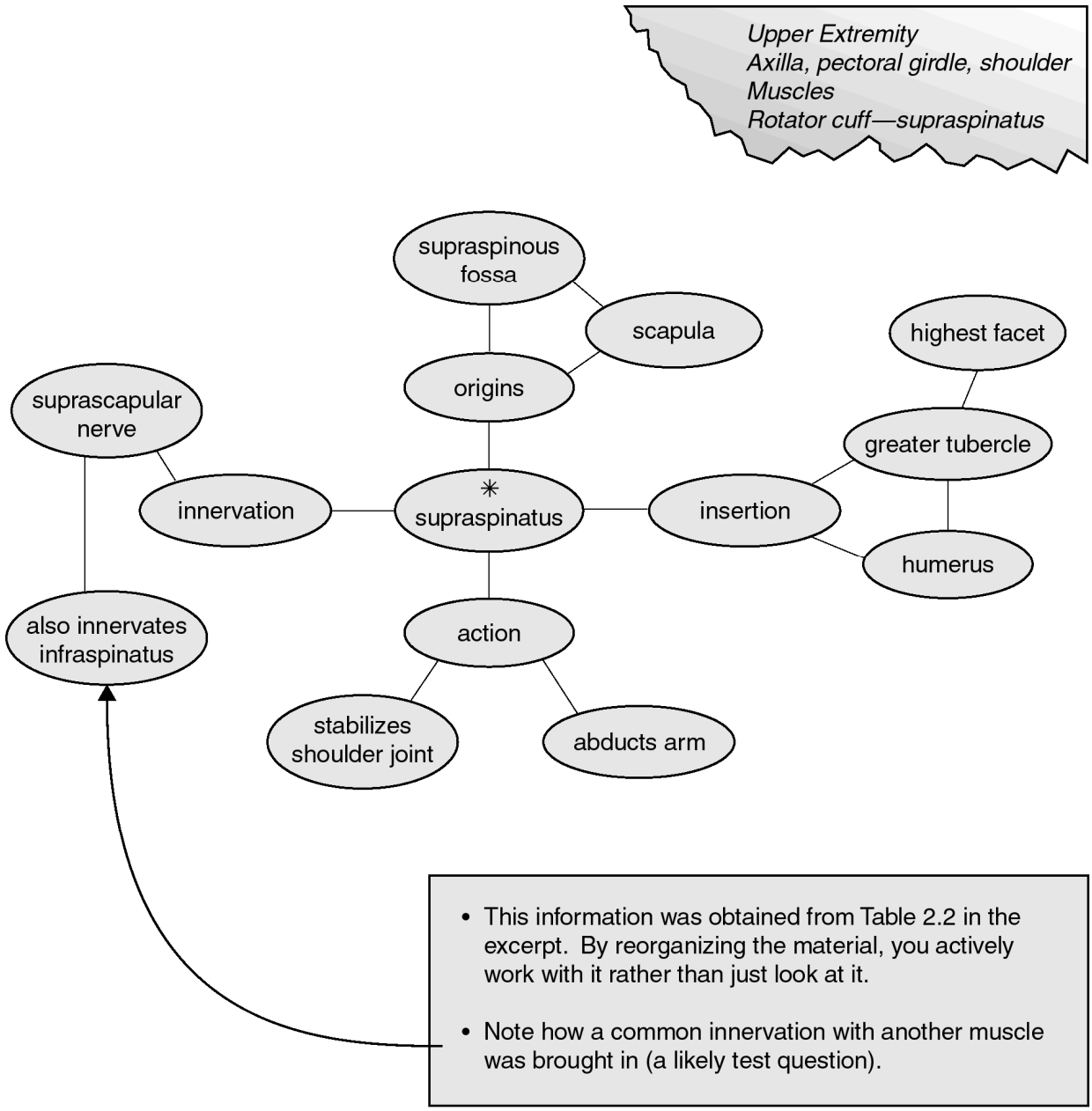

Figure 7-27: The supraspinatus muscle of the rotator cuff. Expanded from Figure 7-26.

Gross Anatomy Example 2: The Afferent Nervous System. The excerpt below illustrates how to summarize the material concerning the anatomy of the afferent nervous system. The excerpt is taken from Chapter 1, "Basic Structure and Concepts." Other than two overview concept maps, only the information in the excerpt concerning the *afferent nervous system* is mapped.

- **Nervous System**
  - Is **conceptionally** divided into the
    - — **Central nervous system** (CNS) consisting of the brain and spinal cord
    - — **Peripheral nervous system** (PNS) consisting of the cranial nerves, the spinal nerves, and their associated ganglia
  - Is **functionally** divided into the
    - — **Somatic nervous system**, which controls voluntary activities
    - — **Visceral nervous stem**, which controls visceral activities
  - **Neuron**
    - — Is the nerve cell, consisting of the cell body, axon, and dendrites
    - — Is the functional unit of the nervous system
    - — Is specialized for the purpose of communication
- **Central nervous system**
  - Consists of the **brain** and **spinal cord**
  - Is composed of **neurons** and specialized supporting cells called **neuroglia** arranged as **gray matter** and **white matter**
  - **White matter**: largely myelinated axons and their supporting neuroglia
  - **Gray matter**: largely neuron cell bodies and dendrites and their supporting neuroglia
  - **Nucleus**: a collection of **neuron cell bodies** within the substance of the **CNS**
    - — *Spinal cord*
      - Begins at the **foramen magnum** where it is continuous with the medulla of the brain stem
      - Ends at the level of the **lower border of the first lumbar vertebra** in the adult
      - Is only about **two thirds** as long as the vertebral canal

- Has a **cervical enlargement** related to the **brachial plexus** and innervation of the **upper extremity**
- Has a **lumbosacral enlargement** related to the **lumbosacral plexus** and innervation of the **lower extremity**
- Has a tapered lower end known as the **conus medullaris**
- Has a centrally located **gray matter** and a peripherally located **white matter**

- **Peripheral nervous system**
  - Consists of **afferent neurons** and **efferent neurons**
  - — *Afferent neurons*
    - Conduct impulses from **sensory receptors** to synapses in the CNS
    - Sense changes in the **external** or **internal** environment
    - Are sensitive to **various modalities**, including touch, pressure, pain, position, muscle tension, chemical concentration, light, and other mechanical stimuli
    - Form the **afferent limb** of the important **reflex arc** controlling the activity of the end organ
    - With only a few exceptions are **pseudounipolar neurons** with an **axon** consisting of
      - — A **central process**, which conducts the impulse from the receptor to the cell body
      - — A **peripheral process**, which conducts the impulse from the cell body into the CNS
    - In **spinal nerves**
      - — Have **cell bodies** located in the **dorsal root ganglion**
      - — Have **axons**, which reach the spinal cord through the **dorsal root** of the spinal nerve
    - In **cranial nerves**
      - — Have **cell bodies** located in the associated **sensory ganglion** of the **cranial nerve**
      - — Have **axons**, which reach the brain through the root of the **cranial nerve**
    - **Ganglion**: collection of **neuron cell bodies** outside the CNS

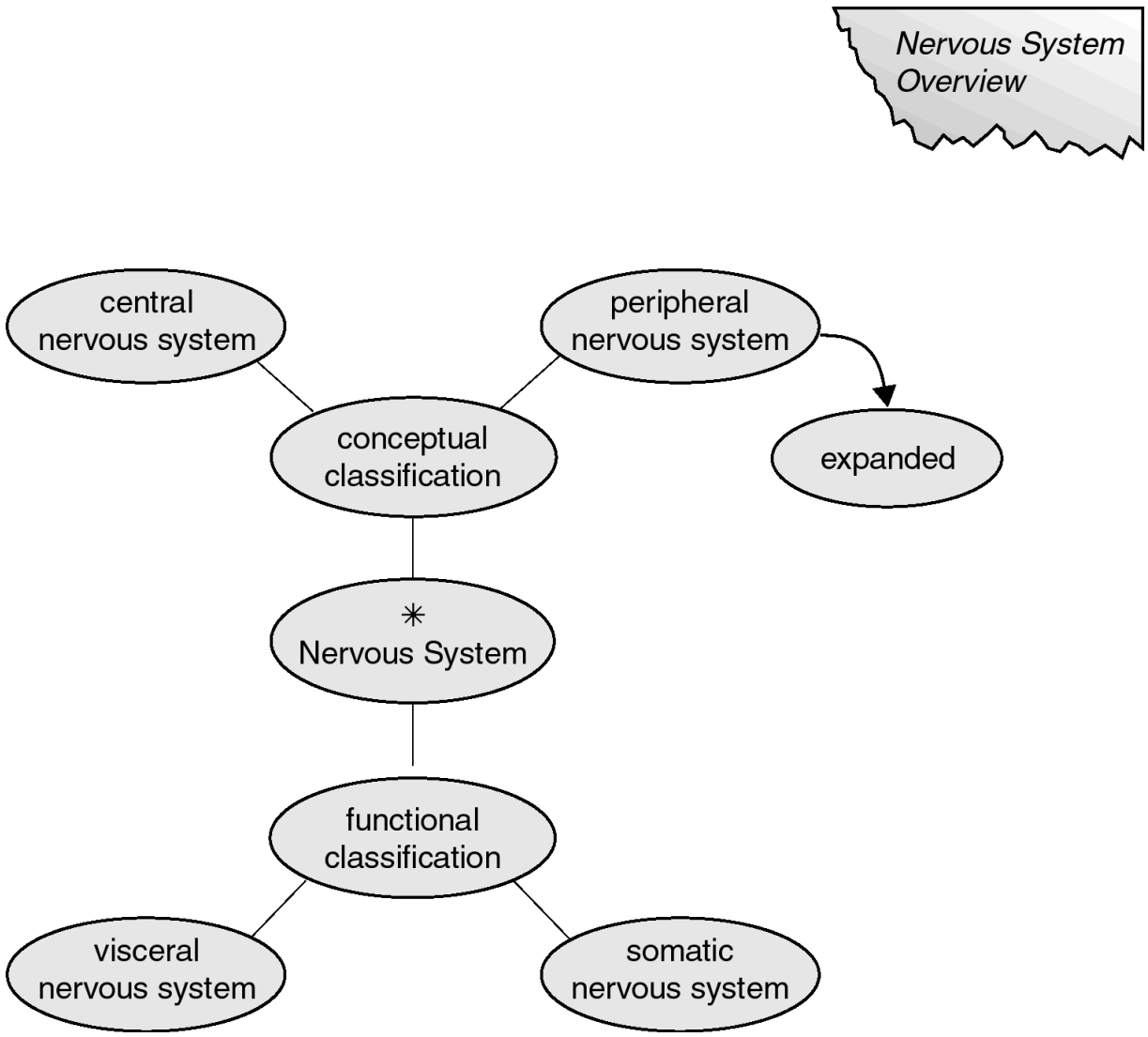

Figure 7-28: Overview of the nervous system.

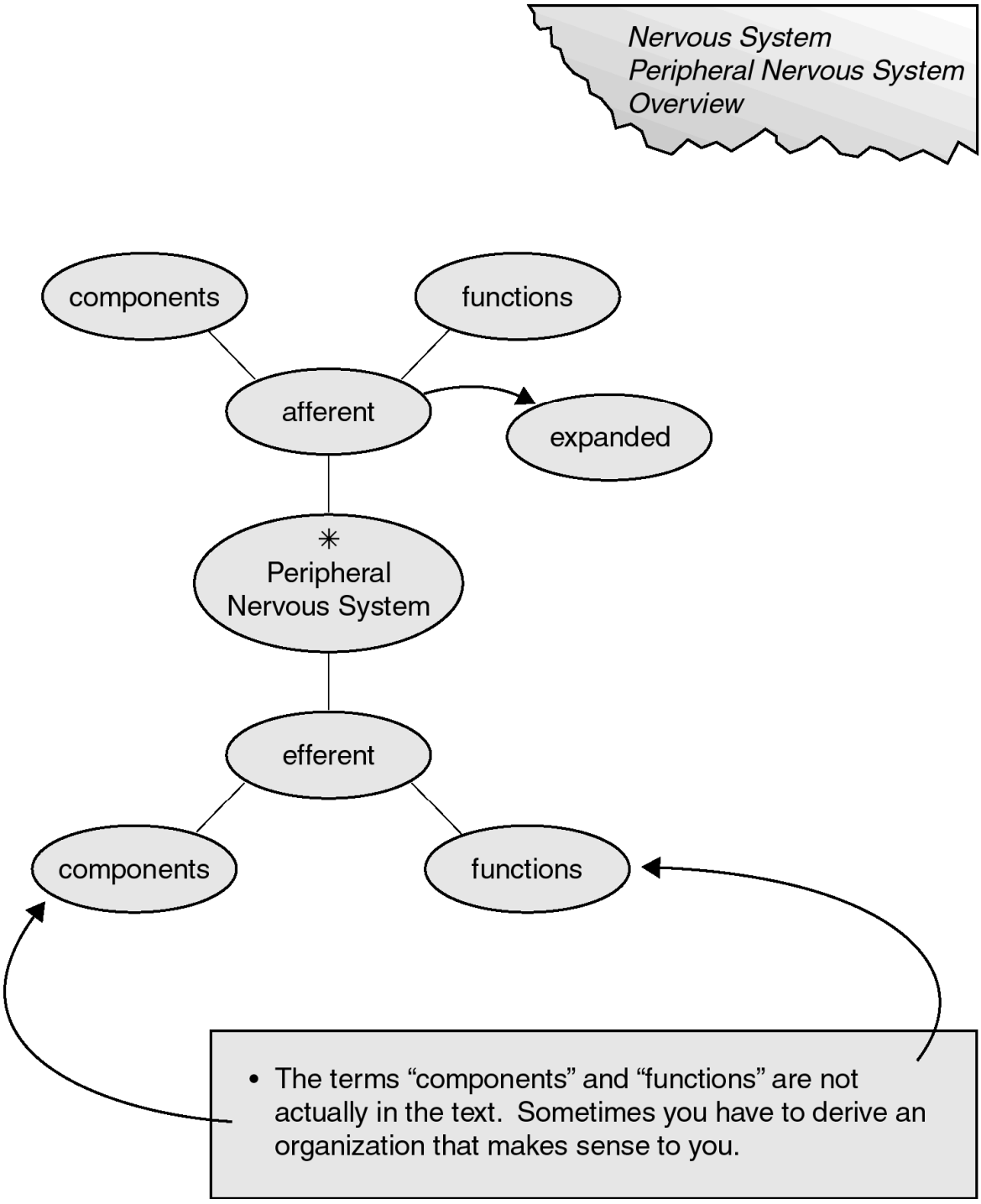

Figure 7-29: Overview of the peripheral nervous system. Expanded from Figure 7-18.

Figure 7-30: Functions and components of the afferent nervous system. Expanded from Figure 7-29.

Gross Anatomy Exercise 1: The Brachial Plexus. Try to concept map the material concerning the *cords* of the brachial plexus from the excerpt below. Start from a general concept map and then expand as needed on the pages that follow. The page headings for the concept maps are given to aid your organization. The answer provided is only for the expansion of the material related to the cords, but you may want to try the other components (divisions, trunks, and roots) also.

■ **Brachial Plexus and Its Branches**

- **Brachial plexus (Fig. 2.7)**
  - Is formed in the neck from the **ventral rami** of spinal nerves **C5 to T1** and extends into the axilla
  - Gives rise to the nerves supplying the upper extremity
  - Is said to be **prefixed** when it receives a large **contribution from C4**

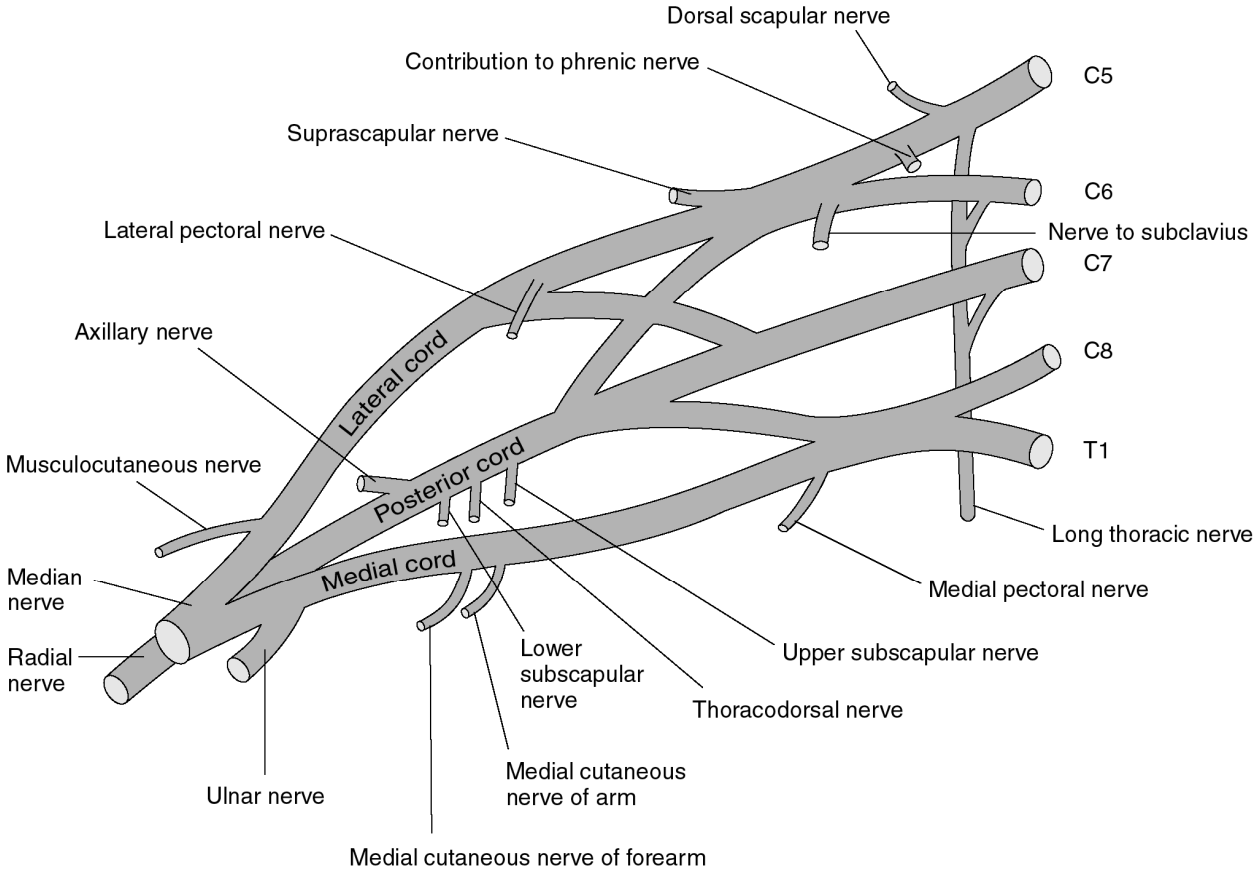

Figure 2.7 The brachial plexus and its branches.

- Is said to be **postfixed** when it receives a large **contribution from T2**
- Is described as having **roots, trunks, divisions, and cords**
- Roots
  - Are the **ventral rami** of the five spinal nerves involved
  - Emerge in the neck between the scalenus anterior and scalenus medius muscles
- Trunks
  - Are three in number, an **upper**, a **middle**, and a **lower**
  - Pass from the neck to the axilla behind the middle third of the clavicle
  - **Upper** forms by union of the **C5 and C6 roots**
  - **Middle** is a continuation of the **C7 root**
  - **Lower** forms by union of the **C8 and T1 roots**
- Divisions
  - Arise from each trunk as **anterior** and **posterior** divisions
  - Lie at the apex of the axilla
- Cords
  - Are three in number, a **medial**, a **lateral**, and a **posterior**
  - Are named from their **positions** relative to the **second part of the axillary artery**
  - Are enclosed with axillary artery and vein within the **axillary sheath**
  - **Posterior cord** forms from the **posterior divisions of all three trunks**
  - **Lateral cord** forms from the **anterior divisions of the upper and middle trunk**
  - **Medial cord** is a continuation of the **anterior division of the lower trunk**

Upper Extremity
Brachial Plexus
Overview

Upper Extremity
Brachial Plexus
Components

Upper Extremity
Brachial Plexus
Cords

Gross Anatomy Exercise 1 Solution. One possible representation of the excerpt is given in the following concept maps. If yours are different, they may still be accurate representations since many topics can be organized in several different ways. You can check the "correctness" of your map by repeating it aloud to see if you can present it as a meaningful lesson to someone else.

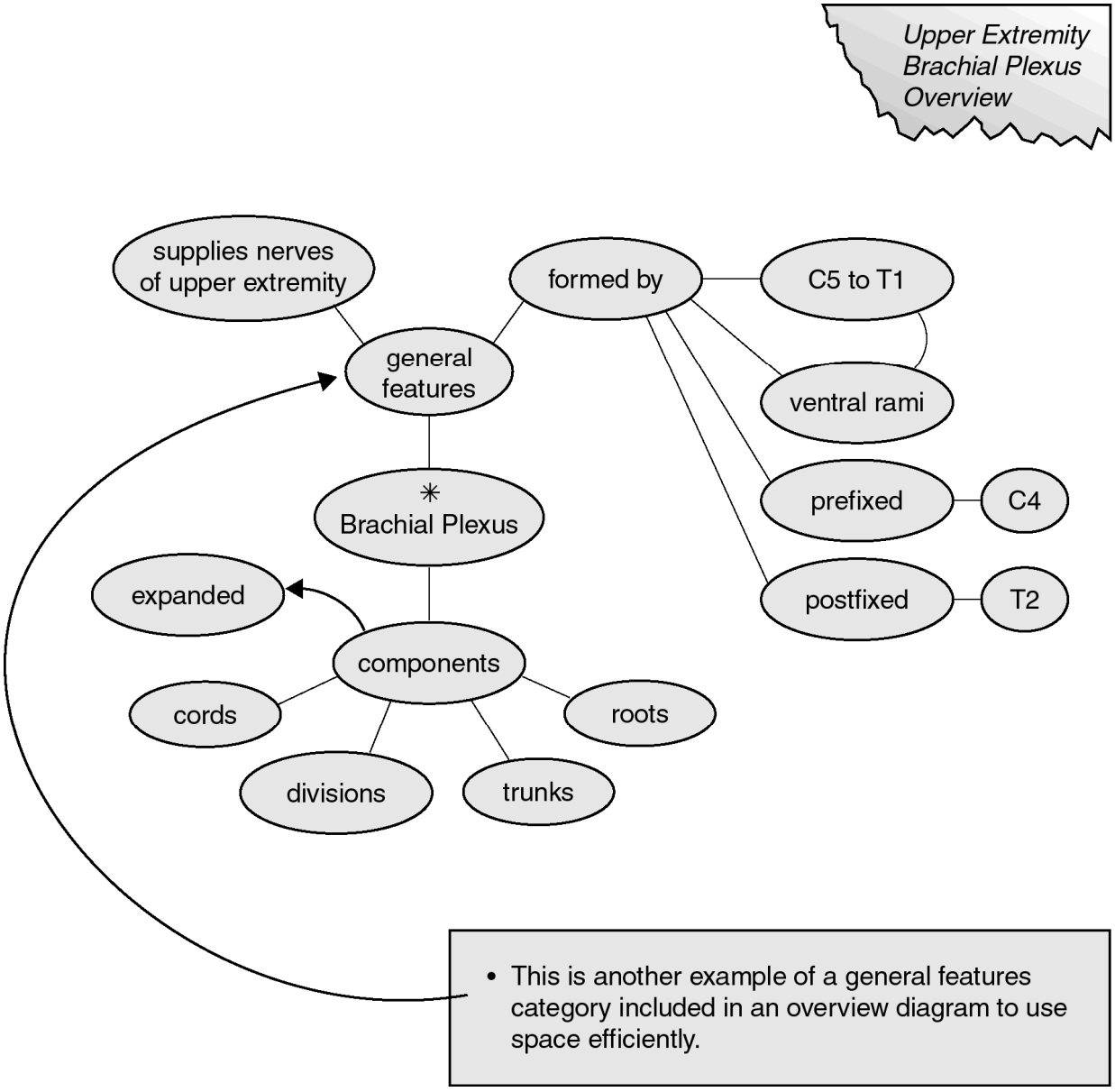

Figure 7-31: Overview of the brachial plexus.

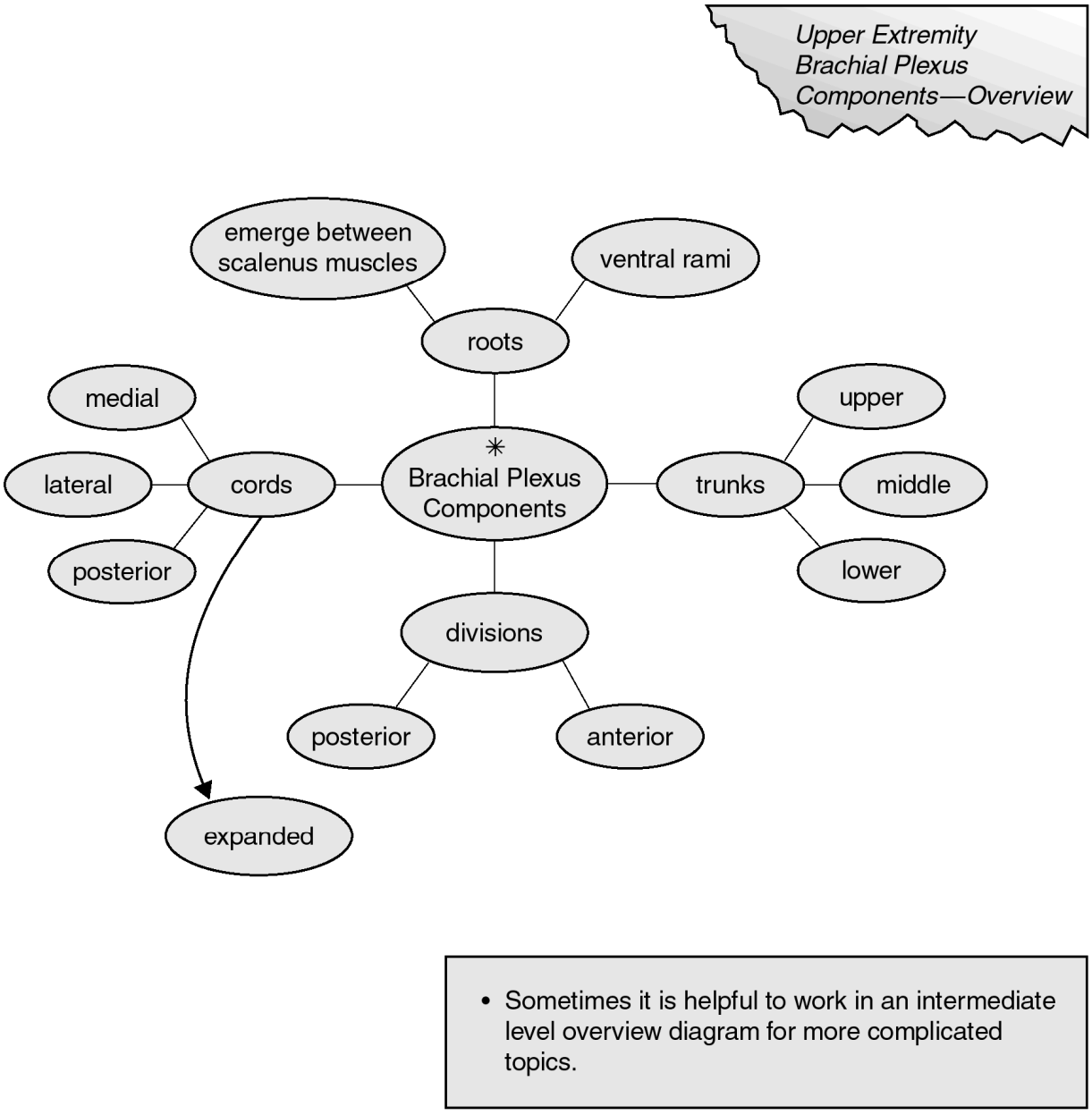

Figure 7-32: Overview of the components of the brachial plexus. Expanded from Figure 7-31.

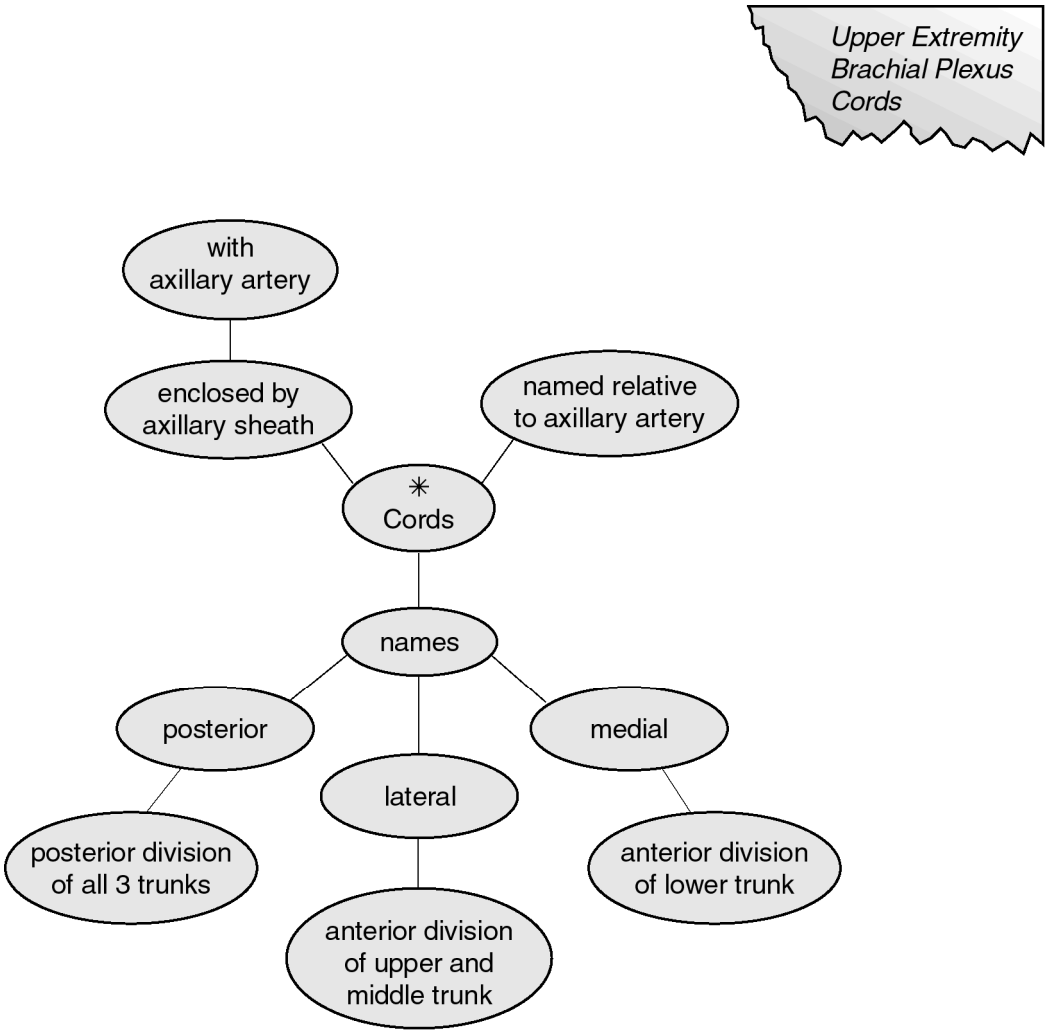

Figure 7-33: Cords of the brachial plexus. Expanded from Figure 7-32.

Gross Anatomy Exercise 2: The Left Ventricle of the Heart. Try to concept map the material concerning the *wall structure* of the left ventricle of the heart from the excerpt below. An overview concept map (Figure 7.34) that is not in the excerpt is provided to serve as a frame of reference. The page headings for the concept maps are given to aid your organization.

- **Heart**
  - — *Structure of the heart*
    - The **epicardium** covers the outside of the heart and is composed of the visceral layer of serous pericardium and a thin subserous layer of connective tissue.
    - The **myocardium** consists of cardiac muscle fibers arranged as spiraling and looping bundles of fibers.
    - The **endocardium** lines the interior of the heart and consists of endothelial cells continuous with the endothelial lining of the great vessels.
    - The **skeleton of the heart** consists of four firmly connected, fibrous connective tissue rings, the annuli fibrosi, and is continuous with the membranous portion of the interventricular septum. It provides a relatively rigid attachment for the myocardial fiber bundles and the pulmonary, aortic, and atrioventricular valves.
  - — *External form, surfaces, and borders*
    - The **base** is the posterior aspect of the heart and is formed largely by the left atrium but also by a narrow portion of the right atrium.
    - The heart projects downward, forward, and to the left from the base to terminate as the blunt **apex**. The apex is located at the level of the fifth intercostal space medial to the nipple and is formed by the left ventricle.
    - The **diaphragmatic surface** rests on the diaphragm and is formed largely by the left ventricle but also by a narrow portion of the right ventricle.
    - The **sternocostal surface** faces anteriorly and is composed largely of the right atrium and right ventricle but also a narrow portion of the left ventricle.
    - The **obtuse margin** is the rounded left side of the heart formed entirely by the left ventricle.
    - The **acute margin** is the narrowed inferior border where the sterno-costal and diaphragmatic surfaces meet. It is formed largely by the right ventricle.

- The **right margin** is formed on radiographs by the superior vena cava and right atrium.
- The **left margin** is formed on radiographs mainly by the left ventricle and to a small extent by the left atrium.

— *Chambers and valves*

Right atrium

- The right atrium receives blood from the superior and inferior venae cavae, the coronary sinus, and the anterior cardiac veins.
- It is larger and thinner walled than the left atrium.
- It communicates with the right ventricle through the **right atrioventricular orifice**, which is guarded by the **tricuspid valve**.
- The posteriorly situated main cavity, the **sinus venarum cavarum**, is smooth walled. It is derived from incorporation of the right sinus horn into the developing right atrium.
- The anterior portion, including the ear-shaped appendage, the **auricle**, is rough walled because of the presence of pectinate muscles. This portion corresponds to the primitive atrium of the embryonic heart.
- The two parts are separated internally by a longitudinal ridge, the **crista terminalis**, and externally by the **sulcus terminalis**. Their superior end marks the location of the **sinoatrial node**, the "pacemaker" of the heart.
- **Pectinate muscles** are ridgelike thickenings of the atrial musculature found in the anterior half of the right atrium and in both auricles.
- The **coronary sinus** opens between the atrioventricular orifice and the inferior vena cava.
- The **valve of the coronary sinus** and the **valve of the inferior vena cava** are rudimentary endothelial folds. They and the crista terminalis are derived from the right sinus valve of the embryonic heart. In the embryonic heart the valve of the inferior vena cava helps direct blood from the inferior vena cava into the left atrium through the patent foramen ovale.
- The **fossa ovalis** is an oval-shaped depression in the interatrial septum and marks the site of the **foramen ovale** of the embryonic heart through which blood passes from the right atrium to the left atrium before birth. The upper margin of the fossa is formed by the **limbus fossa ovale**.
- The **interatrial septum** forms part of the posterior wall.

Tricuspid valve

- Guards the **right atrioventricular orifice**
- Has **anterior**, **posterior**, and **septal cusps**

- Allows the flow of blood from the right atrium to the right ventricle during ventricular relaxation (diastole)
- Closes during ventricular contraction (systole)
- Is prevented from being everted into the right ventricle by the papillary muscles and chordae tendinae attached to their margins

Right ventricle

- The right ventricle is considerable thicker walled than the right atrium.
- It forms much of the sternocostal (anterior) surface of the heart and a small part of the diaphragmatic surface.
- It lies anterior to most of the left ventricle.
- The superior portion is the funnel-shaped outflow tract, the **conus arteriosus** or **infundibulum**, which leads to the pulmonary trunk. It is smooth walled and is separated from the ventricle proper by the **supraventricular crest**.
- The ventricle proper is rough walled because of the presence of prominent, irregular muscular projections, the **trabeculae carnae**.
- **Papillary muscles** are projecting cones of ventricular musculature that give rise at their apex to the **chordae tendinae**. The right ventricle typically has three papillary muscles named according to the location of their bases (**anterior**, **posterior**, and **septal**).
- **Chordae tendinae** are fibrous strands that extend from the apices of the papillary muscles to the free margin of the atrioventricular valve cusps. Chordae tendinae from a single papillary muscle typically connect to more than one cusp.
- The **septomarginal trabecula** or **moderator band** is a relatively constant trabeculae carnae in the form of a free band that passes as a bridge between the interventricular septum and the anterior wall of the ventricle. It conveys the right branch of the atrioventricular bundle.

Pulmonary valve

- The pulmonary valve has **three semilunar cusps**, which are named according to their fetal position.
- In the adult heart, the **right** cusp lies posteriorly and the **anterior** and **left** cusps lie anteriorly.
- The pulmonary valve is forced closed by pressure in the pulmonary trunk during relaxation of the right ventricle.
- It has associated **pulmonary sinuses**, which are dilations of the pulmonary trunk adjacent to each cusp.

Left atrium

- The left atrium receives blood from the four pulmonary veins.

- It is smaller and thicker walled than the right atrium.
- It communicates with the left ventricle through the **left atrioventricular orifice**, which is guarded by the **mitral valve**.
- The posterior portion is smooth walled and receives the four pulmonary veins. It is derived from the incorporarion of the proximal portions of the embryonic pulmonary veins.
- The anterior portion, including the ear-shaped appendage, the **auricle**, is rough walled because of the presence of pectinate muscles. This portion is derived from the embryonic atrium.
- The **interatrial septum** forms part of the anterior wall.

Mitral valve

- Guards the **left atrioventricular orifice**
- Has anterior and posterior cusps

Left ventricle

- Forms much of the diaphragmatic surface of the heart and a small part of the sternocostal surface
- Lies largely behind the right ventricle
- Has a wall two to three times as thick as that of the right ventricle because it works harder pumping against the systemic resistance
- Has **trabeculae carnae** that are less coarse than those of the right ventricle
- Has no **moderator band**
- Has two large **papillary muscles**, **anterior** and **posterior**, each of which sends chordae tendinae to both mitral cusps

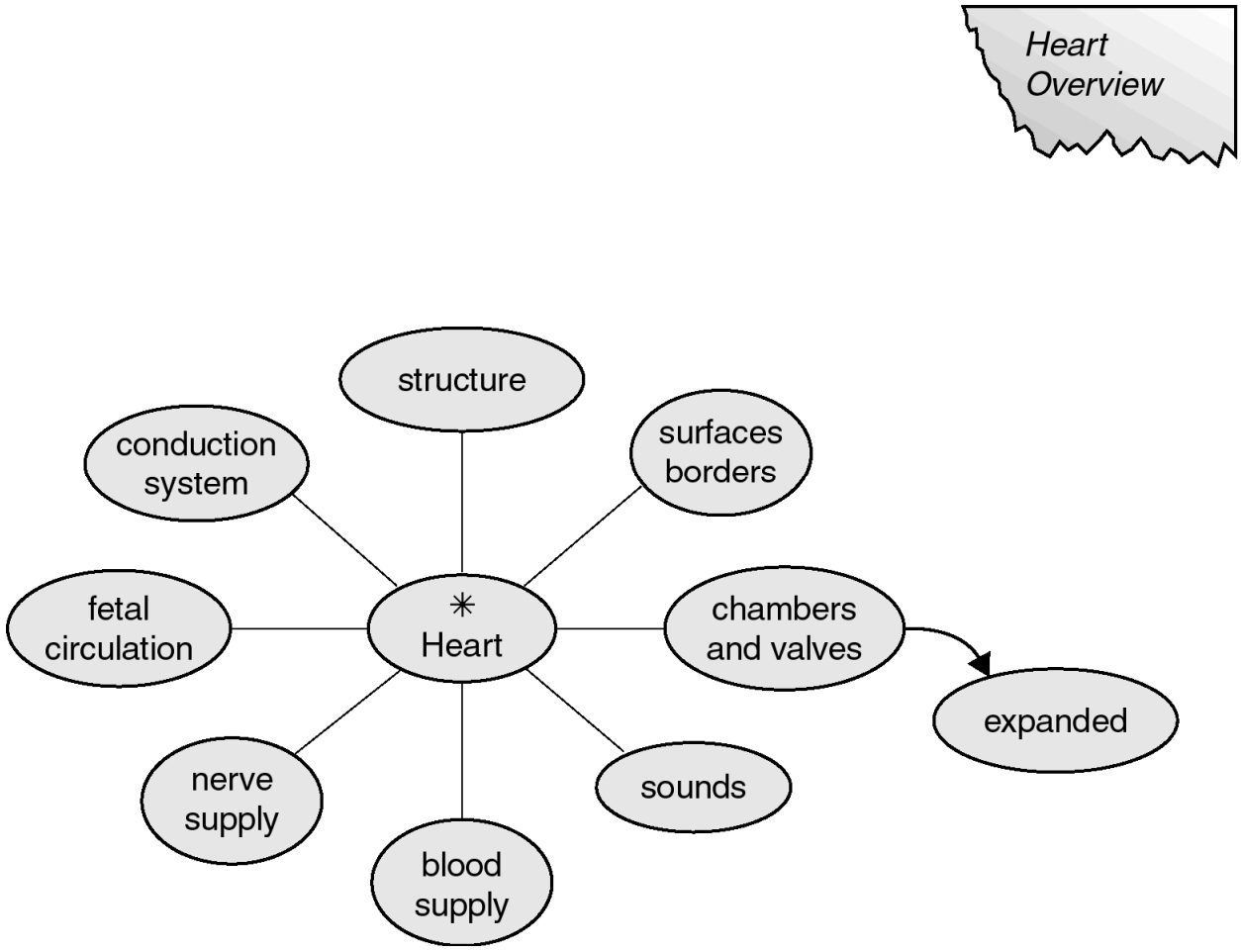

Figure 7-34: Overview of heart anatomy.

Heart
Chambers and Valves

Heart
Chambers and Valves
Left Ventricle

Heart
Chambers and Valves
Left Ventricle
Wall Structure

Gross Anatomy Exercise 2 Solution. One possible representation of the excerpt is given in the following concept maps. If yours are different, they may still be accurate representations since many topics can be organized in several different ways. You can check the "correctness" of your map by repeating it aloud to see if you can present it as a meaningful lesson to someone else.

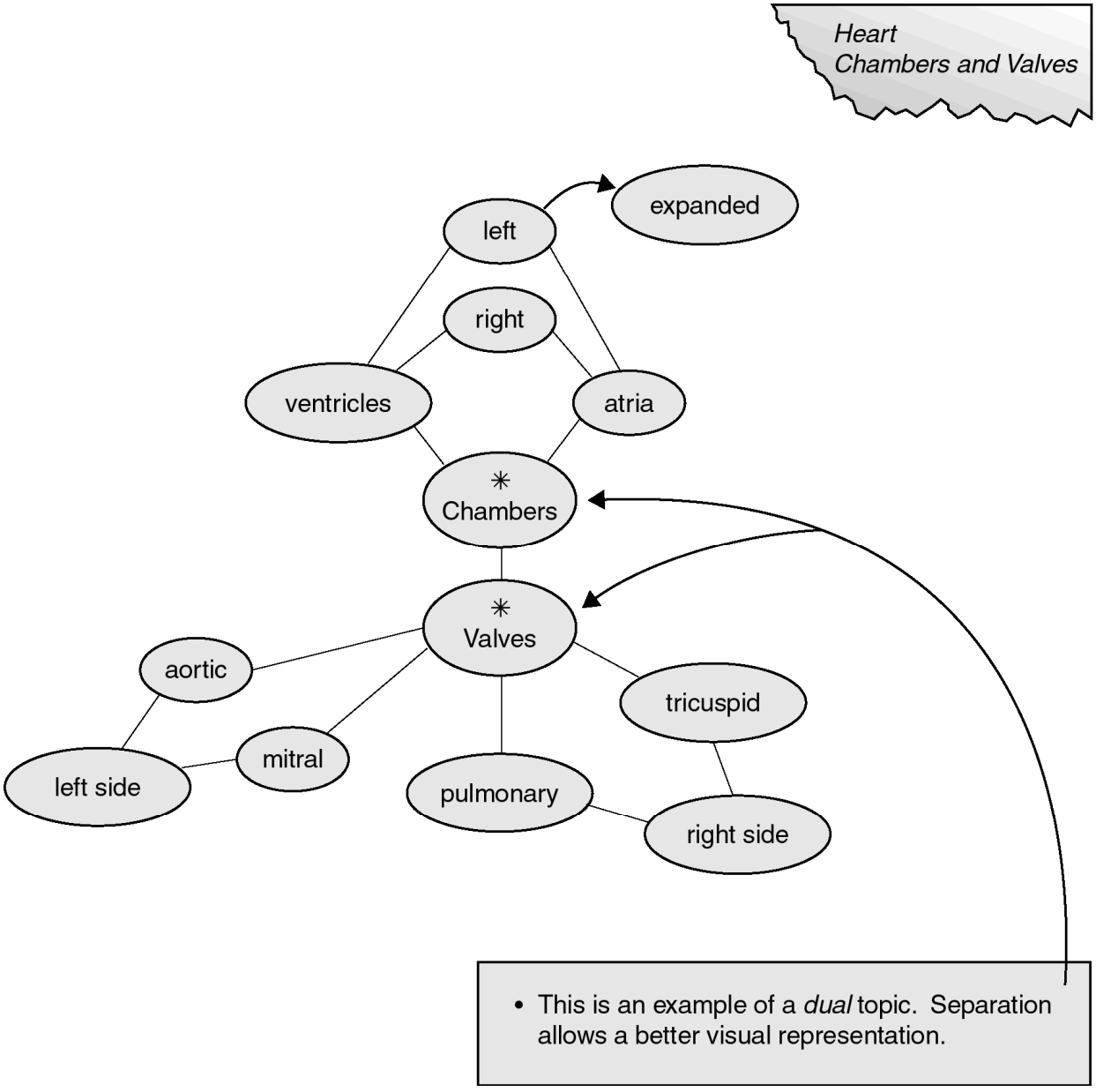

Figure 7-35: Chambers and valves of the heart. Expanded from Figure 7-34.

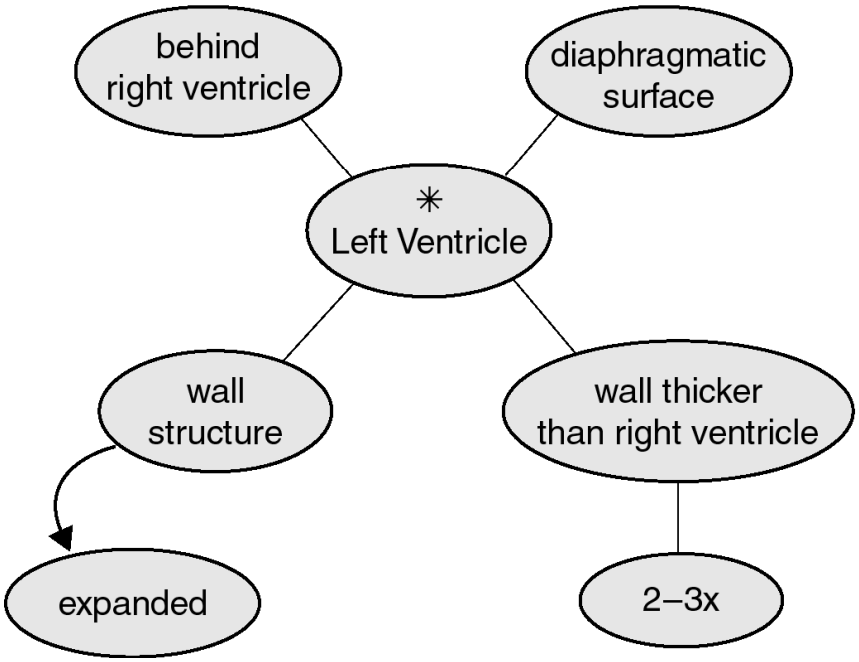

Figure 7-36: Left ventricle of the heart. Expanded from Figure 7-35.

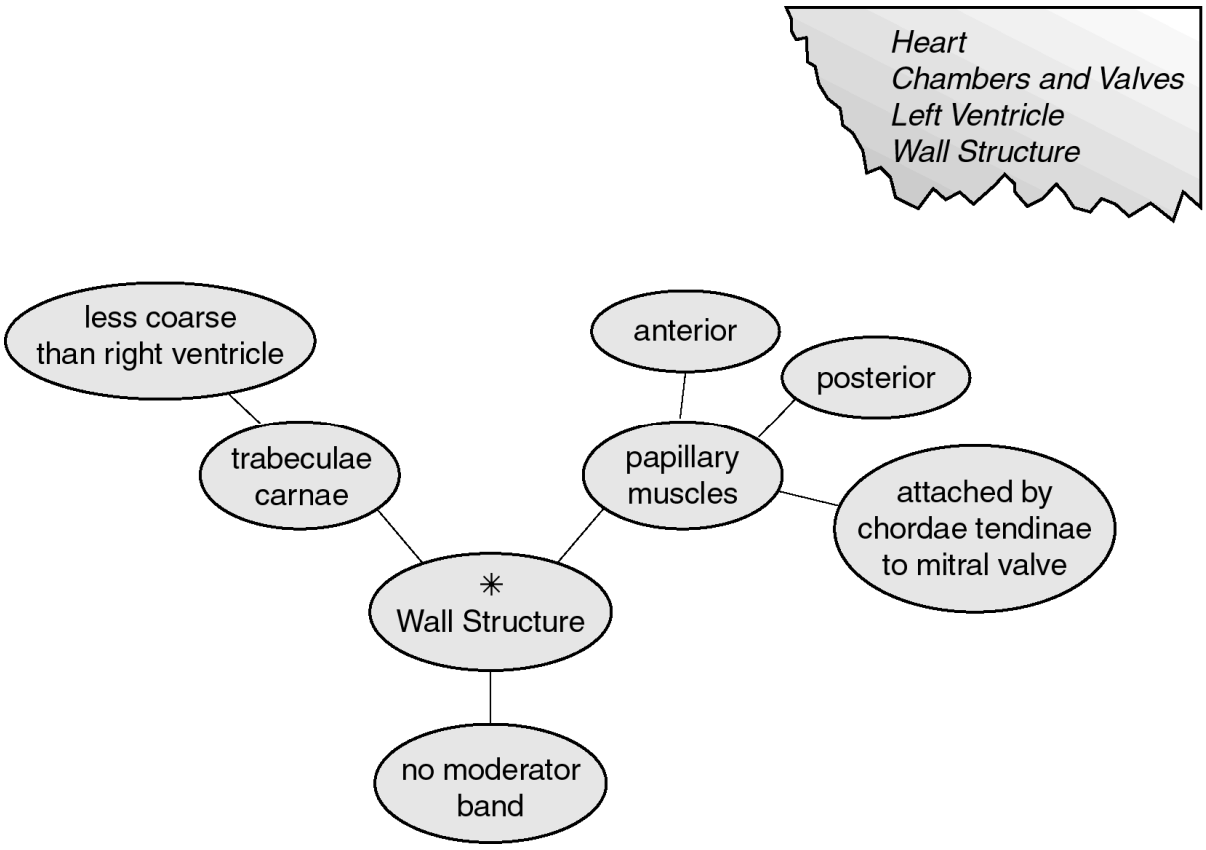

Figure 7-37: Wall structure of the left ventricle. Expanded from Figure 7-36.

Examples and Exercises in Medical Histology

All of the examples and exercises in this section are based on excerpts from *Histology and Cell Biology: Mosby's USMLE Step 1 Review* used with permission from Mosby—Year Book, Inc.[3] The following steps will help you make best use of the examples and exercises:

1) Study the following examples to see how the terms and concepts from the excerpts might be represented in concept maps.

2) To complete the exercises that follow the examples, refer to the excerpts provided and try your hand at summarizing the material in concept maps. Blank pages labeled with appropriate page headings are provided for this purpose. [*Author's note: The blank pages have been intentionally retained in this web-version of SuccessTypes*.] You may want to refer to the steps for creating concept maps that begin on page 57.

3) Compare your concept maps with the "solution" concept maps, keeping in mind that yours may also be correct but not compare exactly. Sensing types very frequently have a concern about the "correctness" of their maps. This concern is greatly diminished after some experience is gained and it can be a great help to compare your finished map with one done by another student.

[3] See Appendix B for complete reference. The material from "board review" books was selected for these examples and exercises because this material is more representative of medical school course notes than a textbook.

Histology Example 1: Thin Myofilaments in Skeletal Muscle. The example below illustrates how to summarize the material concerning the characteristics of the thin myofilaments that make up the myofibrils of skeletal muscle. The subtopic of actin is also shown in an expansion concept map. The excerpt is taken from Chapter 7, "Muscular Tissue."

Skeletal Muscle

Skeletal muscle consists of large multinucleated fibers (up to 30 cm long and 100 μm thick). The cytoplasm (sarcoplasm) of the cell is filled with myofibrils. The skeletal muscle fiber is a multinucleate cell that arises in the embryonic connective tissue mesenchyme. The earliest muscle cell is called the **myoblast**. The fusion of many myoblasts gives rise to a tubelike cell with many nuclei, the **myotube**. As the cell differentiates, it lays down myofilaments, which organize into striated myofibrils. As the number of myofibrils increase, the nuclei are displaced to the periphery of the cell under the plasma membrane.

Growth of muscle after puberty occurs by an increase in the size of muscle fibers (hypertrophy) rather than an increase in the number of fibers (hyperplasia).

Myofibrils run parallel to the long axis of the fiber and give to the fiber a cross-banded (striated) appearance. Each myofibril itself, like the fiber, is cross-striated. There are dark **A bands** (anisotropic), and adjacent to each A band is a light **I band** (isotropic). A **Z line** bisects each I band. The **sarcomere** is the functional unit of the fiber and is the distance between two Z lines. It is the smallest unit capable of contraction.

Myofilaments are the basic components of myofibril. There are two types of myofilaments.

- **Thick Filaments (Myosin-containing Myofilaments)** Each thick myofilament is about 1.5 μm long, 14 nm thick, and contains hundreds of myosin molecules. Myosin is a thin, rodlike protein with a globular head region and a long tail. Its molecular weight is 500 kDa, and it measures 150 nm in length.

  In the thick filament, the tails of the myosin molecules associate to form cigar-shaped structures such that the molecules at one end of the thick filament are oriented 180 degrees opposite to the molecules at the other end. The heads of the myosin molecules project from the thick filament, and they attach to actin in the thin filament. The heads bind and hydrolyze ATP.

- **Thin Filaments (Actin-containing Myofilaments)** Each thin filament measures 1 μm long, 8 nm thick. Thin filaments are composed of 300 to 400 units of the globular protein actin (G-actin) (MW 42 kDa). These spherical particles of G-actin are arrayed like a twisted double-helical strand of beads in fibrous actin (F-actin).

  Tropomyosin is a long filamentous protein that runs over several actin subunits along the groove in the helix. Each tropomyosin molecule spans seven actin molecules. Troponin is a globular protein complex that attaches to a specific site on each tropomyosin molecule. There is one troponin complex/tropomyosin molecule. The troponin complex has 3 subunits.

- TnT, which attaches to tropomyosin
- TnC, which binds Ca^{++}
- TnI, which inhibits the actin-myosin interaction

Each G-actin monomer contains a myosin-binding site. If thin filaments are isolated, intact and then incubated with the heads of myosin molecules, the thin filaments bind the myosin heads. The myosin heads bound on one side of the Z line are oriented at 180 degrees to those on the other side of the Z line, indicating a polarity in the thin filaments.

The Organization of Myofilaments in the Myofibril (at Rest)

Thick filaments are limited to the A band. Thin filaments extend from the Z line through the I band and into the A band. The thin filaments are firmly attached to the Z line. Alpha actinin anchors the actin-containing filaments to the Z line. They interdigitate with the thick filaments. The thin filaments overlap the thick filaments extending into the A band where they form a hexagonal array about each thick filament. The thin filaments are absent from the H zone. In the center of the H zone is the M line.

The "A" and "I" bands of adjacent myofibrils are in register, giving to the entire fiber a cross-striated appearance. Intermediate filaments (desmin) form a delicate framework linking myofibrils together laterally and keeping the A and I bands in register. At Z bands, desmin filaments form a planar network that interacts with alpha actinin at the Z line and extends laterally to the plasma membrane (sarcolemma). The protein dystrophin links the desmin-actinin complex to the plasma membrane (sarcolemma). Dystrophin is absent or defective in individuals with muscular dystrophy.

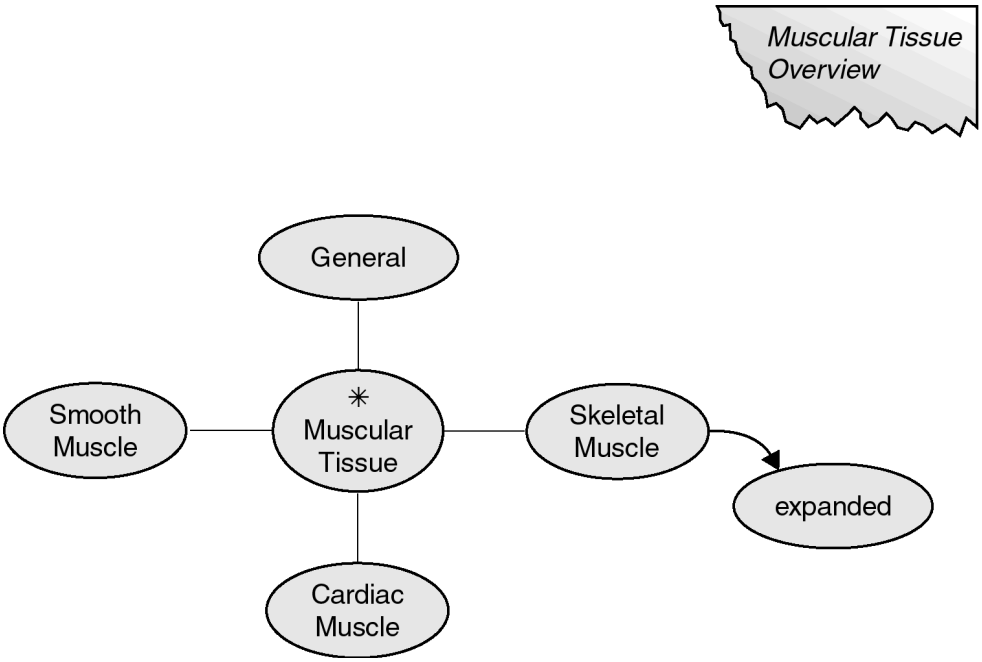

Figure 7-38: Overview of muscular tissue.

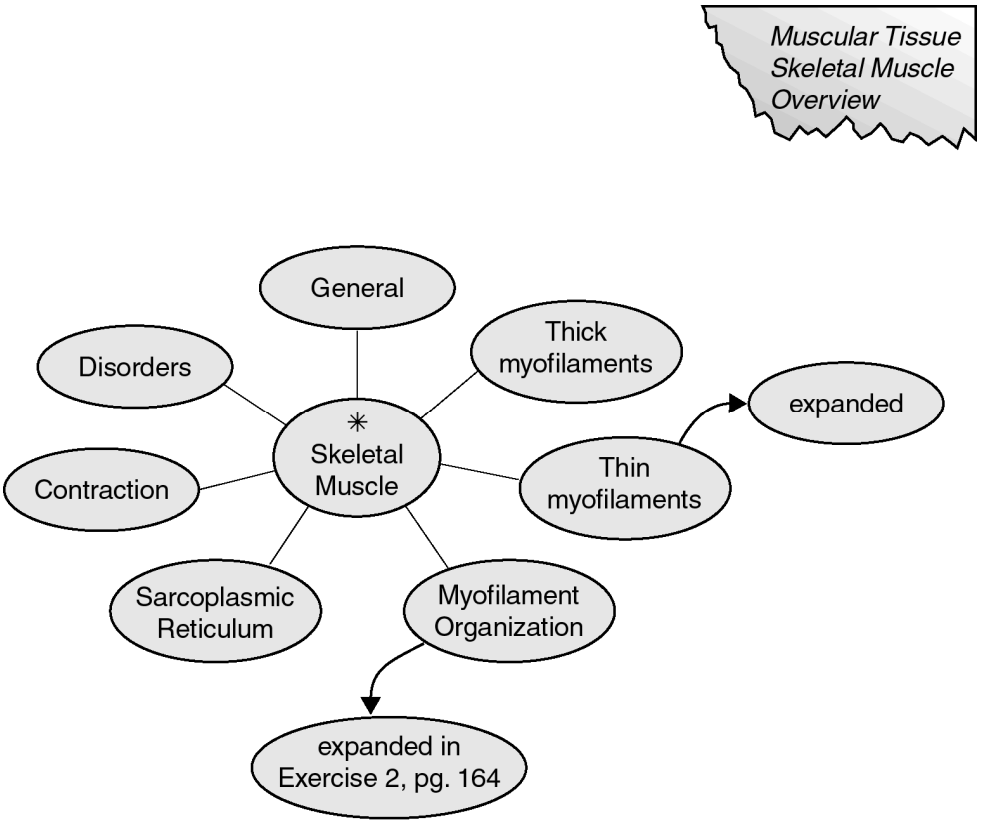

Figure 7-39: Overview of skeletal muscle. Expanded from Figure 7-37.

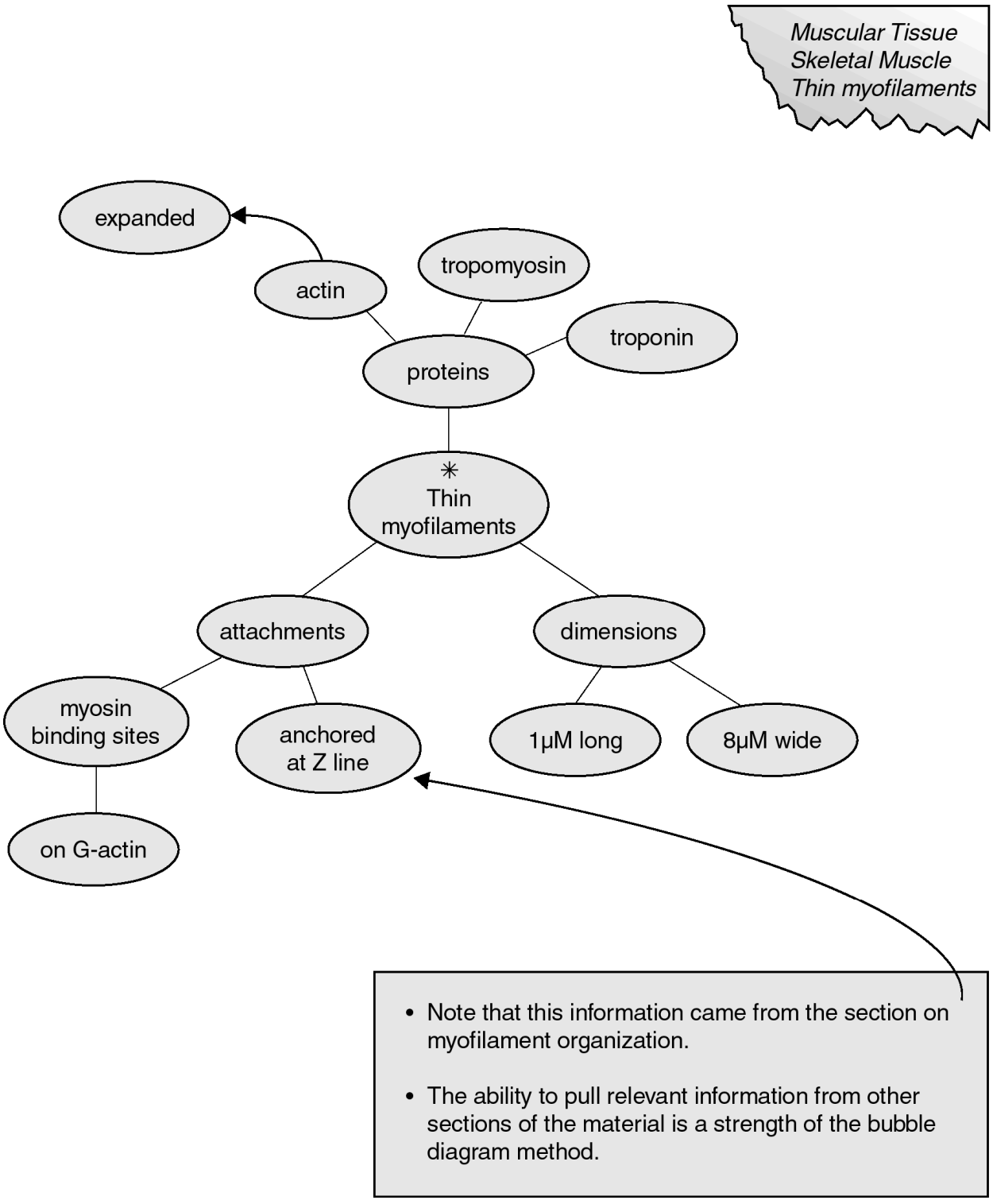

Figure 7-40: Properties of myofilaments. Expanded from Figure 7-39.

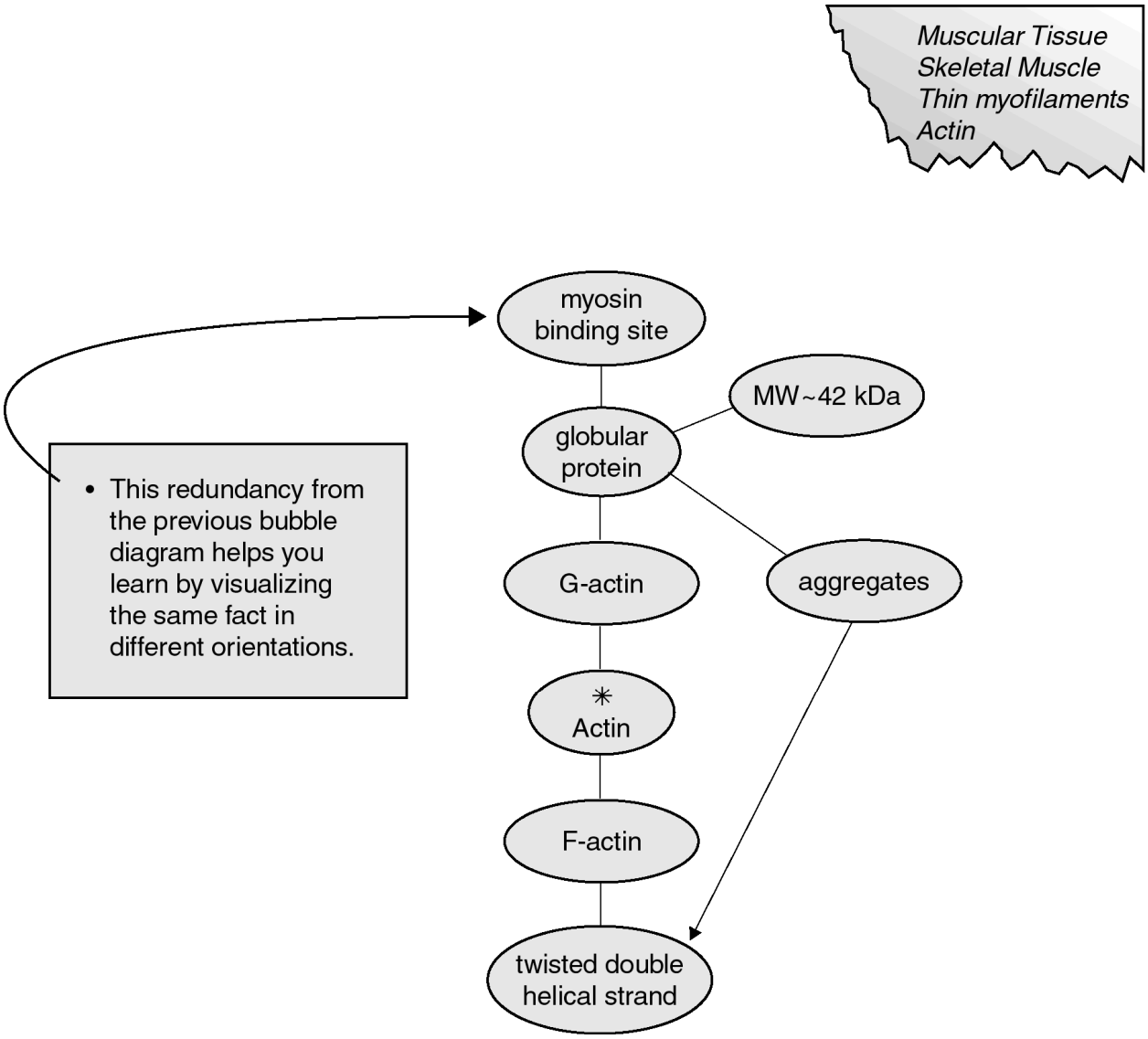

Figure 7-41: Properties of actin. Expanded from Figure 7-40.

Histology Example 2: The Erythrocyte. The example below illustrates how to summarize the material concerning the characteristics of the erythrocyte, one of the formed elements of the blood. The excerpt is taken from Chapter 12, "Blood." This set of concept maps illustrates the linking of bubbles containing common characteristics and the inclusion of lists within a bubble.

GENERAL

Blood is a **specialized connective tissue**. It is of mesodermal origin. It consists of tw major components — **formed elements** and **plasma**. If blood is centrifuged, the formed elements are packed to the bottom of the tube leaving the plasma at the top. The percentage by volume of the formed elements relative to the liquid component is a **hematocrit**. A normal hematocrit is about **45**. Allowing the plasma to clot and removing the clot leaves **serum**. Blood is a window into the body because no tissue is so accessible and so often examined morphologically, chemically, and immunologically.

FORMED ELEMENTS

- **Types**
  - **Red blood cells (RBCs), or enthrocytes (4.5 to 5.5 × 10^6/mm^3)**
  - **White blood cells (WBCs), or leukocytes (5000 to 9000/mm^3)**
    - — *Granulocytes*
      - Neutrophils
      - Basophils
      - Eosinophils
    - — *Agranulocytes*
      - Lymphocytes
      - Monocytes
  - **Platelets or thrombocytes (250,000/mm^3)**
- **Numerical Abnormalities (more than normal vs less than normal)**
  - Leukocytosis versus leukopenia
  - Thrombocytosis versus thrombocytopenia
  - Polycythemia versus anemia

ERYTHROCYTES

- 7.2 microns in diameter (since present everywhere, it is a histologic ruler)
- No nucleus and no organelles
- Life-span of 120 days; constantly aging, dying; thus constantly replaced
- Highly deformable biconcave disks
  - Poikilocytes (RBCs of abnormal shape)
  - Sickle cell anemia
  - Spherocytosis
- Biconcave shape increases surface area; 4000 square meters total for all RBCs in body
- Plasmalemma-bound bags of water (60%) and hemoglobin (35%)
  - HbA: adult normal hemoglobin
  - Decrease in amount of oxyhemoglobin (cyanosis)
  - HbS: sickle cell anemia
  - HbF: normal fetal type
- Tonicity
  - Isotonic with 0.9% NaCl (normal saline solution); i.e., RBCs in saline retain normal size and shape.
  - NaCl higher than 0.9% — hypertonic to RBC; water leaves, RBC shrinks, wrinkled — crenates
  - NaCl lower than 0.9% — hypotonic to RBC; water enters, RBC swells, bursts — hemolysis
- Cytoskeleton
  - Interaction between cytoskeleton and plasmalemma is well studied
  - **Spectrin** — large, long cytoskeletal protein microfilament with actin-binding sites at each end; forms dense meshwork under P surface of plasmalemma; hereditary spherocytosis involves a defect in spectrin

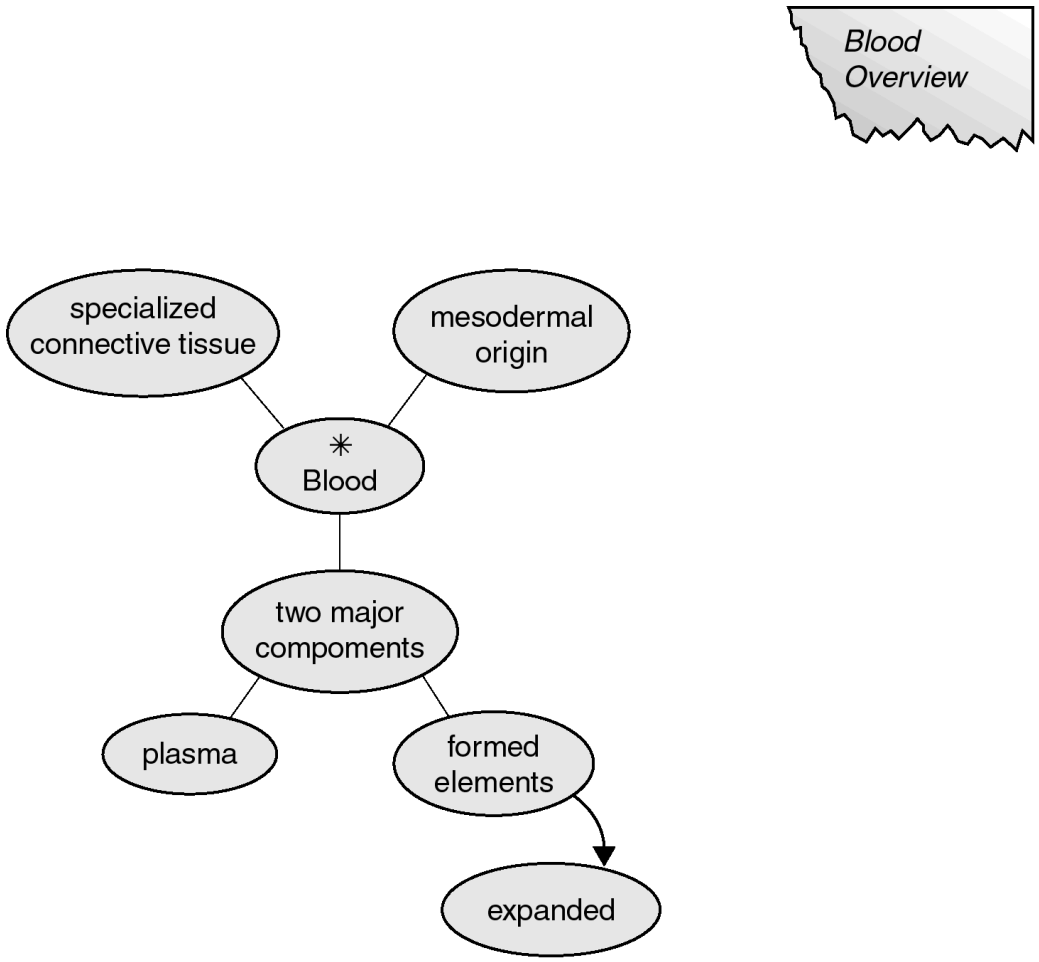

Figure 7-42: Overview of blood.

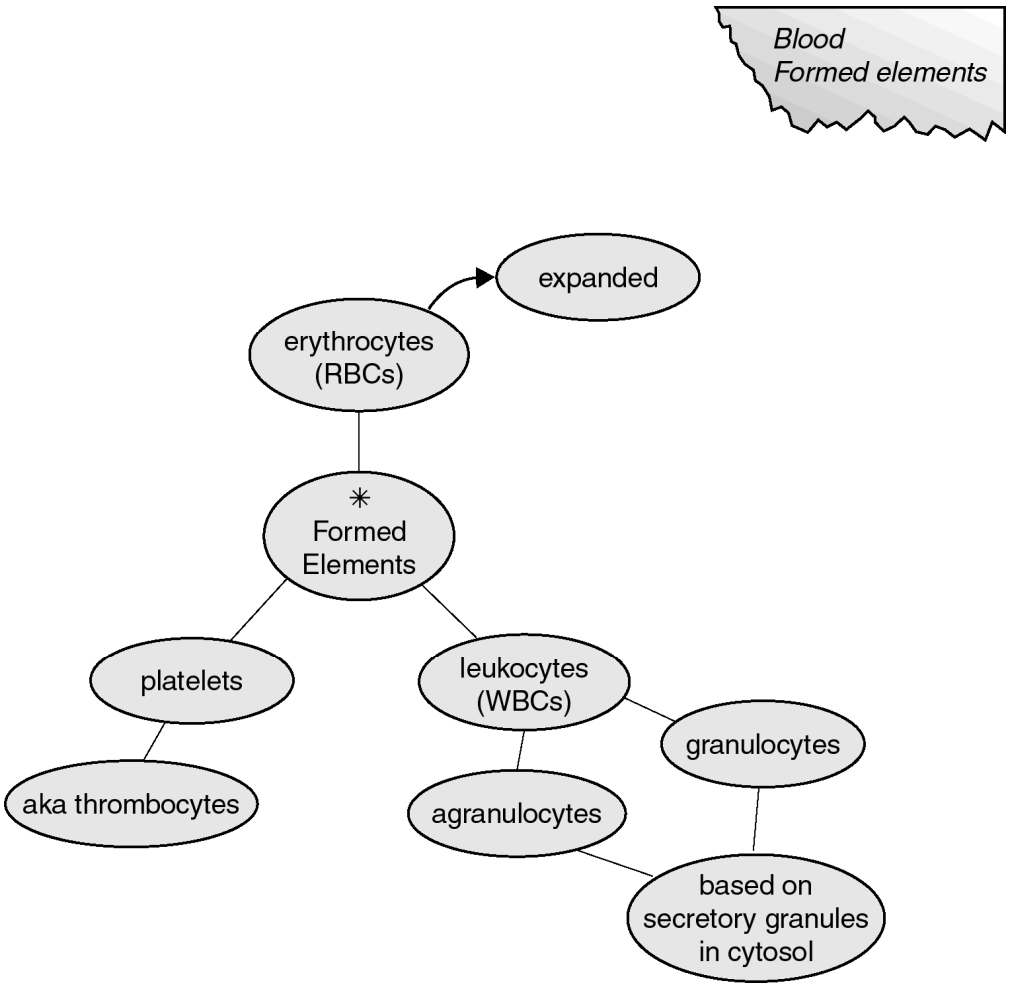

Figure 7-43: Overview of skeletal muscle. Expanded from Figure 7-42.

- If the diagram gets too busy, it can be divided between two or more pages.
- Numbering in the heading and the main topic bubble indicates splitting.

Blood
Formed Elements
Erythrocytes 1

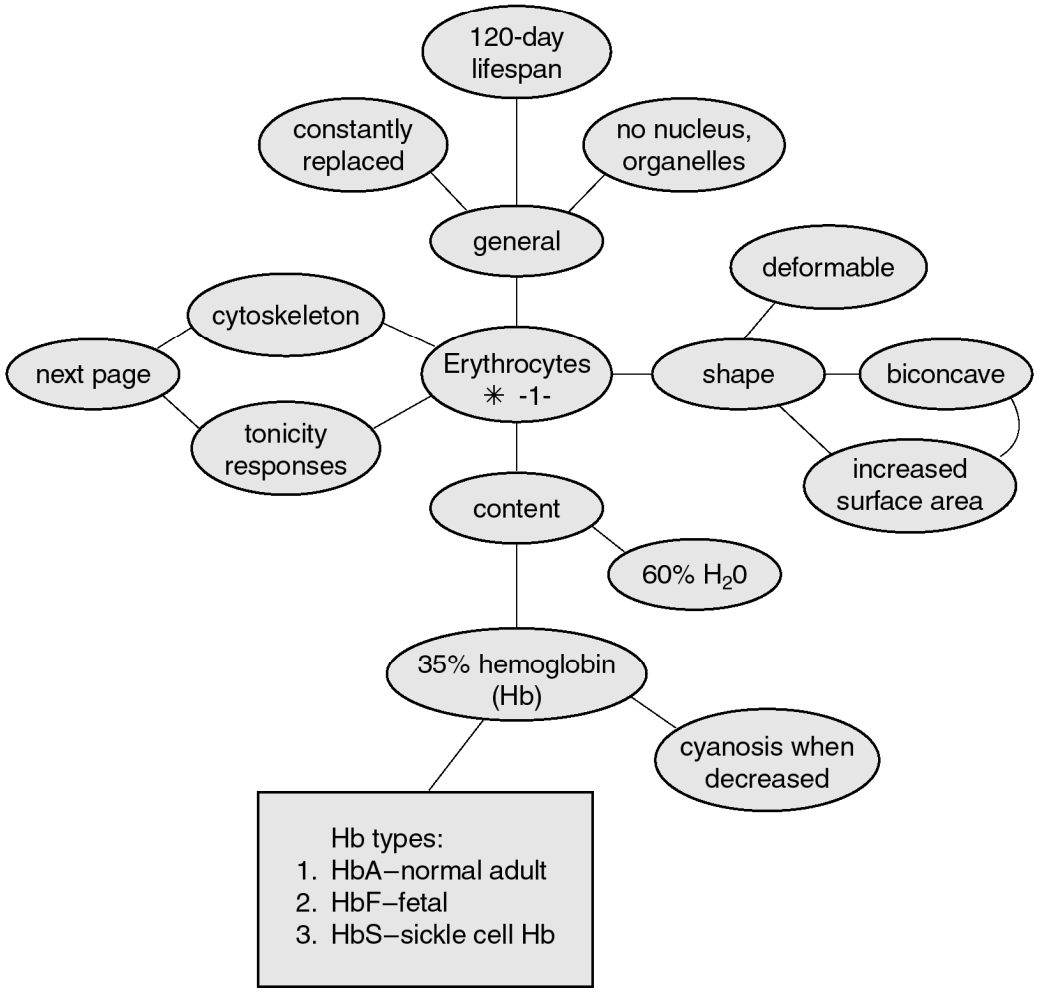

Figure 7-44: Properties of erythrocytes, part 1. Expanded from Figure 7-43.

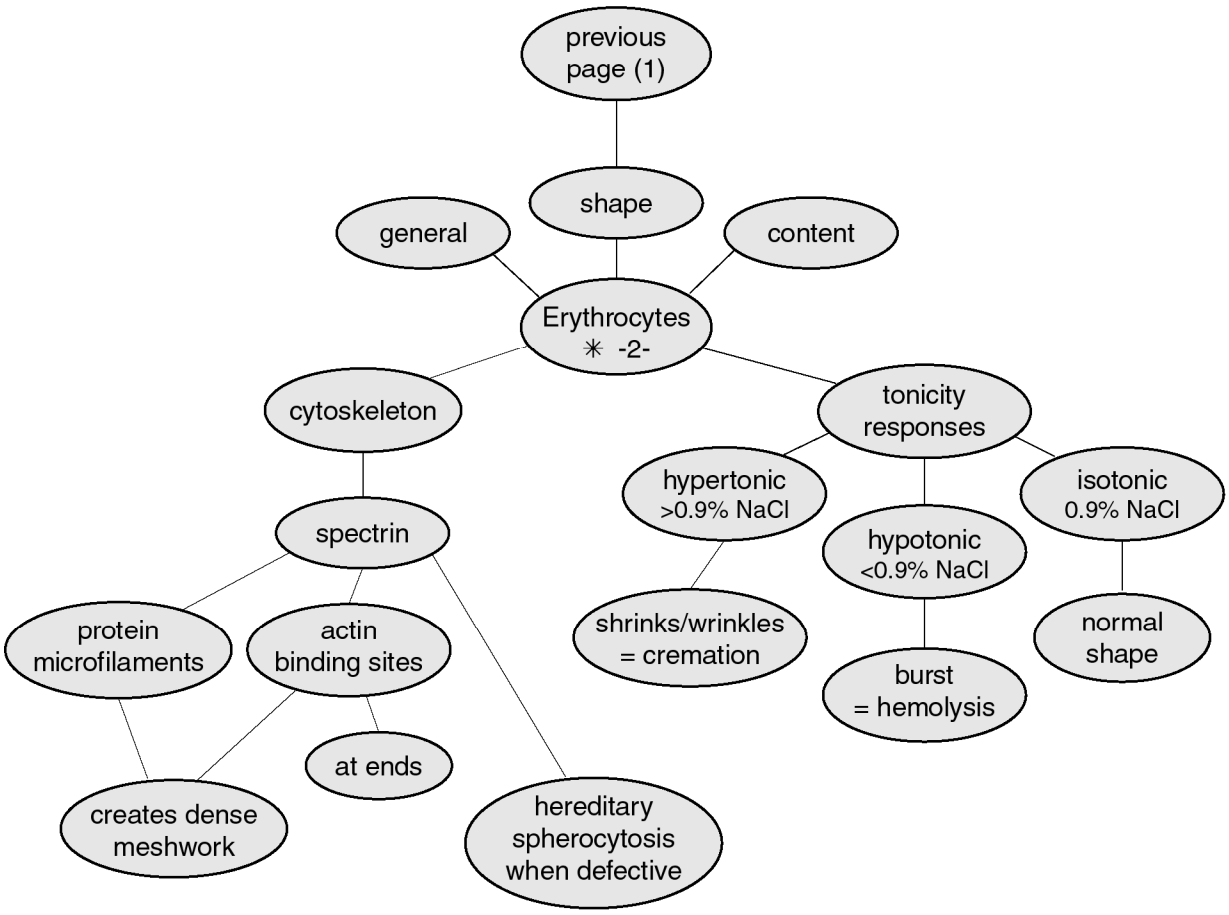

Figure 7-44: Properties of erythrocytes, part 2. Expanded from Figure 7-43.

Histology Exercise 1: Stratified Squamous Epithelium. Try to concept map the material concerning the characteristics of stratified epithelium from the excerpt below. The page headings for the concept maps are given to aid your organization.

Classification of Epithelia

There are two basic types of epithelia:

- Sheetlike, or membranous
- Secretory, or glandular

Membranous, or sheetlike, epithelia cover or line surfaces. Membranous epithelia may be simple or stratified.

Simple epithelia are composed of a single layer of cells and are classified on the basis of the shape of those cells.

- **Simple squamous epithelium** a single layer of flattened epithelial cells (e.g., endothelium, mesothelium)
- **Simple cuboidal epithelium** a single layer of cuboidal epithelial cells (e.g., lining of terminal bronchiole)
- **Simple columnar epithelium** a single layer of columnar epithelial cells (lining of gallbladder)
- **Pseudostratified columnar epithelium** a single layer of cells, some of which are tall columnar and others are short basal cells, all of which contact the basement membrane, giving to the epithelium a stratified appearance (e.g., lining of trachea)

Stratified epithelia are composed of more than one layer of cells and are named according to the shape of the surface cells.

- **Stratified squamous epithelium** Demonstrates squamous surface cells which may be
  - Dry (cornified, keratinized) — Cells are filled with keratin, and most cellular organelles are gone. Cell nuclei are not present in plaque-like remains of surface cell (e.g., epidermis).
  - Wet (noncornified, nonkeratinized) — Cells are filled with keratin. Cell nuclei are present in surface cells (e.g., lining of esophagus).
- **Stratified cuboidal epithelium** Surface cells are cuboidal.
- **Stratified columnar epithelium** Surface cells are columnar.
- **Transitional epithelium** Surface cells are large and accommodate stretching or contracting of the organ by going from a flattened to a thickened state.

  Glandular epithelia produce a secretory product. There are two types of glandular epithelia.

- Exocrine glands deliver their secretion externally (to a surface).
- Endocrine glands do not have ducts and deliver their secretion internally (into the bloodstream) and from there to other organs.

Exocrine glands with ducts are classified on the basis of branching of their ducts and the shape of the secretory unit.

Epithelial Tissue
Overview

Epithelial Tissue
Classification

Epithelial Tissue
Classification
Stratified Epithelium

Epithelial Tissue
Classification
Stratified Squamous Epithelium

Histology Exercise 1 Solution. One possible representation of the excerpt is given in the following concept maps. If yours are different, they may still be accurate representations since many topics can be organized in several different ways. You can check the "correctness" of your map by repeating it aloud to see if you can present it as a meaningful lesson to someone else.

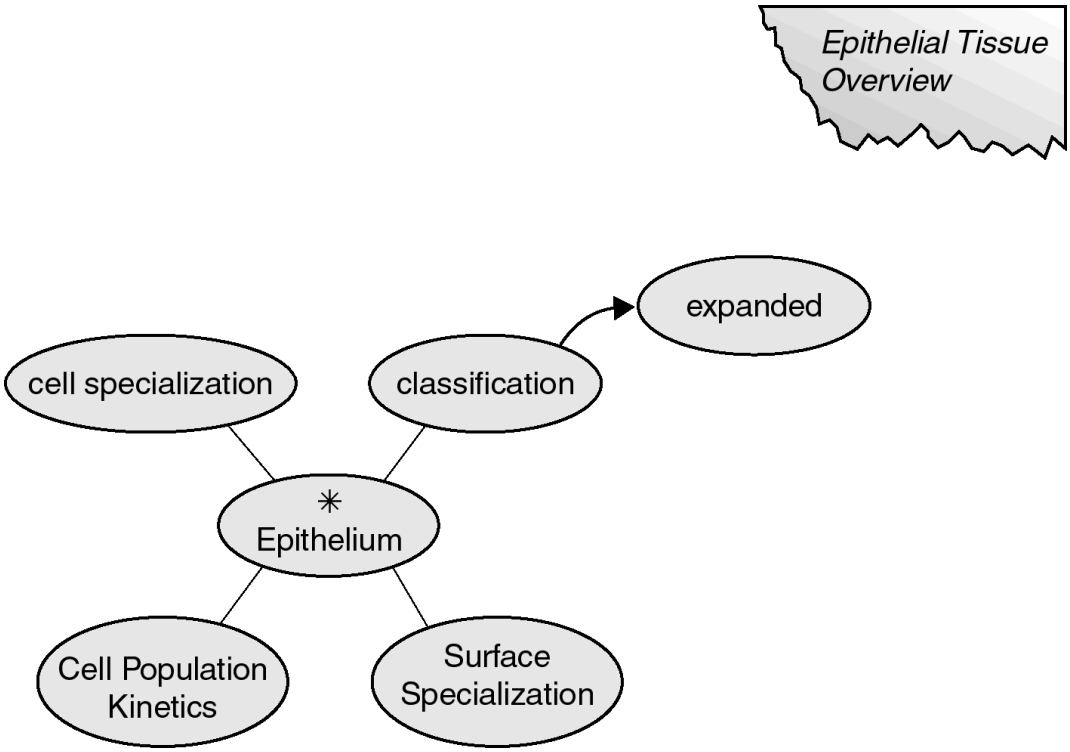

Figure 7-46: Overview of epithelial tissue.

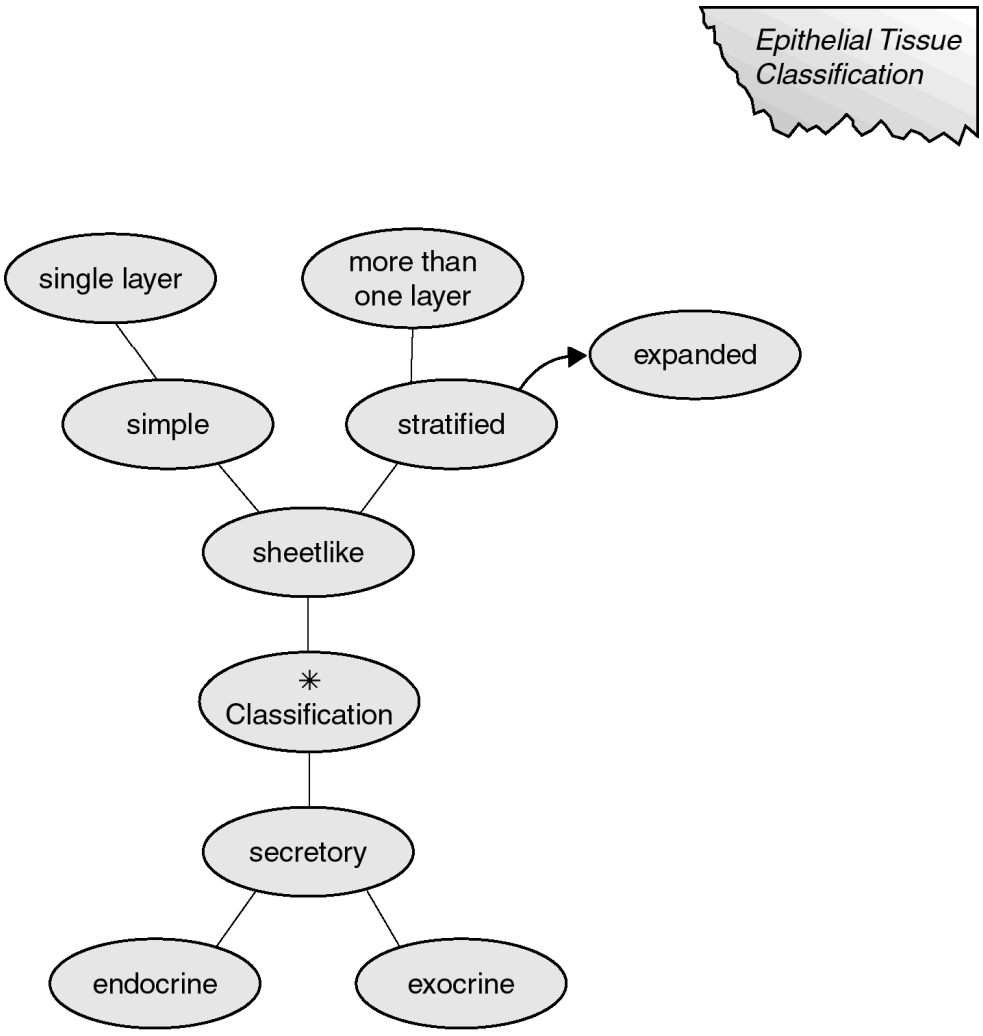

Figure 7-47: Classification of epithelial tissue. Expanded from Figure 7-46.

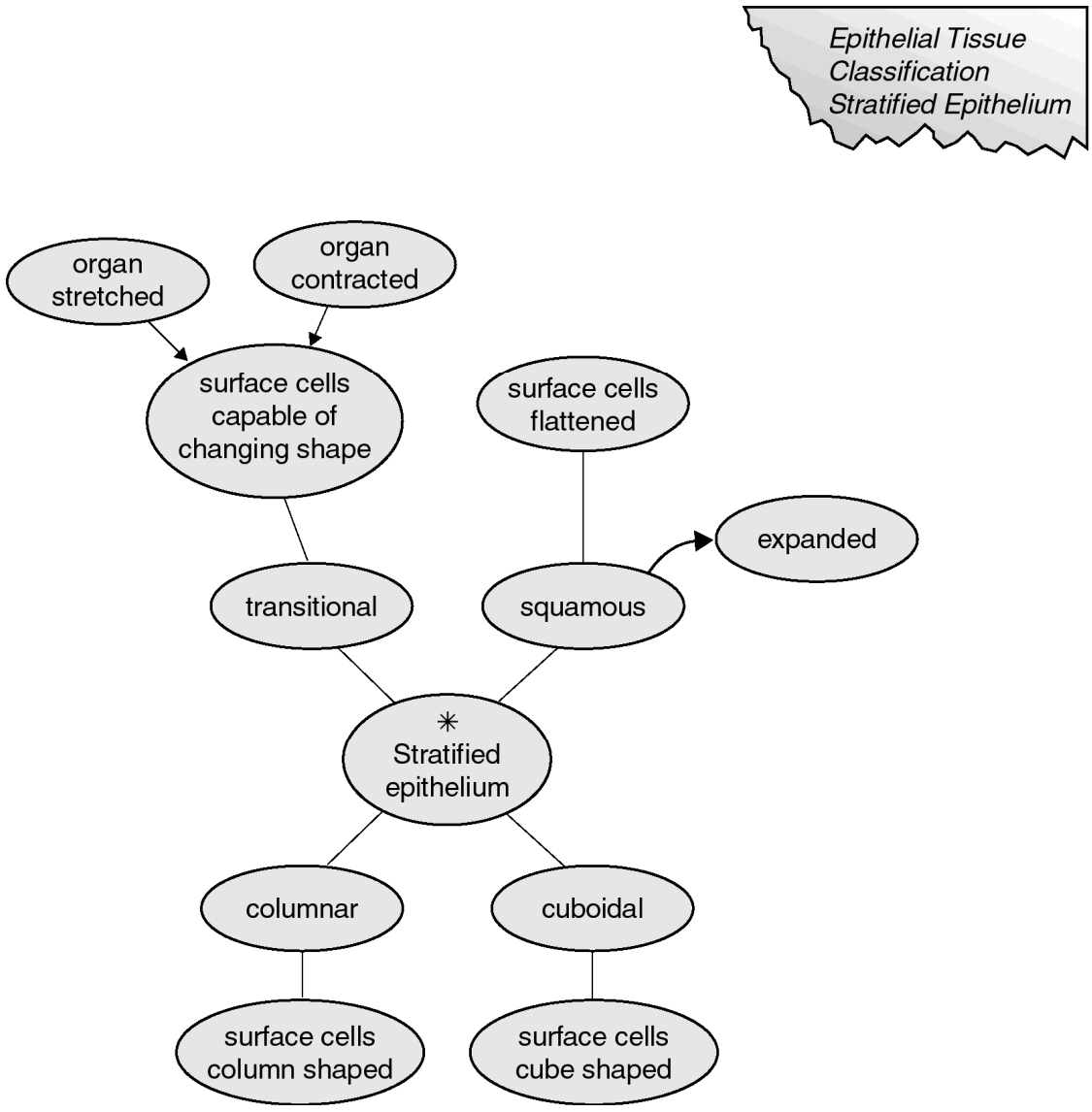

Figure 7-48: Classification of stratified epithelium. Expanded from Figure 7-47.

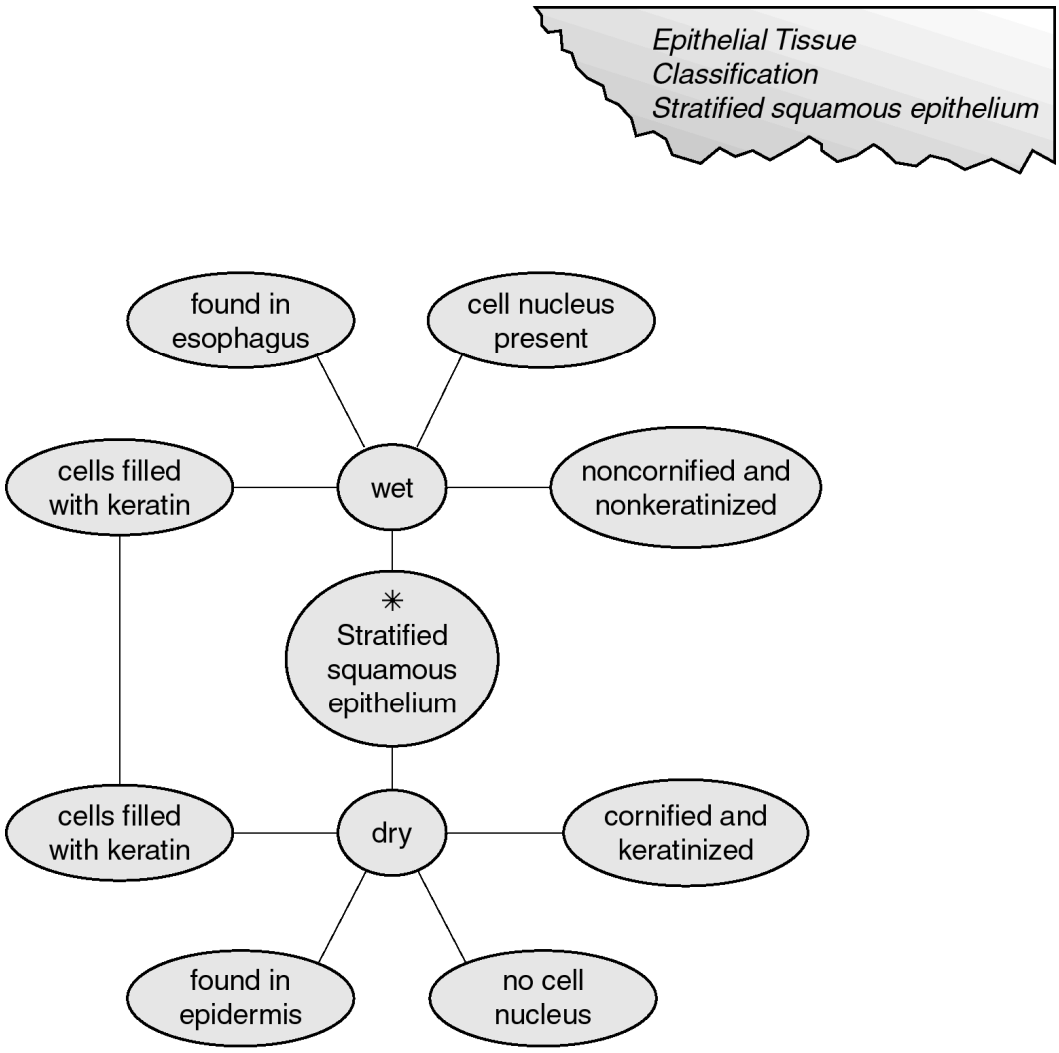

Figure 7-49: Stratified squamous epithelium. Expanded from Figure 7-48.

Histology Exercise 2: Myofilament Organization in Skeletal Muscle. Try to concept map the material concerning myofilament organization from the Histology Example 1 on pages 121-122. In this example, the information for this concept map is located in two different sections of text. Remember to keep in mind that you are trying to pull together all of the information relating to cross striations and answer the question, "How is this topic best organized?" Refer to Figures 7.38 and 7.39 for overview concept maps. The page headings for the concept maps are given to aid your organization.

Muscular Tissue
Skeletal Muscle
Myofilament Organization 1

Muscular Tissue
Skeletal Muscle
Myofilament Organization 2

Histology Exercise 2 Solution. One possible representation of the excerpt is given in the following concept maps. If yours are different, they may still be accurate representations since many topics can be organized in several different ways. You can check the "correctness" of your map by repeating it aloud to see if you can present it as a meaningful lesson to someone else.

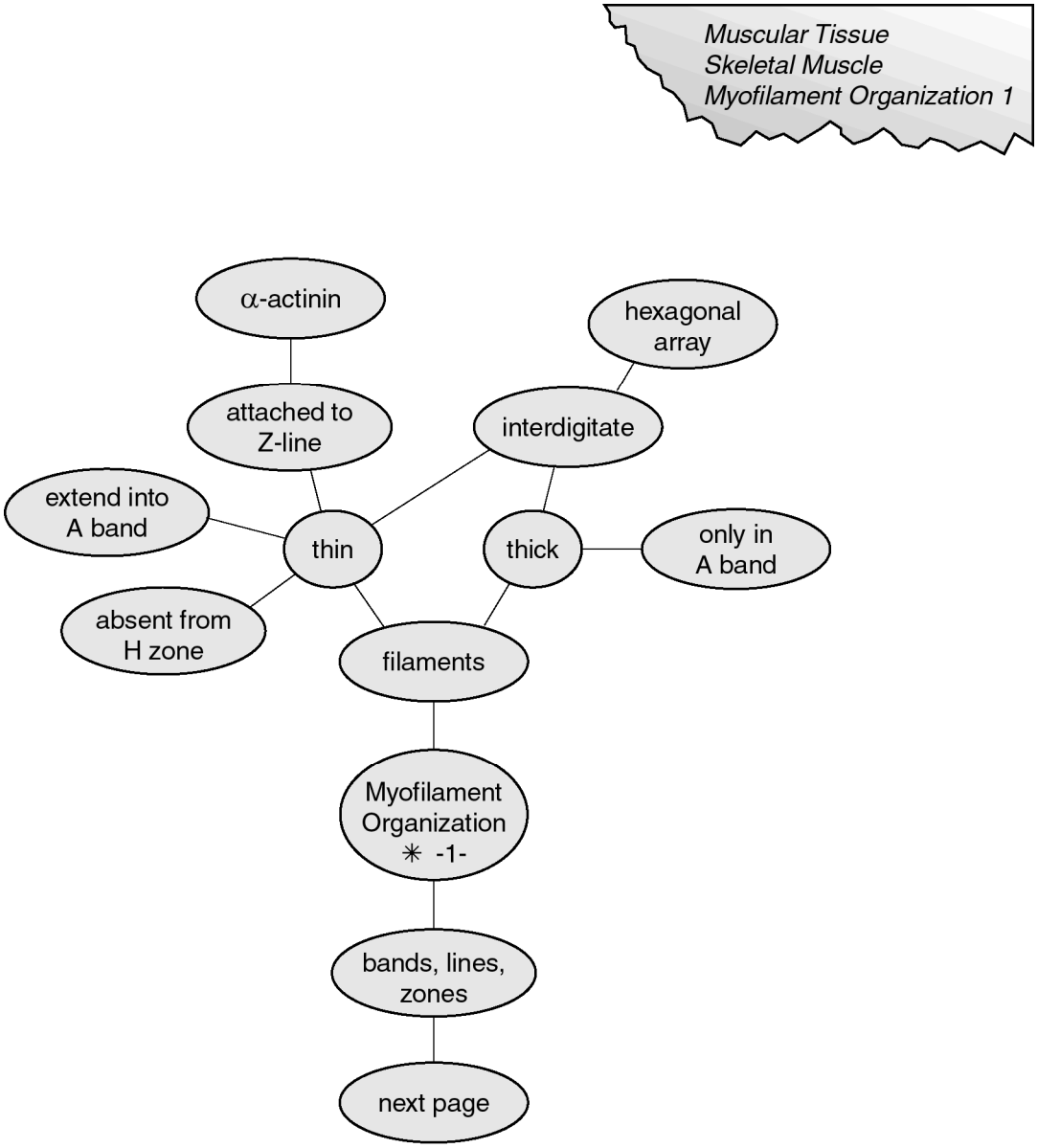

Figure 7-50: Myofilament organization in skeletal muscle, part 1. Expanded from Figure 7-39.

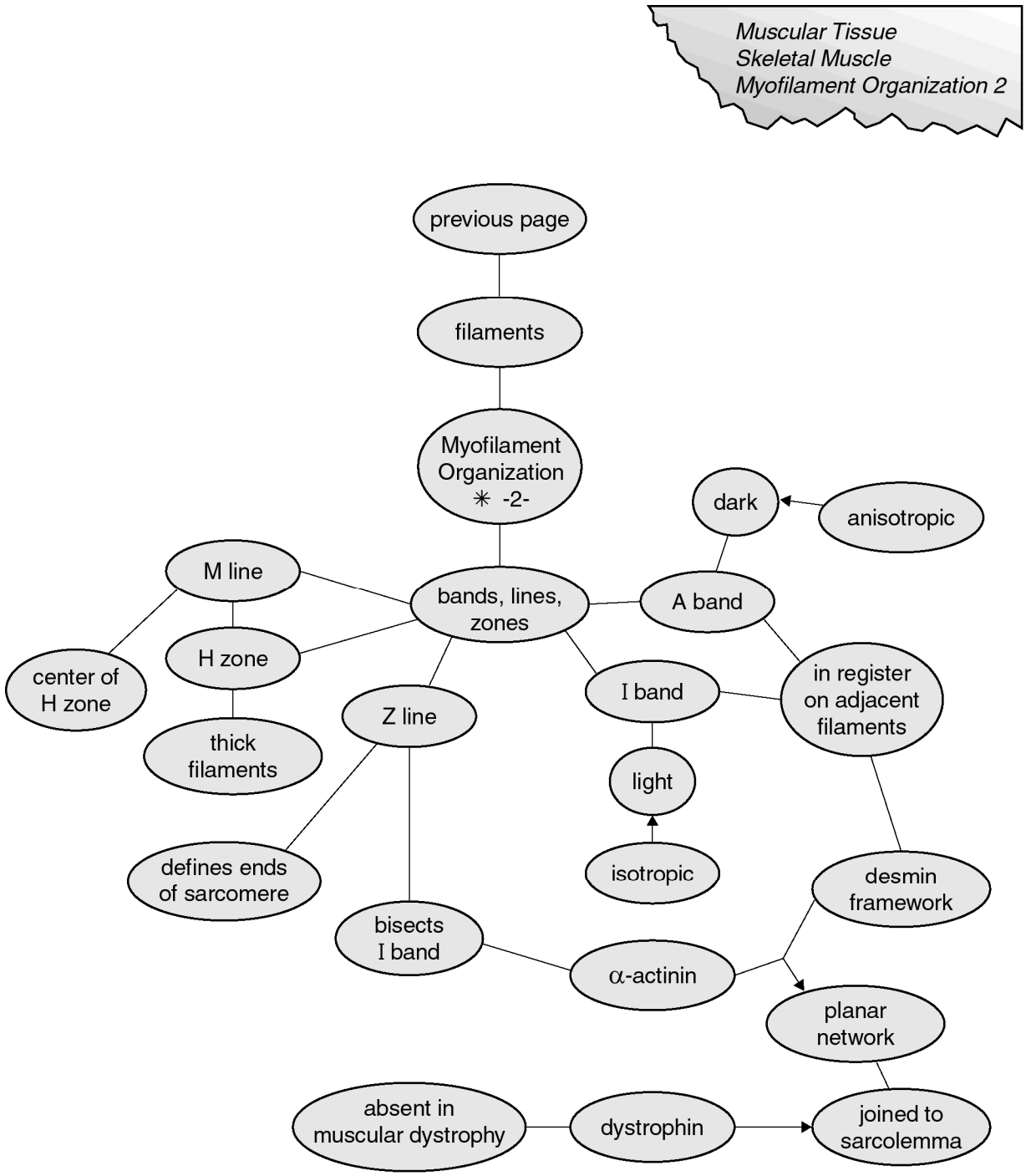

Figure 7-51: Myofilament organization in skeletal muscle, part 1. Expanded from Figure 7-39.

Chapter 8
Question analysis develops intuitive skills in sensing types.

Practice exam questions that are generally available either from files of old course examinations or from board review books can serve you as powerful study aids. However, if you take them too literally, exam questions can actually restrict your learning and limit the number of examination topics you are prepared to address. The method for question analysis described in this chapter will show you how to analyze any exam question beyond its literal content and develop your intuitive skills in the process. As mentioned in Chapter 7, this method can serve as a valuable aid in organizing a topic in a concept map.

Exam questions are topics.

Teaching faculty organize their exam questions in the same way that they organize their teaching—by topics. Many professors keep all previous examination questions on file and organized by topic. Exams are then constructed by first selecting topics to be examined and then choosing from the questions filed under each topic. If the faculty teach and examine by topic, then you can use examination questions to learn about those topics. In fact, you can learn not only which topics need to be studied, but also how you will be expected to think about them.

Understanding a question involves more than just knowing the correct answer.

As discussed in Chapter 6, multiple choice questions assess knowledge of different aspects of a topic in each of the answer choices and require a good understanding of that topic. If you are a sensing type, you might expect that you will know the correct answer when you see it and that your sensing preferences will cause you to start *looking for the answer* that is closest to the way you memorized it from your notes. However, in most cases the correct answer won't be phrased the same way you have memorized it. In fact, the majority of questions do not test memorization, and you will be unlikely to find the correct answer with this approach.

In contrast to the more literal preferences of the sensing type, if you are an intuitive type and you don't see the correct answer, your tendency will be to start *eliminating incorrect answers*. This process of elimination requires some knowledge about each of the answer choices, which, in turn, requires an understanding of the topic. Your ability to eliminate incorrect answers based on a more thorough understanding of the topic will improve the probability that you will make a correct choice.

There are four important steps in question analysis.

Question analysis is a process of identifying the topics covered by test questions and determining what type of knowledge is needed to answer the question correctly. The process is divided into four steps: identifying topics, understanding the correct answer, understanding the wrong answers, and rephrasing the question.

Step 1: Identifying topics. Taking each question in turn, identify (highlight, circle, rewrite, etc.) all the topics covered by that question. You will find that questions frequently address several topics beyond the central one being tested. Look for topics in both the body of the question and the answer choices. Many of the wrong answers on an exam are especially valid study topics since they test whether or not you can distinguish between two or more related subject areas. You will have to use some judgment here because some incorrect multiple choice answers are intentionally not sensible, and thus not relevant. You should also be aware that questions from departmental examination files at your school can contain typographical and answer key errors.

Step 2: Understanding the correct answer. Determine for each of the topics you identified in Step 1 what information you need to study to know why the correct answer is correct. As you begin looking for this information, you will notice something very striking: it is not always in one place. If you are a sensing type, this experience will lead to a better understanding of how important integrative learning can be. Regular practice with this approach in your study routine will develop a better sense of how information in different sections of the text or lecture notes can be related. As you discover these relationships, you should try to include them in the appropriate places in your concept maps.

Step 3: Understanding the wrong answers. Determine what you would have had to learn about the topics you identified in Step 1 to know why the wrong answers were wrong. Keep in mind that wrong answers are designed for the most part to sound correct so that they test whether you are guessing or whether you really know about the topic in the question. Developing an understanding of the basis for a wrong answer may be the most powerful strategy in your study routine because at the same time you are automatically developing an understanding of the correct answer. As you see special cases or potential sources of confusion, make the appropriate entries in your concept maps. If you are a sensing type, this exercise will train you to think more clearly when evaluating each of the answer choices during an actual examination. If you are an intuitive type, you will also benefit from this approach by expanding and confirming the related topics that you instinctively seek out.

Step 4: Rephrasing the question. Determine alternative ways each question could be asked and especially consider possible alternatives for the wrong answers. As you proceed through Steps 2 and 3, you will find that changes in the main body of the question can make a different answer choice correct. In some cases, small changes in some of the answer choices will make them correct. When you create these alternative ways of phrasing the question, you are mirroring the same thinking process that professors use when they make up new examinations. Since there are a limited number of ways that you can test a given topic, many questions are derived by simply rewriting old ones. When you use rephrasing as a study method, you are preparing yourself to answer four or five questions rather than just one.

Let's go over the main points:

1) Practice exam questions are powerful study aids because they help you to focus on topics that are likely to serve as the basis for questions.
2) Understanding a question requires knowledge about the wrong answers as well as the right answers.
3) Question analysis involves topic identification, understanding of the correct and incorrect answers, and rephrasing of questions and answers.
4) More than one topic can be found in exam questions.
5) The information needed to determine the correct answer is not always found in one place.
6) Understanding wrong answers leads to a better understanding wrong understanding of the correct answers.

7) Rephrasing questions and answers prepares you for a wider variety of questions on the real examination.

Examples in Medical Biochemistry

The following example questions were taken with permission from *Biochemistry: Mosby's USMLE Step 1 Reviews*. Each question is followed by an explanation based on the four steps of question analysis discussed in this chapter. The discussion of each example is structured so that a background in biochemistry is not required to understand the study strategies.

Example 1. Which of the following enzymes forms alpha-1,6 linkages in glycogen?

A. α-1,6 glucosidase
B. glycogen synthase
C. glycogen branching enzyme
D. glucose 6-phosphatase
E. phosphorylase kinase

Step 1. Identifying topics. In this example, the central topic being tested is the *glycogen branching enzyme*. The α-1,6 linkages contained in the main body of the question are the branch points in the glycogen molecule that give it the appearance of a piece of tumbleweed. These branch points are formed by glycogen branching enzyme, which makes "C" the correct answer. All of the other answer choices are also good topics for study because they are all enzymes that are related to glycogen metabolism. The question is trying to determine whether you know the difference in the functions of these various enzymes involved in glycogen metabolism. A well-written question will usually have the wrong answer choices related in some way to the central topic in order to test your ability to discriminate between them.

Step 2. Understanding the correct answer. This question asks for a straightforward correspondence between the enzyme and its function, and no interpretation or understanding is required to find the correct answer. However, the probability of your guessing correctly will increase if you also are familiar with the function of the enzymes in the wrong answers. Much of the ability of so-called "test-wise" students to perform well on multiple choice examinations is due to their ability to eliminate wrong answers. The function of each of the enzymes listed in this question could easily be learned by constructing a concept map containing each enzyme and its function.

The question in this example is classified as a first-order question because it requires only a straightforward identification of the correct answer. By comparison, a second-order question requires some functional organization of the facts concerning the topic of the question, and a third-order question requires that information must be applied in order to answer a problem, generally a clinical problem.

Step 3. Understanding the wrong answers. Each of the wrong answers for this question may be understood in relatively simple terms. No interpretation is needed since there is a straightforward knowledge of the catalytic function for each enzyme that can be used to eliminate each wrong answer.

Step 4. Rephrasing the question. This question could have been rephrased by asking "What is the function of glycogen branching enzyme?" The answer choices would then include the formation of alpha-1,6 linkages (the branch points) in glycogen as the correct answer, and the wrong answers would include the other reactions in glycogen metabolism. By substituting either the names of the other answers by substituting four enzymes, or their catalytic functions, in the main body of the question, you can come up with eight more questions. This is the way I write many of my test questions.

> Multiple choice questions are similar to clinical diagnosis. During clinical diagnosis you determine what the patient doesn't have with different degrees of certainty. Likewise, when answering a multiple choice question you guess which answers are wrong with different degrees of certainty. You may not immediately recognize the correct answer on an exam, just as you may not immediately recognize what is wrong with your patient.

Example 2. A drug that acts as a noncompetitive inhibitor

A. increases the steady-state concentration of the ES complex.
B. has a structure similar to a substrate.
C. acts by removing active enzyme from the substrate pool.
D. doesn't affect the Lineweaver-Burke plot.
E. is usually irreversible.

Step 1. Identifying topics. In this example, the central topic being tested is *noncompetitive inhibitors of enzymes*, one of the major topics covered in the study of enzymes. Below is a list of the study topics identified from this question that should be found somewhere in your concept maps of the topic, "enzymes;" they summarize the lectures on enzymes:

- noncompetitive inhibitors,
- ES complex,
- substrate,
- active enzyme,
- Lineweaver-Burke plot, and
- irreversible.

Question analysis will very likely identify topics that you missed during your initial attempt to organize the topics from the lectures on enzymes. In this case, for example, if the topic of irreversible inhibitors (from answer E above) had been missing from your concept maps, you would now have the opportunity to fit it in where it belonged. Verifying that the rest of the topics are correctly included in your concept maps can be very beneficial.

Step 2. Understanding the correct answer. This question requires considerably more interpretation than Example 1 because each answer choice relates to different aspects of enzyme inhibition. Some of the answers are true for another class of inhibitors, called competitive inhibitors, and others are true for the absence of inhibitors. In this question, the probability of a correct guess is substantially aided by a thorough knowledge of all aspects of enzyme inhibition, not just noncompetitive inhibitors. The information needed to understand the correct answer (removal of active enzyme) will be found in several different places in your notes or the text under headings such as:

- normal enzyme function,
- the Michaelis-Menten model of enzyme catalysis, the enzyme active site, and
- irreversible inhibition.

Each of these topics address important aspects of both the correct answer and the incorrect answers and are part of any standard discussion of enzymes.

Step 3. Understanding the wrong answers. Each of the wrong answers for this example relate to some other valid aspect of enzyme function. For example, the Lineweaver-Burke plot is an analytical graph applied to several other types of enzyme inhibition. Developing an understanding of each of the wrong answers for this single question requires you to touch on

virtually all of the major concepts in enzyme function. In other words, a thorough understanding of this one question prepares you for at least 20 to 30 other questions on enzymes, covering topics that extend beyond enzyme inhibition.

Step 4. Rephrasing the question. It would be a very effective use of your time to rephrase the main body of questions like this to make each of the wrong answers correct. For example, if this question were rephrased to read, "A drug that acts as a competitive inhibitor," then the correct answer would be B, not C. You have to read your text and notes very analytically to find ways to rephrase questions correctly. This process develops your ability to anticipate exam questions and also helps you realize that the number of ways that you can ask about a given topic is limited. Once you are familiar with a few of them, you will likely know them all.

Examples in Human Gross Anatomy

The following examples were taken by Dr. Dalley from his own test item bank in gross anatomy. Each question is followed by a discussion based on the four steps of question analysis. The discussion of each example is structured so that a background in gross anatomy is not required to understand the study strategies.

Example 1. A tumor within the middle cranial fossa at the foramen rotundum would most likely

A. cause a dry eve due to loss of parasympathetic innervation to the lacrimal gland.
B. result in loss of sensory innervation to the anterior aspect of the nasal septum.
C. have an effect on sympathetic innervation to the nasal cavity.
D. produce loss of sensation to the maxillary sinus.
E. cause paralysis of the tensor tympani muscle.

Step 1. Identifying topics. In this example, the central topic being tested is the trigeminal nerve. However, you will notice that the trigeminal nerve is not mentioned anywhere in the question. This type of question is a third-order question. This question is a rich source of topics that relate to the nerves that exit the skull. The topics that can be identified from this question do not require an advanced knowledge of anatomy. If you refer to both the list below and the question above, you will see that the topics are

- the middle cranial fossa,
- the foramen rotundum,
- parasympathetic innervation,
- the lacrimal gland,

- sensory innervation,
- the nasal septum,
- the nasal cavity,
- sympathetic innervation,
- the maxillary sinus, and
- the tensor tympani muscle.

Step 2. Understanding the correct answer. In order to determine the correct answer, you have to know what the middle cranial fossa is and what nerve exits the skull by going through the foramen rotundum (round hole). It is also necessary to know the functions of this nerve and where it extends. Finally, it is necessary to know what will result from damaging this nerve as a result of pressure from a tumor at the middle cranial fossa. In this case, the structure that exits via the foramen rotundum of the skull is the maxillary division of the trigeminal nerve. This is a sensory nerve to the nasal cavity including the maxillary sinus (see answer D).

The sympathetic innervation to the nasal cavity that is referred to in answer C does run with the maxillary nerve for part of the way as a means of innervating the mucosa (the lining) of the nasal cavity. However. the sympathetic innervation joins the nerve only after it exits the skull and, therefore, would not be affected by a tumor to the middle cranial fossa, which makes C a close, but incorrect, guess. This is the kind of detail that should be included in your concept map when you organize your lectures on the innervation of the head.

Step 3. Understanding the wrong answers. Each of the wrong answers for this example requires an understanding of a cause-and-effect relationship. Sometimes these relationships are given as facts during a lecture, but many of them are left for you to deduce for yourself as you study. Using concept maps will help you to make connections between anatomical structures and their functions. Questions like this one are the most difficult type because they require the integration and application of information in order to solve the problem. However, their clinical relevance also can make them the most fun, since diagnosis is a large part of what you will be doing all of your professional lives.

Step 4. Rephrasing the question. This question could be rewritten with a different nerve in the main stem that, in turn, makes any of the other wrong answers correct. Since the facial nerve, for example, supplies parasympathetic innervation to the lacrimal gland, the main body of the question could be written, "Damage to the facial nerve would most likely...," making answer A

correct. It will help if you can visualize the types of disease or injury that would cause the effects given in each of the answer choices. Mental images of this sort will not only serve you well on gross anatomy exams, but they will help you relearn the material faster in your clinical courses.

Example 2. Answer A if the statement is true only of item A, answer B if the statement is true only of item B, answer C if the statement is true of both A and B, or answer D if the statement is true of neither A nor B.

A. Sympathetic nerves
B. Parasympathetic nerves
C. Both
D. Neither

Question I. Constitutes part of the vagus nerve.
Question II. Postganglionic fibers typically innervate skeletal muscle.

Step 1. Identifying topics. This example was chosen to illustrate a type of question that evaluates the characteristics of two *related* central topics, the sympathetic and the parasympathetic nervous systems. This example provides only a limited number of specific topics for these two nervous systems. However, you could easily identify several others in the process of looking these up in your course notes or text:

- sympathetic nervous system,
- parasympathetic nervous system,
- vagus nerve, and
- postganglionic fibers.

Step 2. Understanding the correct answer. In order to recognize the correct answers, you have to utilize the study strategy that will be discussed in Chapter 9; it emphasizes differences and similarities. For example, you could have learned the material needed for Question I, concerning the vagus nerve, in two different ways. First, both text and lecture content will emphasize that the vagus nerve contains parasympathetic nerves. If you are learning linearly, you may easily memorize that particular fact. However, what is missing here is that it is rarely if ever stated that the vagus *doesn't* contain sympathetic innervation. Information will be presented that sympathetic nerves emerge from multiple sites (called a sympathetic chain) along the vertebral column, but you are rarely if ever told that the sympathetic chain isn't part of the vagus nerve. So where do you learn this important fact? You learn it by the process of discovery when

constructing concept maps that link similarities and differences between the two types of nervous systems. This is especially useful for the sympathetic and parasympathetic nervous systems since they are generally antagonistic to one another.

Step 3. Understanding the wrong answers. Sometimes there are familiar-looking terms or other key phrases that make an answer choice look correct. For example, in Question II the innervation of skeletal muscle by postganglionic fibers may seem correct. That is because postganglionic fibers of the sympathetic nervous system do innervate muscle, but not *skeletal* muscle. By constructing a concept map that summarizes the function of the different branches of the autonomic nervous system, you would discover that the autonomics innervate only *visceral* (smooth and cardiac) muscle.

Step 4. Rephrasing the question. This question could be asked in many different ways by constructing questions that examine all of the similarities and differences of the sympathetic and parasympathetic nervous systems and the differences between the autonomic nervous system and the somatic nervous system.

Examples in Medical Histology

The following examples were taken by Dr. Dalley from his test item bank in histology. Each question is followed by a discussion based on the four steps of question analysis. The discussion of each example, is structured so that a background in histology is not required to understand the study strategies.

Example 1. Of the approximately 700,000 primordial follicles present in the ovary at birth, approximately _____ will eventually be ovulated during the reproductive life of the individual.

A. 4
B. 40
C. 400
D. 4000
E. 40,000

Step 1. Identifying topics. In this example, the central topic being tested is oocyte production. Other topics that can be derived for subsequent review from this question are primordial follicles, ovulation, and reproductive lifetime.

Step 2. Understanding the correct answer. This is a first-order question because it simply asks for straightforward information. With just a little reasoning, it should be possible to figure the answer without ever memorizing the factual information. A human female ovulates approximately once a month, and her reproductive life is approximately 40 years. If one did the math, that would be 12 oocytes per year times 40 years = 480, making C the best answer.

Step 3. Understanding the wrong answers. This is an example of a rare type of question where only a limited number of study options can be derived from the wrong answers. An understanding of why certain answers are wrong depends on a knowledge of a) how many years constitute the reproductive life of a woman, and b) how many eggs are released during each ovulation. When you come to a question like this, don't spin your wheels trying to find study topics, just move on.

Step 4. Rephrasing the question. For this type of question, it is not worth the time to try and rephrase it because the alternative questions would not lead to meaningful learning. This illustrates that you have to use judgment as you try to apply these study methods. Some study strategies work better in some situations and not in others.

Example 2. In the pigmentation of skin, all of the following are true EXCEPT:

A. In keratinocytes of the stratum spinosum, melanosomes are deposited near the nucleus on the side of the cell nearest the stratum basale.
B. Even individuals with albinism possess melanocytes.
C. Increased pigmentation is due in part to increase in the amount of melanin contained within "secreted" melanosomes.
D. Red-haired individuals will produce more pheomelanin.
E. Darker skinned races will possess larger melanosomes.

Step 1. Identifying topics. In this type of question, which is classified as a *negatively phrased question*, the central topic being tested is skin pigmentation. The list of additional topics from each of the answer choices would then be:

- keratinocytes,
- stratum spinosum,
- melanosomes,
- stratum basale,
- albinism,
- melanocytes,
- melanin production,
- "secreted" melanosomes,
- pheomelanin, and
- melanosome size.

Step 2. Understanding the correct answer. This type of question is classified as a second-order question. It requires that you apply information about the topic rather than just recognize the correct answer. In this example, it is a pivotal word or phrase that makes the statement true or false. That pivotal phrase is "nearest the stratum basale." Here's the rationale: Pigment granules in the cells of the skin are a result of ultraviolet radiation damage to the DNA and they protect the nuclei of these cells from further harmful effects of the sun. The melanosomes, cytoplasmic organelles that contain the melanin, are deposited on the side of the nucleus *nearest the surface* — i.e., on the "sunny side" of the nucleus. But, the stratum basale is toward the *base* of the epithelium and *away* from the sun, making answer A untrue and, for this type of question, the correct answer.

In this type of negatively phrased question, the correct answer happens to be the untrue answer choice. Questions of this type, although not permitted on licensure examinations, are common on medical school exams, probably because it is easier for faculty to think of true statements about a topic than to make up false Ones.

Step 3. Understanding the wrong answers. The wrong answers in this type of question are, in fact, the true statements. Nevertheless, an understanding of why they are true will make a substantial contribution to your preparation for other questions on the overall topic of skin pigmentation.

Step 4. Rephrasing the question. By using different pivotal phrases as discussed above, you can make any of the true answer choices untrue, and therefore correct answers. For example, if you rephrased choice F to read, "Darker skinned races will possess melanosomes of similar size containing more melanin," you would make it an untrue statement and a correct answer. However, to understand why the statement was untrue, you would need to develop a good understanding of the melanosome.

Chapter 9
Here are more methods for developing intuitive skills.

This chapter contains three additional learning strategies: 1) the use of prior knowledge, 2) the identification of similarities and differences, and 3) group study. The first two strategies can be especially useful in helping you develop more complete concept maps, and examples for these methods are provided at the end of the chapter. Group study provides the best learning for all personality types, and I describe a system here that is highly effective for conducting these study sessions.

What you already know can help you.

Have you ever noticed how a gifted teacher explains things by using interesting examples as illustrations? It seems that the simpler the example, the more elegant the teacher appears. This is because everything that you learn has to connect with what you already know. Thus, the more familiar the example, the easier it is to understand and remember the new material you are trying to learn. You will find it extremely difficult to learn something, that is completely unrelated to anything in your prior experience.

When you are trying to organize the information about a new topic, you can use the same approach as the gifted teacher by relating the new topic to something that you already know. The example you choose doesn't have to be scientific in nature; rather, it can be from your everyday experiences. When August Kekulé solved the circular structure of the benzene ring in the mid-1800s, his breakthrough wasn't from analysis of scientific data but from a dream in which he saw six snakes in a circle swallowing each other's tails! Whether or not Kekulé ever actually saw one snake eating another, his imagination conjured up a visual image.

If you are a sensing type, you likely don't spend enough time doing this type of thinking. Even though you can and do make analogies for what you already know; you probably don't *trust* your thinking to be correct. This is why sensing types would rather have the analogy related to them as a specific fact. However, you will find as you work at developing this skill that no analogy by

its very nature is perfect anyway. In fact, if you also develop an awareness of the limitations of an analogy, you will have a much stronger understanding of the concept itself. The examples in this chapter will help you to develop the ability to create analogies and understand their limitations.

How to develop understanding through differences and similarities.

Many test questions ask you to identify differences and similarities between two topics. Such questions tell the professor whether you have learned to discriminate between concepts that are similar but not identical. If you try to identify differences and similarities between different topics when you are studying, you will develop your intuitive skills because you are actively studying two concepts at once. If you are a sensing type, this process of comparison will appeal to your preference for a systematic study method, while it automatically develops your less preferred integrative (intuitive) learning skills and avoids your tendency to learn topics in a linear fashion. The examples in this chapter will help you develop a system for identifying the differences and similarities between topics.

Group study works for introverts, too.

It would be a mistake to think that group study is only valuable for extraverts. If you are an extravert, you will more likely prefer to study in groups, but you should be careful to give yourself enough "alone time" to think deeply about what you are learning. If you are an introvert, you should make use of groups even if only once a week. The opportunity to verbalize what you are learning with real (as opposed to imagined) people will provide another form of active learning.

Group study is valuable because all personality types are able to benefit from the strengths of the other types in the group. Group study provides an opportunity for sensing types to hear intuitive thought and develop their own intuitive skills, while intuitive types can be reminded of all those details that they tend to overlook. Feeling types have an opportunity to develop the logical organization that comes from thinking skills, and thinking types can benefit from the enthusiasm of the feeling types. Perceptive types have an incentive to stay on schedule in order to be prepared for the group session, and judging types will keep the group on task. When everyone in

the group is aware of and understands the contributions of their type, the synergism of the group is enhanced even further.

The most effective group study method is the rotating oral examination where each student takes a turn standing at a blackboard or other writing surface, if possible, and answering questions from the group. Here are a few guidelines that will help you get the most out of your time:

- Set a time limit of 2 to 3 hours. People start to tire out after several hours even when they are having fun grilling their fellow classmates. Also, a time limit will tend to keep the focus on the major topics and to discourage spending too much time on minor issues.
- The correctness of an answer should be agreed upon by the group. Group consensus helps to refine the understanding of all members of the group.
- When the student being questioned is unable to come up with a correct answer, try to ask the question in alternative ways to lead the student to the correct answer. The value of rephrasing questions was discussed in Chapter 8 with regard to written practice questions and it is no less valuable here.
- Even though the student at the blackboard is answering from memory, the students asking the questions should keep their notes open. You need to refer to them to verify the accuracy of the answers, and you can also refine them based on the discussion.
- The questions for a weekly review should focus on the previous week's material, but in some cases it will be relevant to include earlier material. Questions for exam reviews should attempt to integrate material by asking for comparisons and contrasts that link concepts together.
- Try to spread the workload evenly by taking turns asking and answering questions.
- Take advantage of the opportunity for group study with your dissection team in gross anatomy laboratory. You can use this setting as an opportunity to prepare for both the written and laboratory practical exams.

It is important to note that when you have finished your turn at answering questions, you will have verified what you did know and you also will have likely clarified what you didn't know. However, this relatively simple approach accomplishes far more than a verification of what you know. The anticipation of a weekend group study session enhances your individual study because you are constantly motivated to devise intelligent questions. This motivation causes you

to look at the material you are learning in a way that develops your intuitive skills. The natural competition to develop and bring the best questions to the group will improve your thinking on a daily basis. I recommend that you try to apply the methods of concept mapping, question analysis, examples from prior knowledge, and identification of similarities and differences in deriving your questions for group study. [*Author's note: My experience over the past 10 years has shown that student involvement is highest and attrition from the group is the lowest when the question analysis method is applied to case vignette questions. For courses early in the curriculum that have not covered sufficient material to integrate into a case vignette, then use other third order level questions. Not only does this review the factual material, but it increases the awareness of high-yield facts.*]

Let's go over the main points:

1) You can improve long-term learning and memory by relating new information to examples from your everyday experiences.
2) When you identify similarities and differences between two topics, you automatically develop intuitive skills.
3) Group study is valuable for all personality types because the strengths and weaknesses of opposite types complement each other.
4) The best method for group study is question analysis of case vignette, or other third order, questions.

Examples in Medical Biochemistry

Using examples from everyday experiences.

Example 1. The structure of heme. Heme is a cyclic planar molecule that is found within hemoglobin and many other molecules. Its structure is often asked about on exams either directly or with respect to its biosynthesis. Herne can be readily visualized as a bicycle wheel with an iron atom at the hub and an asymmetric arrangement of side chains around the rim (Figure 9.1). The rim itself is composed of four pyrrole rings connected by methenyl bridges (a tetrapyrrole ring), and the spokes are the coordination bonds formed between each pyrrole and the iron atom. This picture contains all four major components of the heme molecule: iron, pyrrole rings, methenyl bridges, and coordination bonds. It also has the components connected to each other properly and it is flat like heme.

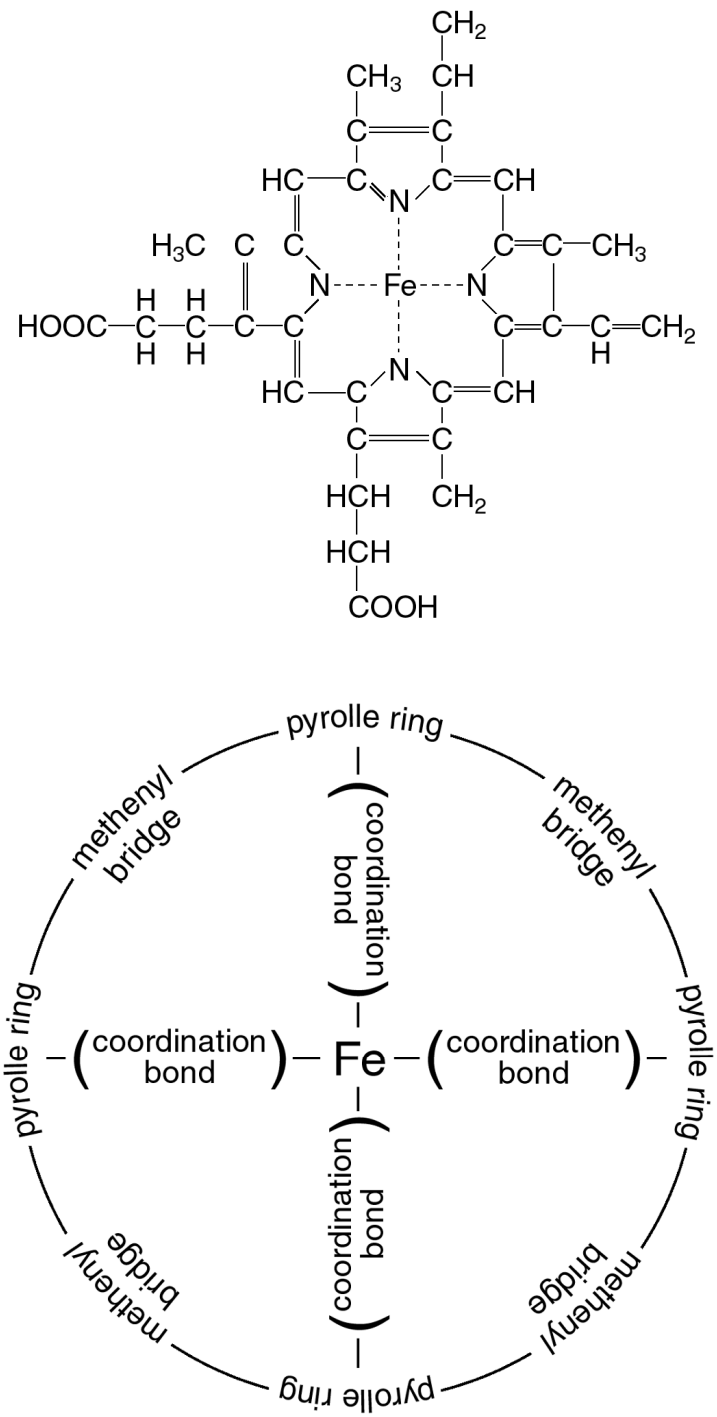

Figure 9-1: Comparison of heme structure with heme drawn as a bicycle wheel.

Example 2. Membrane composition and structure. Membranes can be thought of as "high-fat sandwiches." Their general structure (Figure 9.2) is that of a bilayer of fatty molecules called phospholipids. The long fatty tails from both layers face each other and intermingle in the center of the membrane sandwich. The slices of bread would be analogous to the charged phosphate groups on the surface. The analogy can be extended even further by envisioning the proteins associated with the membrane as lunch meat for the sandwich. There is an important exception here that can be remembered easily if the image has some of the meat on the inside of the sandwich where it should be and some of the meat stuck to the outside of the sandwich. This easy to remember unusual image illustrates the integral membrane proteins that are found inside the membrane as compared to the peripheral membrane proteins that are only found on the surface.

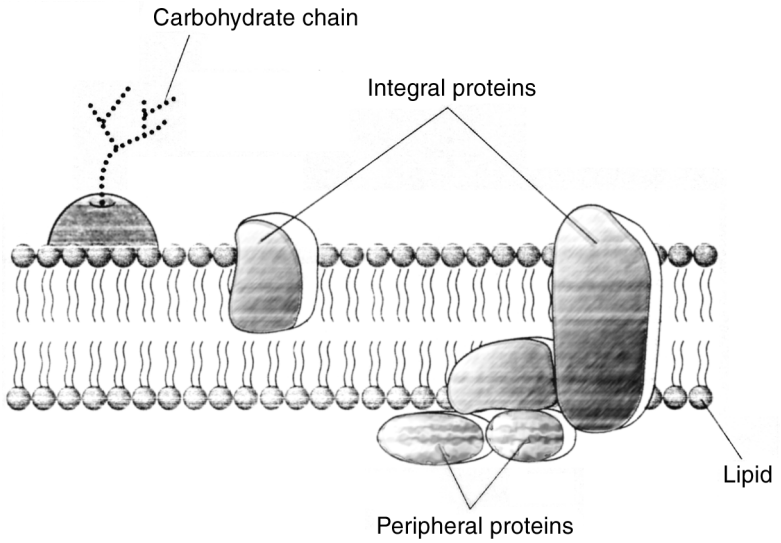

Figure 9-2: Structure of cell membranes. (From Biochemistry: Mosby's USMLE Step 1 Reviews by J. Pelley, 1997, St. Louis: Mosby–Year Book, Inc.)

Similarities and differences between two topics

Example 1. Hemoglobin vs. myoglobin. Hemoglobin and myoglobin are two oxygen-binding proteins that have many attributes in common. However, knowledge of their important differences is essential to understanding their physiological function. An excerpt from

Biochemistry: Mosby's USMLE Step I Reviews[1] is followed by a concept map that summarizes the major similarities and differences from this excerpt.

Model Proteins Help to Illustrate Common Principles of Structure and Function.

Hemoglobin and myoglobin are well-studied, clinically relevant model proteins that illustrate basic aspects of protein structure and function. The similarities and differences in these proteins illustrate how they are adapted to their intracellular roles.

Hemoglobin and Myoglobin Have Different Cellular Roles.

Hemoglobin and myoglobin have small differences in primary structure that lead to large differences in function.

- **Hemoglobin** is an oxygen transport protein. It exists only in the erythrocyte. Hemoglobin is designed to have *low* affinity for oxygen in the tissues and *high* affinity for oxygen in the lungs.
- **Myoglobin** is designed as an oxygen storage protein. It exists only in skeletal muscle. It is designed to bind large amounts of oxygen at normal tissue partial pressure of oxygen (Po_2) and to release it when the tissue becomes hypoxic. Myoglobin doesn't change its affinity with the oxygen concentration.

Hemoglobin Has Quarternary Structure; Myoglobin Does Not.

Several normal types of hemoglobin are produced at different stages of development. Each type of human hemoglobin has a **tetrameric quaternary structure.** Each subunit is a spherical protein called a **globin.** Each globin is produced by a different gene, and different genes are active during various stages of development. Various combinations of globins produce various quaternary structures of hemoglobin, each having a slightly different function.

- **Hemoglobin A_{1c},** a subclass of hemoglobin A, is not determined genetically but instead is the result of a spontaneous low rate of reaction between blood glucose and the terminal amino of the β-globin subunits. Since the rate of reaction is proportional to the average blood glucose level, patients with uncontrolled diabetes mellitus have higher than normal concentrations of Hb A_{1c}, reflecting the elevation in blood glucose.
- Table 4.1 shows some normal human hemoglobins.
- Myoglobin is always a monomer; it has no quaternary structure.

[1] See Appendix B for full reference.

Hemoglobin and Myoglobin Have Similar Tertiary Structures.

The tertiary structure of β-globin (or α-globin) and myoglobin is almost identical.

- Both are all α-helical, with connecting regions between the helices (Fig. 4.1).
- Both are highly compact, with the hydrophilic residues toward the outside and the hydrophobic residues toward the inside.
- The interior hydrophobic residues create a hydrophobic pocket for the binding of the heme prosthetic group.

Hemoglobin and myoglobin tertiary structures have important differences on their surfaces.

- Myoglobin has surface amino acids that serve only a solubility function.
- Hemoglobin subunits have surfaces that serve both solubility and subunit association functions. Subunit contact provides for globin-to-globin communication.

Heme Serves As a Prosthetic Group for Both Myoglobin and Hemoglobin.

One heme associates with each globin molecule by noncovalent bonding in a hydrophobic pocket. The heme molecule (Fig. 4.2) is a planar iron containing porphyrin ring with the iron held in position by liganding to the **pyrrole rings of heme** (**ligand:** a smaller molecule that binds in a specific way to a larger molecule). The heme Fe^{++} atom forms a total of six coordination bonds.

- Four bonds are formed with the pyrrole rings in the heme.
- A fifth bond is formed with a histidine residue, called the **proximal histidine.**
- The sixth coordinate bond is reserved for binding oxygen or is unoccupied.

Methemoglobin is hemoglobin containing one or more heme iron atoms oxidized to Fe^{+++}.

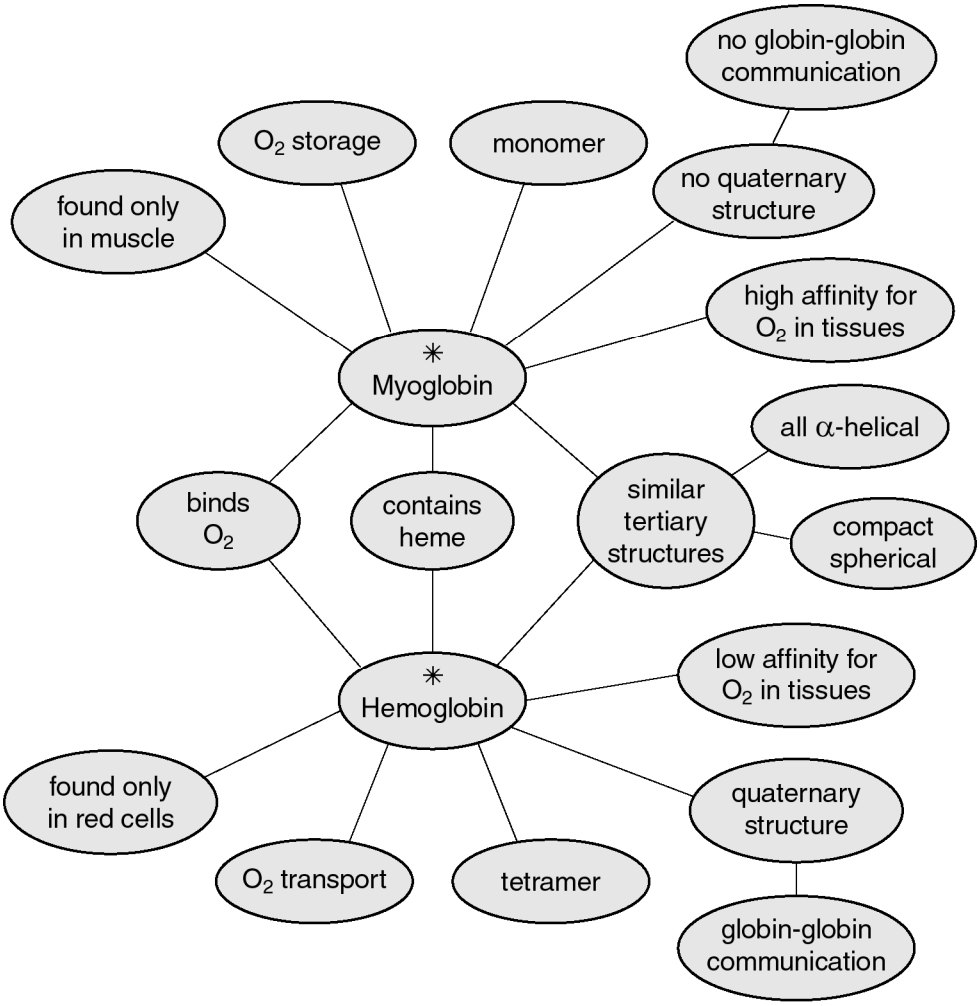

Figure 9-3: Similarities and differences for hemoglobin and myoglobin. Not all features from the excerpt are diagrammed.

Examples in Human Gross Anatomy

Using examples from everyday experiences.

Example 1. Sensory innervation of the hand. Sometimes you can develop examples from movies or television, which are also part of everyday life. For example, the Vulcan peace sign from Star-Trek is a visual method for remembering the sensory innervation of the hand (Figure 9.4). The important information to remember is that three spinal nerves supply sensation to the skin of the fingers and hand:

1. The sixth cervical nerve (C6) supplies the thumb and thenar eminence (the mound on the palm at the base of the thumb).
2. The seventh cervical nerve (C7) supplies the index and middle fingers and the associated palm.
3. The eighth cervical nerve (C8) supplies the ring and little fingers plus the hypothenar palm (the ridge along the base and outer edge).

The Vulcan peace sign assigns each digit with its proper innervation.

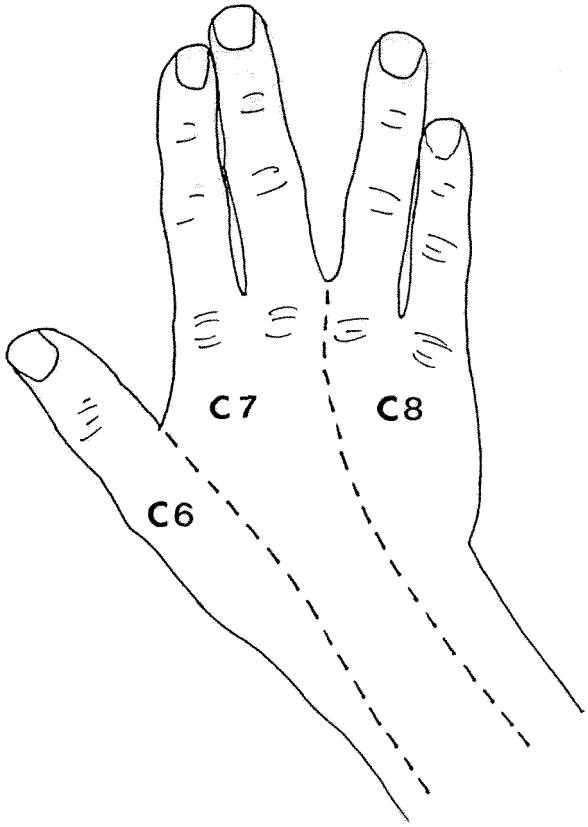

Figure 9.4: Sensory innervation of the hand.

Example 2. The pes anserinus. The pes anserinus, literally "the foot of the goose," is used to recall the names of the attachments of three important thigh muscles to the tibia bone in the lower leg. You will learn in your gross anatomy course that the sartorius, the gracillus, and the semitendinosus muscles each flare out from their attachment to the tibia in the lower leg to occupy different spaces, called compartments, in the thigh (Figure 9.5). As these muscles flare out, they remain interconnected for a short distance, like the web spaces of the goose's foot. They then separate to head toward their respective compartments in the thigh like the three toes of the goose's foot. The analogy to the goose's foot has grown so popular that the anatomists tried to make it more sophisticated by using the Latin roots pes ("foot") and anserinus ("of the goose"), and the term has even started showing up in textbooks.

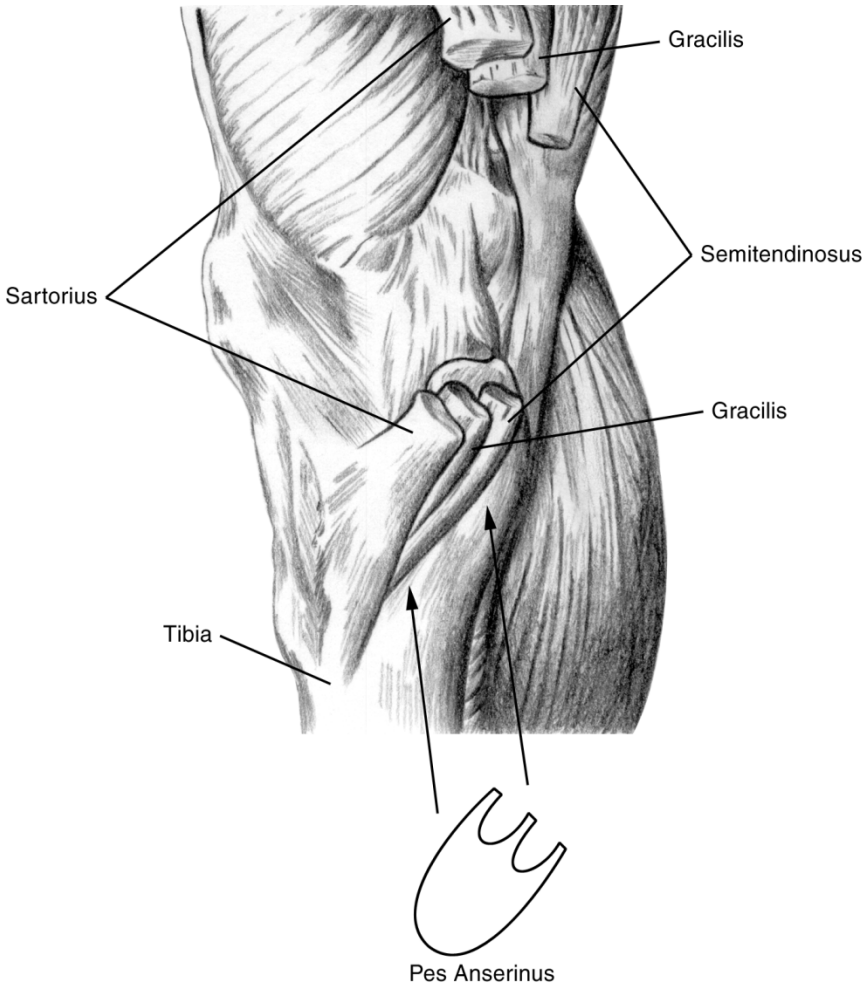

Figure 9.5: The pes anserinus. This illustration is a cutaway view of the medial (center) side of the right knee. The location of the pes anserinus is indicated by the webbed foot.

Speaking of Latin roots, an effective way to remember many anatomical terms is to look up their Latin and Greek roots in a medical dictionary. In many cases, the meaning of the actual root word can be so picturesque that it creates its own visual image!

Similarities and differences between two topics

Example 1. The biceps brachii vs. the brachialis. Both the biceps brachii (commonly known as the biceps) and the brachialis are similar in that both are found on the anterior, or front, of the upper arm. Also, both flex the elbow and are innervated by the musculocutaneous nerve from the brachial plexus. But, there are several important differences, such as their origin and insertion, that could show up on multiple choice questions. The excerpt below contains Table 2.4 from *Anatomy: Mosby's USMLE Step 1 Reviews*[2] and it is followed by a concept map that summarizes the similarities and differences listed.

Table 2.4: *Muscles of the Arm*

Name	Origin	Insertion	Action	Innervation
Coracobrachialis	Coracoid process of scapula	Middle portion of the medial surface of humerus	Flexes and adducts arm	Musculocutaneous nerve
Brachialis	Anterior surface of lower half of humerus	Coronoid process and tuberosity of ulna	Flexes the elbow joint	Musculocutaneous nerve
Biceps brachii	*Short head:* coracoid process *Long head:* supraglenoid tubercle	Radial tuberosity and by the bicipital aponeurosis into deep fascia of forearm	Flexes the elbow joint, supinates the forearm, and weakly flexes the shoulder joint	Musculocutaneous nerve
Triceps brachii	*Long head:* infraglenoid tubercle *Lateral head:* posterior humerus above spiral groove *Medial head:* posterior humerus below spiral groove	Olecranon process of ulna	Extends the elbow joint	Radial nerve
Anconeous	Lateral epicondyle of humerus	Upper posterior surface of ulna	Extends the elbow joint	Radial nerve

[2] See Appendix B for full reference.

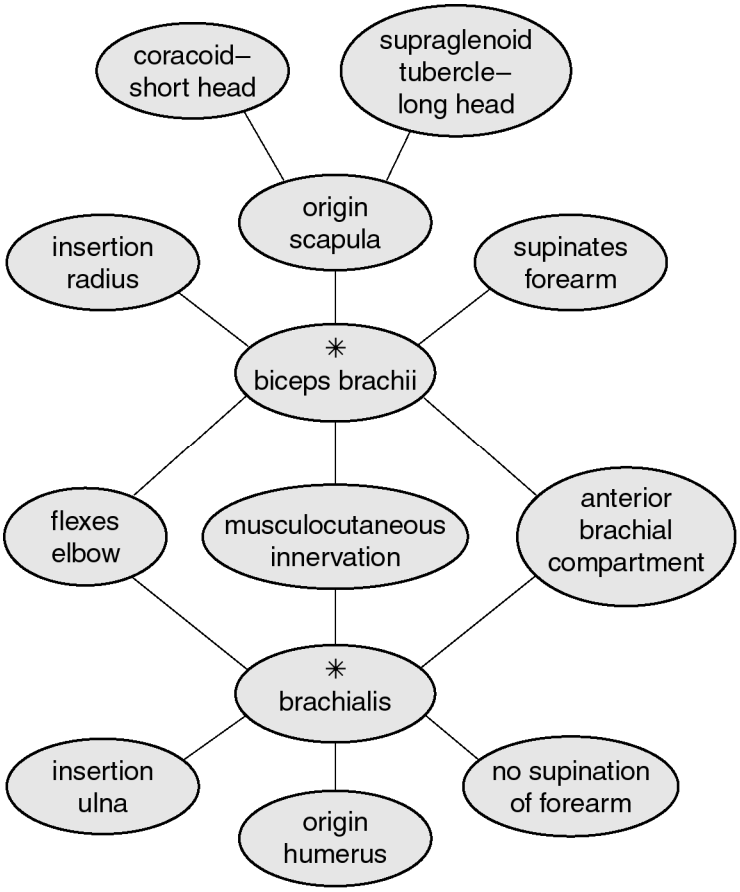

Figure 9.6: Similarities and differences for biceps brachii vs. brachialis. Not all features from Table 2.4 are diagrammed.

Examples in Medical Histology

Using examples from everyday experiences.

Example 1. Compact bone. Compact bone is the type of bone tissue found in the weight-bearing bones of the body. When one observes this bone with the naked eye, it looks like it has a smooth, evenly composed structure. A microscopic view, however, reveals a complex network of calcified cylinders, called osteons, held together by bone matrix (Figure 9.7). Each osteon is composed of concentric rings called concentric lamellae. The arrangement of these osteons in bone can be visualized as the effect you would see if you threw several stones in a pool of still water. The point of impact of each stone would represent the center of each osteon, and the multiple waves spreading away from the point of impact represent each of the concentric lamellae.

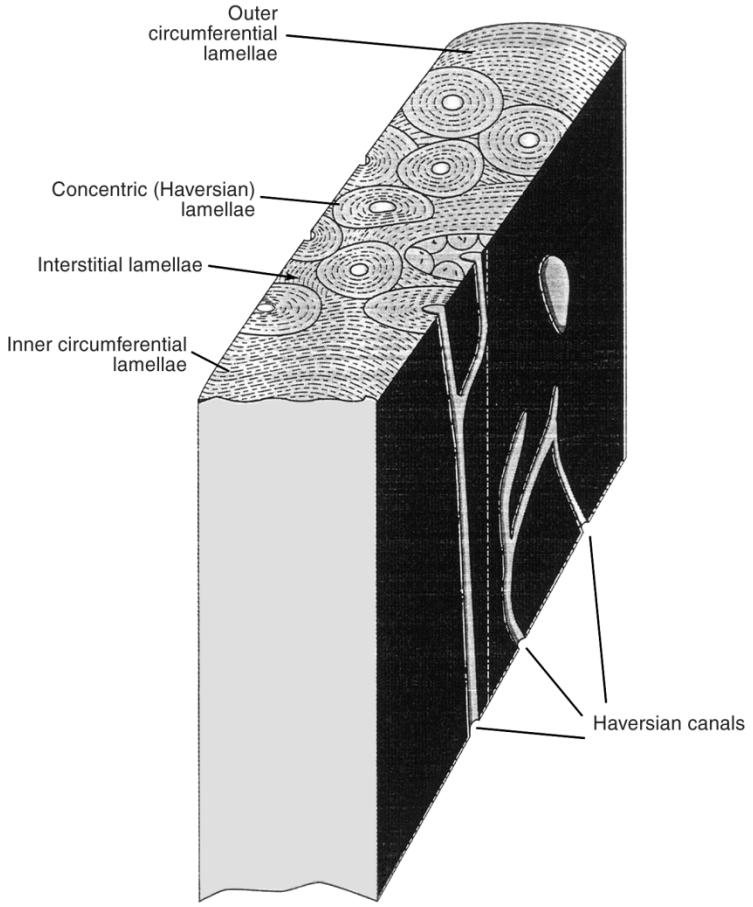

Figure 9.7: Cross section from compact bone. (From *Histology arid Cell Biology: Mosby's USMLE Step 1 Reviews* by E. Burns, and M. Cave, 1996, St. Louis: Mosby–Year Book, Inc.)

This example also illustrates how even the inconsistencies in an analogy can be useful. For example, the lamellae do not form from the center out as ripples from a stone do. Instead, they are formed from the outside in so that the last lamella to be laid down is the one closest to the center. Another inconsistency is that the osteon cannot keep expanding like the ripples in the pond. Because of its outside-in development, it is limited in size to its outer perimeter. The analogy could also be modified to include the sudden freezing of the pond as soon as the ripples touch each other. The pond then becomes hard like bone, and the concentric lamellae touch each other at their perimeters.

Example 2. Transitional epithelium in the urinary bladder. The cells that line the urinary bladder are classified as transitional epithelium. One of their interesting properties is their ability to dramatically change their shape as the bladder stretches and contracts. In an empty bladder, the surface cells are rounded in shape, but as the bladder begins to fill, the wall stretches to accommodate the increase in volume. We know from the laws of physics that a sphere is the most efficient use of surface area, and as the spherical shape is flattened, the surface area increases. This flattening of the surface cells is accommodated by adding more membrane to the surface from specialized vesicles that have been stored in the cytoplasm. A useful analogy here is that the cell membrane is like a dining room table that can be expanded by adding leaves. When there are no guests to serve, the most efficient use of space is to "store" the leaves in a closet the way the epithelial cell stores the cell membrane in the cytoplasm in the form of vesicles. Then, when guests arrive (e.g., the bladder is filling) and the table must be expanded, the leaves can be added to the table to help "stretch" it.

Again, an inconsistency can help to visualize some of the important details. Unlike the dining room table, the cell membrane doesn't open a gap and then fill in with the membrane from the vesicle. Instead, the vesicle first fuses with the membrane allowing the membrane to stretch. The membrane is flexible and bends to fuse with the vesicle where it needs to stretch out, but the table leaf is rigid and space must he made for it first.

Similarities and differences between two topics

Example 1. Skeletal muscle vs. cardiac muscle. Both skeletal muscle and cardiac muscle are cross-striated and contain sarcomeres as their structural and functional units. However, there are some important differences between them, and visualizing them together in the same concept

map can reinforce the memory for both. The excerpt below contains Table 7.1 from *Histology and Cell Biology: Mosby's USMLE Step I Reviews*[3], and it is followed by a concept map that summarizes the similarities and differences listed for skeletal and cardiac muscle.

Table 7.1: *Characteristics of Muscle Fibers*

	Skeletal	Cardiac	Smooth
Structure			
Location	Muscles of skeleton	Heart	Vessels, organs, and viscera
Connective tissue component	Epimysium, perimysium, endomysium	Endomysium	Sheaths and bundles
Fibers	Single large cells	Branched single cells	Single cells
Striations	+	+	–
Nucleus	Many peripheral	Single central	Single central
T tubules	A-I junction	Z lines	Replaced by caveolae
Cell junctions	–	Zonula adherens, zonula occludens, nexus	Nexus
Special features	Sarcoplasmic reticulum well developed	Intercalated disk	
Function			
Regulation of contraction	Voluntary	Involuntary	Involuntary
Type of contraction	All or none (red and white fibers)	All or none, rhythmic	Slow, partial
Efferent Innervation	Somatic efferent, motor end plate	Autonomic efferent (nexi)	Autonomic efferent (nexi)
Growth and Regeneration			
Mitosis	–	–	+
Response to demand	Hypertrophy	Hypertrophy	Hypertrophy
Regeneration	Limited, satellite cells (pericytes)	–	+

[3] See Appendix B for full reference.

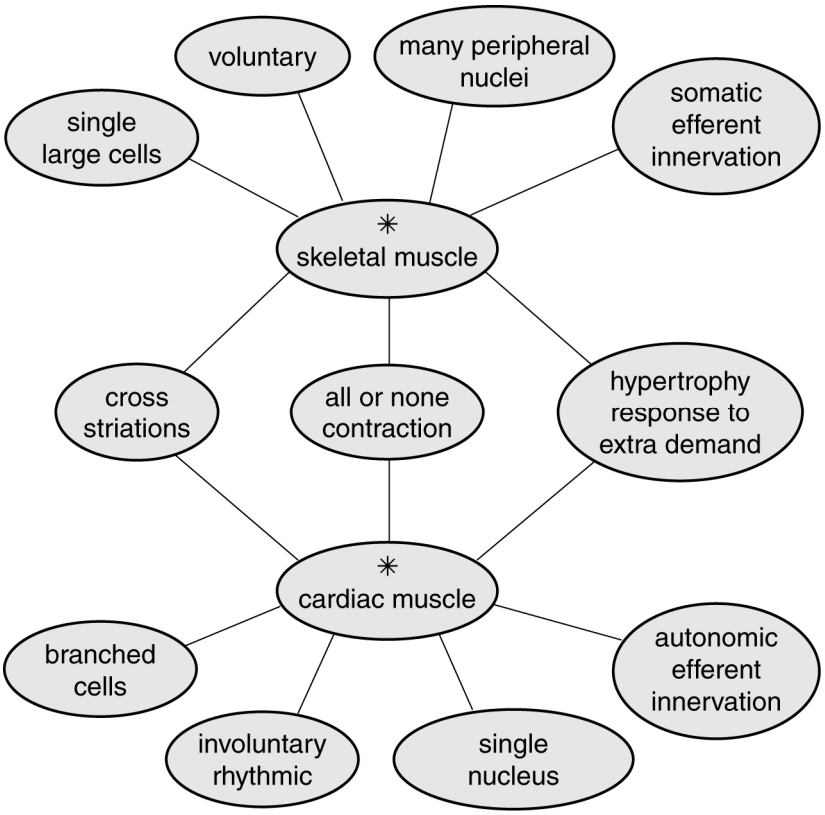

Figure 9-8: Similarities and differences for skeletal muscle vs. cardiac muscle. Not all features from Table 7.1 are included.

Part III

Beyond Multiple Choice Exams

Chapter 10
Time management can have built-in flexibility.

If you are going to become a SuccessType, you must have a plan for using your time effectively. This need to work within a schedule won't bother you if you are a judging type. However, if you are a perceptive type, you may be concerned that sticking to a schedule will be too confining. These concerns are taken into account by the SuccessTypes time management system because it provides enough flexibility to keep you from feeling trapped. In fact, the trap you need to avoid is an ineffective time management system...or no system at all.

You need more than just a schedule, you need a system.

As a medical student, you will have little trouble filling up your time with things to do. However, the flexibility of the premedical curriculum may not have prepared you for filling your time effectively. The typical undergraduate premedical curriculum provides adequate study time for just about any learning style, and, if the workload is too great, a course can be dropped and taken at a later time. In contrast, the medical curriculum can overwhelm you quickly because of its heavier course load and faster pace—and no option for dropping courses. A common truism among medical students states that medical school is like "trying to take a sip of water from a fire hydrant!"

If you are going to avoid drowning in this deluge of information, you need to be able to divert and channel the flow into a system that you can handle day after day. Effective time management involves more than just plugging activities into scheduled time slots. It also involves a system for plugging the *right* activities into the *right* time slots.

Like muscles, brains also respond better to *progressive* exercise.

A learning program compares in several ways to an exercise program. Both types of programs are intended to prepare you to perform at a certain level, and both have mental *and* physical components. If you begin an exercise program that progresses gradually, one that is challenging but never overwhelming, then the resulting feeling of well-being will likely encourage you to continue. You are also likely to experience a feeling of well-being and continue with a learning system that progresses gradually, one that is also like challenging exercises, but never overwhelming. I developed the SuccessTypes time management system to help you avoid the exhaustion and discouragement that I saw develop in students who became overwhelmed because they had no system. Although they were attempting to study harder and longer, they were really just staying busy reading and re-reading the material, and much of this "reading" was nothing more than just looking. Robotic reading and re-reading is a common time-waster for students. Re-reading material you already know can be addictive because it feels good compared to reading material you haven't learned yet. You can avoid becoming trapped in this unproductive kind of behavior if you accept the idea that it is more important for you to study smart than to study hard.

Study *smart*, not hard.

Smart study is more effective than hard study.

In a progressive system, each stage in the system takes advantage of, or builds upon, the earlier stages. When each stage follows the basic learning principles described in Chapter 6, the system becomes a "smart" system. A smart system does more than keep you busy; it keeps you busy doing the right things. In the SuccessTypes system, four identifiable stages of learning recur on a daily and weekly basis:

1. The identification stage (daily)
2. The orientation stage (daily)
3. The organization stage (daily)
4. The verification stage (weekly)

The identification stage prepares you for lecture.

You should prepare yourself for learning in lectures with the question in mind, "What *don't* I already know about this topic?" Don't worry about the amount of the material you actually do know or don't know because it's your state of mind that's important. The act of looking for terms and concepts gives your mind a way to actively involve itself in the material by giving you something to *identify*. By looking for what you don't know, you are also evaluating what you do know. Every term or concept that you identify constitutes a thoughtful decision about the material. You can't decide on what you do or don't know in a passive state of mind. Also, identifying what you don't know takes advantage of your unique background by making you more aware of what you already know. For example, if you are a biochemistry major, you will have a smaller list of topics to learn in your medical biochemistry course, sparing some extra time for learning anatomy. Likewise, if you have had prior courses in physiology or vertebrate anatomy, you may be able to trim a little of your workload in gross anatomy and medical physiology.

The goal of the identification stage is to produce some type of list that represents all of the terms that you *don't know* something about. This list can be handwritten on a notepad or highlighted in the text. [*Author's note: It is important to be selective when highlighting. Many sensing type students are uncertain about what should be highlighted, so entire sentences or even paragraphs are highlighted. Try to pick the most important words or groups of words, even if you change your mind later. When you have to decide on what to highlight, you are in active learning mode*.] It is important to limit your time spent on this stage in order to have enough time available for the organizational stage discussed below. You should only spend about 5-10 minutes for each hour of lecture on this stage, and you should do it either the last thing in the evening, or the first thing in the morning. This activity is not learning yet, but it will make meaningful learning more effective later.

Identification accomplishes several important things:

- It establishes a starting point.
- It sensitizes you to the terms and concepts to listen for during the lecture.
- It gives you an opportunity to take advantage of your unique background.

The orientation stage uses lecture to prepare you for learning.

Lecture provides an *orientation* to a topic and indicates what is important to learn. If you have completed the identification stage correctly, then you are ready to listen for the items on your list. You should check off each of the concepts and terms that you have identified as they are covered in the lecture. Listening for and checking off concepts and terms during the lecture is an active involvement that will provide you with your list of objectives for the evening. You can also inquire about any items that you had identified and were not covered in order to clarify their importance. In some cases. the professor may want you to pursue these topics on your own; in other cases, the professor may decide at the last minute not to require some topics. In the latter circumstance, you will have wasted only a minimum of time on these topics.

During the lecture, listen for what is emphasized and repeated. Especially note where examples or anecdotes have been given because these are clues as to what was important to the professor. Your notes should be structured to help you recall the major features of the topics presented, not for rereading the professor's exact words. When you are taking notes verbatim, you are not able to engage your mind in active listening. Not only will this cause you to miss much of the material anyway, but it will reduce the effectiveness of the learning stages that follow this one.

If you are a sensing type, you will be especially tempted to take down everything literally. You can train yourself away from this tendency by practicing the concept mapping method described in Chapter 7. You should avoid concept mapping in lecture, but a little practice outside of lecture will train your mind to eliminate nonessential words and phrases and to listen for the more important connections, descriptions, and relationships that will be added into your maps later.

Using lecture as an orientation stage accomplishes several important things:

- It engages your mind actively in listening for the material that is important.
- It defines the material that needs to be learned.
- It causes you to start interpreting the material in a way that will aid active learning later.

The organization stage elicits active learning.

At this point, you have sensitized yourself to the material that you didn't know and you have heard this material discussed. You have heard whether each topic that you have identified is of major importance or of lesser importance. Now you need to *organize* the topics that are important. Effective organization of what you are learning not only develops the ability to recall information better, but it develops the ability to think in terms of key relationships. Most test questions require an ability to remember relationships among and between facts and concepts. This type of reasoning, which involves inference and deduction, is a higher order thinking skill compared to simple memorization.

It is urgent that you organize the material to be learned as soon as possible after lecture since studies suggest that if you practice this strategy, less time and effort will be required to learn new information. You may not have time to do this during a typical school day, which is usually filled with lecture and laboratory sessions, so it is probably best to schedule your evening hours for this activity. Most of the evening should be spent this way, but remember to set aside approximately 5-10 minutes per lecture hour at the end of the evening for the next day's identification stage. [*Author's note: Many students are overwhelmed initially at the task of completing an entire concept map. I have found it effective to recommend that, if this is the case with you, just do a 2-level map at first. That means to only map two levels down from the main, or top, bubble. This is usually accomplished by finding major headings and subheadings, and only takes about 10 minutes. After a week or two, you will find it more comfortable, and faster, to start adding additional levels.*]

The overall goal of the organization stage is to review all of the concepts and terms that you checked off in lecture using methods that provide a visual organization. Concept mapping and/or other visual constructs will help you do this. These methods force your mind to work on the material actively to develop a mental picture of what you are learning. As you proceed, you should always have the question in the back of your mind, "How is this material best organized?" This is the most effective time to actually read the material in the textbook because now you have a question to answer. By the time you have diagrammed all of the concepts and terms from lecture, you will have read what is necessary from the text. Of equal importance, you will have skipped reading what was unnecessary. [*Author's note: I have often been asked by sensing types*

if they can read their regular way before making their maps. The answer is yes, but with the extra step of writing in the margin for each paragraph the three or four most important words in the paragraph. Even if you change your mind about their importance later, this one addition to your regular reading will not only produce better reading, but it will be a head start on starting your concept maps since they usually need a list of topics to pick out the major bubbles anyway.]

The organization stage accomplishes several important things:

- It develops visual relationships between facts and concepts.
- It promotes the ability to use inference and deduction on test questions.
- It promotes active learning.
- It facilitates effective reading of the text.

The verification stage determines where you need to spend most of your time.

At this point, you have sensitized yourself on a daily basis to the material that you didn't know, you have heard it discussed, and you have actively organized it. That is about all your daily schedule, can handle. However, after you have accumulated a full week of material, you need to review what you have studied and *verify* how much of it you have learned. Verification offsets the normal process of forgetting, and it provides the opportunity to give greater attention to areas that need more work. [*Author's note: It is important to consider that brain research shows that the brain is designed to forget information that is not used. This is an active and normal function of the brain and is only overcome by using information actively.*] The method for verification is surprisingly simple, and it contributes to highly effective learning.

You need to have available the concept maps (Chapter 7) that you developed from the terms and concepts discussed in lecture. While referring only to the concept maps, attempt to repeat back all of the material you organized throughout the week. The only time you should refer to the textbook or notes is when you are unable to verbalize the material. If you can make sense out of all of the material, you are in pretty good shape. It is likely, however, that you will encounter some concept maps that don't work well. In those cases, you may want to refer back to your notes and redesign them so that you can now paraphrase from it. If a particular topic begins to consume too much time, it could be an indication that you need to contact the professor for assistance.

You should dedicate large enough blocks of time to each course to allow you to verbalize the entire week's material. If you are an extravert, you may want to arrange regular group sessions and share your thinking out loud, and if you are an introvert you will probably want to maximize the time you study alone. When verbalizing material while you are alone, it is important to imagine a listener and actually speak out loud. It is too easy to take shortcuts in your explanations when you are in a hurry, and it could result in your assuming you know something just because it looks familiar. You can only be sure you know something when you can explain it.

The verification stage accomplishes several important things:

1) It reinforces memory by reviewing the material one more time.
2) It develops a continuity between topics that can be missed when your focus is day by day.
3) It provides audible feedback that verifies you understand the material.

The SuccessTypes system operates on a weekly cycle.

The stages of learning in the SuccessTypes system are summarized below. The actual amount of time you devote to each activity is up to you. Keep a flexible frame of mind so that, as circumstances change, you can reallocate the time devoted to any one subject. The skills of the judging type that will keep you on schedule will be more effective if you balance them with the adaptive skills of the perceptive type. If circumstances cause you to fall behind, remember to stick with today's material and catch up on the weekend or holidays unless you absolutely need yesterday's information.

> It is not enough to be busy…
>
> The question is: What are we busy about?
>
> Th

Review for examinations should mirror the verification stage.

If you have verified your learning every weekend and you have stayed on schedule, then you will have produced a complete set of review notes for examinations. You will have identified on a daily basis all of the terms and concepts that are important, you will have organized them into a

visual recall system, and you will have reworked any areas of uncertainty during your weekend verifications. At this point, the text and notes have served their purpose, and the only thing you need in order to prepare for the exam is your review notes.

SuccessTypes time management

Identification stage. Identify material you don't already know the night before lecture. Highlight terms and concepts you don't know, or write them down. Spend 5-10 minutes or less per lecture hour.

Orientation stage. Use the lecture to give you an orientation to the terms and concepts that need to be learned. Check off the concepts you highlighted or listed during the identification stage.

Organization stage. Develop a visual organization of the material as soon as possible (at least on the same day). Spend most of your available time doing this.

Verification stage. Dedicate blocks of time on the weekend to each course. Use verbal paraphrasing to review your notes and to determine what topics need more study. When your verification process shows that you have a specific area of difficulty, refer to the text or notes, or arrange to see the instructor.

Let's go over the main points:

1) Effective time management involves a system for plugging the *right* activities into the *right* time slots.
2) Your time management system should progress gradually so that it is challenging but not overwhelming.
3) In the SuccessTypes system, there are four identifiable stages of learning: 1) identification, 2) orientation, 3) organization, and 4) verification.
4) You should prepare for lecture by actively identifying all of the terms you don't know something about.
5) You should use the lecture as an orientation to the material to be learned and to discriminate between the more important and less important concepts.
6) You should organize the material you need to learn on a daily basis.
7) The overall goal of the organization stage is to provide a visual structure that relates facts and concepts.
8) You should verify what you have learned by verbally paraphrasing the material on a weekly basis.

Chapter 11
How do you cope with stress?... Your shadow knows.

This chapter and the next address the topics of stress and personal growth. In this chapter, I describe how your type affects your reactions to stress, and in Chapter 12, I describe how you can use your knowledge of type to provide yourself with opportunities for personal growth and improved relationships. Although these two chapters don't emphasize learning skills, they will nevertheless impact your effectiveness as a medical student.

How do *you* react to stress?

Because medical education constantly demands your best thinking, it creates a constantly stressful environment. The question, however, is not how much stress you have — rather, it is how you react to stress. Your reaction to stress can be unproductive or useless if you are unprepared. However, your reaction can also be useful if your response helps, you adapt to the situation. A part of your response to stress is determined by what you have learned from your day-to-day experiences with other stressful situations. But there is also an *unlearned* part of your response to stress that is determined by your type. That means that your response to stress may be as unique as your learning style.

> How you react to stress is more important than the amount of stress you have.

Your weakest mental function emerges under stress.

Stress happens when the outcomes of a situation don't match your expectations. Examples might be that you didn't do as well on an examination as you expected or you're only halfway through the material you expected to learn and it's time to quit for the night. Significant stress can emerge in your personal life from unexpected events such as the death of a loved one or an unwanted breakup of a relationship. In my experience with at-risk students, the cause of their

academic problems, when it was not due to learning style, was usually from stress in their personal life.

You may have noticed that when stress is unusually demanding, you're not at your best and you tend to behave "out of character." In other words, your behavior is out of control, and the way you behave is not at all like you. This behavior, which is usually primitive and childlike, was referred to by Carl Jung as your "shadow side," and it represents the influence of your weakest mental function. You know your shadow was at work when you hear yourself say, "I didn't mean that! I don't know what came over me!" or, "That just wasn't like me!"

Your weakest mental function is the least developed.

If you will refer back to Figure 4.1, you will be reminded that your type is defined, in part, by the development of a *dominant preference* for one of the four mental functions: sensing, intuition, thinking, or feeling. We begin to establish this dominant preference during childhood as we experiment with using sensing or intuition for perception and with thinking or feeling for judging our perceptions. One of these mental functions emerges as a preference first and remains throughout life as the dominant mental function. Because the dominant mental function is the most preferred, it is the most used and becomes the best developed. Your dominant function can be found in Table 4.2. This table also lists your least preferred mental function, called the *inferior*, or *fourth*, function. Because this function is the least preferred, it is used the least and develops much later in life, if at all. Until your fourth function is developed to the point that you can use it well, you will not trust it and it will remain a weak point in your personality. This weakness will allow your shadow side to emerge unconsciously under extreme stress.

Each of the four functions produces characteristic shadow behaviors under stress.

You can find out how your shadow side usually emerges by finding your type in the descriptions below. The types are combined into four groups that contain those types with the fourth function in common. Although each of these fourth functions is used appropriately under normal conditions, *they become exaggerated under stress* and produce a response that reveals your

shadow side. Each description below provides an example and includes a recommendation for coping by your using the strengths of our dominant mental function.

Fourth function: Sensing (ENTP, ENFP, INTJ, INFJ)

Characteristic Stress Behavior. If your fourth function is sensing, you tend not to trust your ability to get a complete grasp of the facts of a situation. When this becomes exaggerated under stress, it leads to poorly controlled sensing type behavior. This can take the form of obsessive behavior such as writing out long lists of observations related to the cause of your stress or as a sensory focus on the body through overeating, increased sexual activity, or substance abuse. For example, suppose you are exhausted from long hours of study and then you learn that you have scored a 50 on an exam that you thought you had mastered. Your exaggerated sensing function might cause you to go home and stuff yourself on snack foods and/or numb the pain with a six-pack of beer. You might also find yourself going back through your notes and writing down the mountain of details that you didn't want to memorize when you were studying for the exam.

Recommendations for Coping. Since your dominant function is intuition, you should use your well-developed creative abilities to focus on new explanations for the situation or on more possibilities for dealing with the stress. A fresh perspective can come from talking with friends or reading about stress coping strategies. While you are using your well-developed creative abilities to find solutions to your stress, you also benefit from suppressing the excesses of your shadow side. In the preceding stress example, you could cope by using your dominant intuitive skills to seek out possibilities as to what went wrong. Reviewing your test results, for example, might reveal that you failed to record an answer for one of the questions on the computer sheet, shifting all the remaining answers out of phase with the question numbers. Knowing this wouldn't help your grade, but it would help to remove the mystery.

Fourth function: Intuition (ESTP, ESFP, ISTJ, ISFJ)

Characteristic Stress Behavior. If your fourth function is intuition, you tend not to trust your ability to use your imagination and to see new alternatives for a stressful situation. Instead, you will tend to assume that your way is the only right way to manage a situation. This leads to uncontrolled intuitive type behavior under stress, such as an unrealistic doom and gloom outlook, which can cause you to give up on seeking alternative solutions to the situation. Let's keep using

the example where you are exhausted from long hours of study and then you learn that you have scored a 50 on an exam that you thought you had mastered. An exaggerated intuitive response would cause your imagination to go spinning out of control, causing you to treat the situation out of proportion as a catastrophic event. Your normally practical behavior would give way to impulsive, rash behavior such as abruptly taking off in the middle of the day to go to a movie or to go buy a new stereo system (which you can't afford).

Recommendations for Coping. Since your dominant function is sensing, you should use your well-developed ability to collect the relevant facts and use them to develop a plan of action. Even a brief escape in a hobby, such as woodworking or gardening, that uses your sensing function will help you avoid being trapped by a runaway imagination and give you time to sort things out in your mind. A hobby would give you a time to reflect and think about the fact that there are many chances to make up a bad performance and that people have bad days as well as good ones. It would give you a chance to see that you made it this far so you must have something going for you, and you can seek help in finding out just what the problem is.

Fourth function: Thinking (ESFJ, ENFJ, ISFP, INFP)

Characteristic Stress Behavior. If your fourth function is thinking, you tend not to trust your use of logic to evaluate a situation. When this becomes exaggerated under stress, it interferes with a complete assessment of the situation, causing you to over generalize through faulty logic about both your own competence or self-worth and the competency of others. Let's keep using the example where you are exhausted from long hours of study and then you learn that you have scored a 50 on an exam that you thought you had mastered. Your exaggerated thinking function might cause you to become excessively critical of yourself or others (especially the faculty). Your self-criticism would lead to a loss of confidence, while your criticism of others would lead to mistrust and second-guessing about the material that needs to be learned for future exams.

Recommendations for Coping. Since your dominant function is feeling, you should use your well-developed abilities in dealing with people in a positive way by talking over your values with a friend or a support group. While your likes and dislikes will not necessarily suggest a solution to the situation, the solution must eventually take these values into account. By paying attention to the legitimacy of your feelings and self worth, you will help avoid compounding your stress with a negative self-image. In the example above, the members of a support group

might reveal that they also worry that the same thing could happen to them and that their outwardly confident behavior is just an act. (This is more common than you might imagine!) The encouragement from those you confide in can help provide the motivation for you to try and find positive ways to keep a low grade from happening again.

Fourth function: Feeling (ESTJ, ENTJ, ISTP, INTP)

Characteristic Stress Behavior. If your fourth function is feeling, you normally don't trust your subjective reactions in evaluating a situation. When this tendency becomes exaggerated under stress, it erupts in an uncontrolled emotional reaction or it brings on feelings of despair and isolation. The irrational nature of the uncontrolled feeling function is often seen either as hatred toward the source of stress or, paradoxically, as feelings of love in an inappropriate relationship. Let's keep using the example that you are exhausted from long hours of study and then you learn that you have scored a 50 on an exam that you thought you had mastered. Your exaggerated feeling function could elicit a reaction in the form of an irrational outburst toward the professor as the source of the problem. The irrational reaction could alternatively take the form of self-criticism and withdrawal. In this state of mind, you also would be very vulnerable to the indiscriminate development of any relationship that would give your pent-up emotions an outlet.

Recommendations for Coping. Since your dominant function is thinking, you should use your well developed reasoning ability to analyze your situation and come up with a logical solution. You can accept your emotional reaction as one of the facts that you include in your reasoning. The time taken for analysis will also help you delay *acting* irrationally on your feelings. In the example above, you might have to face the fact that you made a bad decision and didn't devote enough time to an important subject. Also, you may have just discovered an area of knowledge where you are weaker than you thought. Facing these facts, however unpleasant, is a good place to start in developing a solution.

Shine a little light on your shadow.

While your well-developed dominant function can help you cope with stress in most situations, a good way of preparing for stressful situations is to develop your ability to use, *and trust*, your fourth function. The more you trust yourself to use your fourth function, the less likely it will become exaggerated and go out of control under stressful conditions. If you are going to develop

the skills of your fourth function, it will be helpful to do it under conditions that are low in stress. Remember that one of Pelley's Profundities states that using a function that is not your preference can be hard work. Therefore, the ideal way to develop your fourth function is during recreation and relaxation. Similar to the previous section in this chapter, your type can be found below in one of the four groups that have the fourth function in common. In each section, I have framed the overall goal for developing that mental function followed by some suggestions for accomplishing this. I invite you to share with me at john.pelley@ttuhsc.edu any suggestions for strategies which you develop that could be included in future versions of this book.

Pelley's Profundities:

1. Performing in your type is play.
2. Performing in your opposite is work.

Fourth function: Sensing (ENTP, ENFP, INTJ, INFJ)

If you want to develop your sensing function, you need to involve yourself in using and paying attention to your senses. The goal is to train your mind to perceive things as they are in the present moment. Try to keep your mind off of what might be ("if only...") because that is an intuitive mental function. It would be very helpful, and more fun, if you could try these activities with a friend who is a dominant sensing type.

1) Engage in activities where you need to follow directions. Try cooking directly from the recipe or try woodworking and model building directly from the instructions. Don't get creative, stick to the directions!
2) Go to a garage sale and buy small appliances and power tools that you can take apart and reassemble.
3) Develop a personal or family budget with your income divided into expense accounts such as utilities, clothing, and recreation, and routinely calculate the standing balances for each account.
4) Go to an art museum and focus on the technical aspects of the work. Look at things like materials, colors, shapes, and textures. Stay away from interpretation and meaning.
5) Get involved in team sports such as softball, volleyball, and soccer. Read *The Inner Game of Tennis*, by Timothy Gallwey, a fascinating book that explains how to develop the use of the senses in all sports, not just tennis.

Fourth function: Intuition (ESTP, ESFP, ISTJ, ISFJ)

If you want to develop your intuitive function, you need to involve yourself in using and paying attention to your imagination. The goal is to train your mind to perceive things not as they are

but as they might be. Try to keep your mind off of what is obvious because that is a sensing mental function. It would be very helpful, and more fun, if you could try these activities with a friend who is a dominant intuitive type.

1) Engage in activities where you can make up your own directions. Cook with recipes that you make up yourself or that you change from the original. Try woodworking and model building based on your own designs or on modifications of other designs. Don't be afraid to get creative even if you make mistakes.
2) Obtain some travel brochures and plan a vacation with your spouse or a friend. Describe different scenarios or activities on the vacation as if you were there experiencing them. Be as detailed and humorous as possible. Humor is very important and effective in exercising intuitive function.
3) Take turns with your friends to see who can make up the most imaginative and humorous story from common advertisements out of newspapers or magazines. This is where an intuitive type partner can really be helpful. Try a variation where each person only tells a part of the story so that each person picks up where the last one finished.
4) Go to an art museum and focus on the imaginative aspects of the work. Try to describe what the artist might have been trying to communicate or express. Stay away from the obvious technical aspects of the work.
5) Make up more exercises like these to help people develop each of the four mental functions. (Don't forget to tell me about them!)

Fourth function: Thinking (ESFJ, ENFJ, ISFP, INFP)

If you want to develop your thinking function, you need to involve yourself in using and paying attention to your logical reasoning. The goal is to train your mind to consider situations objectively. Try to keep your mind off of the human implications and focus on what makes logical sense. It would be very helpful, and more fun, if you could try these activities with a friend who is a dominant thinking type.

1) Take turns with your friends pointing out and analyzing the emotional arguments in political speeches and in advertisements.
2) Learn to play chess or bridge or other games of strategy. The necessity to follow logical rules in order to compete will develop your thinking skills.
3) Try to discover the most efficient way to do different tasks in different situations such as at home or at school. Discuss with your spouse or roommate how to arrange your home or apartment to be more efficient. Try not to offend anybody while you are doing this!
4) Take turns with your friends trying to determine the logical long-range outcomes of front-page stories in the newspaper.
5) Try to find statements, in this hook that don't make sense. (Please let me know!)

Fourth function: Feeling (ESTJ, ENTJ, ISTP, INTP)

If you want to develop your feeling function, you need to involve yourself in using and paying attention to your compassion and empathy. The goal is to train your mind to consider the human implications of different situations. Try to keep your mind off of what is logical or what ought to be and focus on quality-of-life issues. It would be very helpful, and more fun, if you could try these activities with a friend who is a dominant feeling type.

1) Take turns with your friends pointing out the advantages of emotional arguments in political speeches and in advertisements. Discuss the constructive ways that emotional arguments can be used.
2) Bring comfort to others through volunteer work or simply give some care and attention to a pet (preferably warm-blooded).
3) Keep a journal where you record only events and situations involving your interactions with people. Focus on things like mood, quality-of-life, and nostalgia.
4) Write regular letters to your parents or others who played a significant role in your upbringing in which you describe memorable anecdotes and events in your childhood.
5) Try to discover the most exciting way to do different tasks in a variety of situations such as at home or at school.
6) Discuss with your spouse or roommate how you can arrange your home or apartment to be more attractive.
7) Take turns with your friends trying to determine the long-range human outcomes of front-page stories in the newspaper.
8) Try to find statements in this hook that help you to feel good about yourself and others.

Stress management techniques may be needed.

Understanding the strengths of your dominant function and the need to develop your fourth function may be enough to help you develop productive and useful ways of coping with stress. However, if you feel you need to learn more about stress management techniques, numerous books are available at your local library or bookstore (also a few titles are listed in Appendix B), or you may want to pay a visit to the student counseling center if you are enrolled at a university. Don't forget to take your type into account as you choose among the various stress management programs. For example, extraverts may prefer more social and active approaches to stress management, while introverts may prefer approaches that can be practiced during alone time.

Let's go over the main points:

1) Your reaction to stress is a more important issue than how much stress you have.
2) Part of your reaction to stress is learned and part is unlearned. The unlearned part is determined by your psychological type.
3) Unusually stressful situations cause your weakest and least developed mental function, called the fourth function, to emerge in behavior that is not like you.
4) The behavior that is due to an undeveloped fourth function is called either your "shadow side" or simply your "shadow."
5) Your shadow is expressed as an exaggeration of the otherwise normal attributes of your fourth function.
6) The use of your well-developed dominant function can be very helpful in dealing with everyday stress.
7) The best long-range protection against the emergence of your shadow is to develop the use of your fourth function so that you can use it positively.
8) If you undertake stress management programs or techniques, be sure to take type into account.

Chapter 12
The bigger picture:
Why is SuccessTypes plural?

Okay, let's get right to the point — I made SuccessTypes plural because I know that all types can become a SuccessType. This was first addressed by describing how the different type preferences contribute to learning and succeeding in medical school. Then the equal importance of understanding your own preferences was emphasized in order for you to develop the skills to become a SuccessType. The application of these principles produced the SuccessTypes program that was outlined with examples and exercises to help you learn these skills. Now, in this capstone chapter, we will consider the long range implications of learning to become a SuccessType.

Performance measures are moving targets.

As I emphasized earlier, the concept of the SuccessType simply refers to developing the combination of mental habits that predispose a person to perform successfully in *any given situation*. In medical school, this situation is primarily testing with multiple choice examinations during the during the basic sciences courses. During the clinical clerkships and electives the performance measures take into account other skills such as record keeping and interpersonal skills. A study at the Ohio State University School of Medicine showed that extraversion and feeling skills emerged as an important combination to achieve high clinical ratings for both medical expertise and for enthusiastic involvement[1]. If you've come to appreciate the purpose served by each of the type dimensions, it won't surprise you to see that each new setting will draw on the attributes of some type dimensions more than others.

It's not what type you are that's important, it's what you do with your type.

The reason any type can become a SuccessType is that everyone can develop the skills that are associated with each of the type dimensions. Your type doesn't confine you to act or learn in a

[1] See Appendix B for the reference.

certain way, but an *awareness* of your type frees you to draw on the strengths of your preferences and to strengthen your ability to use those opposite to yours. This process of using and developing both the skills of your preferences is called *type development*. Your type has been developing throughout your life because you use your preferences the most. It's like handwriting. Although you can write with both hands, you prefer one over the other. Your preferred hand has become well-developed because you use it almost exclusively. If you have some reason for writing with your off-hand on a regular basis — e.g., you broke your writing arm and it is in a cast — it will develop to the point that it is also useful. As in the handwriting example, if you develop your ability to use the mental skills that are opposite to your type preferences, your thinking will develop in a balanced fashion. This is a conscious attempt at *skill development* since it doesn't refer to a type preference. This balancing of your thinking between your preferences and the skills of their opposites gives you more effective learning and performing. When your thinking is balanced, you can function like a SuccessType in any new situation.

Type is like walking a tightrope...if you're going to make any progress, you have to work at keeping your balance.

You need to believe in your ability to develop the skills of your opposite because, according to Pelley's Profundities that define work and play, it will be hard work. The effort to use the skills of your opposite will compare to the extra effort needed to write with your off-hand. The effort is worth it, though, because each of the type dimensions has skills that can contribute to your success. Furthermore, any aspect of your type that isn't balanced can create a real drag on your effectiveness. This is illustrated in Table 12-1, which shows you how each type dimension performs when it is well-developed compared to when it is underdeveloped. It shows that developing your skills for using each type dimension brings balance to your life.

Opposite types can bring an important dimension to relationships.

Type takes on a whole new significance when you understand what it can mean to your relationships. Contemplate for a moment the importance of your relationships with others. Your

relationships at work can help you get work done better, your relationships at play can help you enjoy your leisure, and your intimate relationship(s) can help you fulfill your basic human needs. These positive outcomes require good communication as a foundation for compatibility. Communication suffers, however, if you don't understand the mutually valid, but different, ways that people view and react to situations. Unless you accept the legitimacy of type preferences, you will tend to see your way of thinking as right and theirs as wrong.

Well-developed type skills		Underdeveloped type skills	
Extraversion	***Introversion***	***Extraversion***	***Introversion***
Active approach	Reflective approach	Hyperactive	Withdrawn & secretive
Bring breadth	Bring depth	Superficial	Overly serious
Sensing	***Intuition***	***Sensing***	***Intuition***
Practical	Imaginative	Slow & dull	Careless
Brings data	Brings perspective	Narrow focus	Impractical & dreamy
Thinking	***Feeling***	***Thinking***	***Feeling***
Analyze situations	Affiliate people	Cold & uncaring	Easily hurt
Bring consistency	Bring harmony	Overly competitive	Overly sentimental
Judging	***Perceiving***	***Judging***	***Perceiving***
Decisive	Inquisitive	Overly opinionated	Indecisive
Bring a plan	Bring options	Controlling	Procrastinating

Table 12-1: Characteristics of each type. Comparison of well-developed skills and underdeveloped skills.

The legitimacy of preferences opposite to yours is illustrated in Table 12-2, which emphasizes what opposites can contribute to each other. An extraverted companion can help bring out the introvert socially, a sensing type friend can bring a practical point of view in order to help the intuitive type avoid irrelevant thinking, a feeling type coworker can help a thinking type take the values of others into account in setting office policy, and a perceptive type colleague can help a judging type see that a decision could be premature without gathering some more information. This brief set of examples illustrates that, when type is taken into account, opposite types help to enrich your relationships and, in the process, they enrich your life.

What the Types Can Offer Each Other

EXTRAVERTS

- Provide the outwardly directed energy needed to move into action.
- Offer responsiveness to what is going on in the environment.
- Have a natural inclination to converse and to network.

INTROVERTS

- Provide the inwardly directed energy needed for focused reflection.
- Offer stability from attending to enduring ideas.
- Have a natural tendency to think and work alone.

SENSING TYPES

- Have a mastery of the facts.
- Bring a knowledge of what materials and resources are available.
- Appreciate knowing and doing what works.

INTUITIVE TYPES

- Know by way of insight and attention to meanings.
- Bring a grasp of what is possible and what the trends are.
- Appreciate doing what hasn't been tried before.

THINKING TYPES

- Take a hard look at the pros and cons of situations, even when they have a personal stake.
- Have an ability to analyze and solve problems.
- Want to discover the "truth" and they naturally notice logical inconsistencies.

FEELING TYPES

- Know what is important to and for people, and adhere to that in the face of opposition.
- Have an ability to build relationships and to be persuasive.
- Want to uncover the greatest "good" in a situation and they notice when people may be harmed.

JUDGING TYPES

- Can organize, plan, and follow through on projects.
- Push to get things settled and decided.
- Appreciate well-oiled efficiency at work.

PERCEIVING TYPES

- Can respond quickly and flexibly to the needs of the moment.
- Strive to keep things open so new information may be gathered.
- Appreciate the need for spontenaity and exploration at work.

From *Looking at Type: The Fundamentals*, page 52, by Charles R. Martin, Ph.D., 1997. Gainesville, FL: Center for Applications of Psychological Type.

Table 12-2: Contribution of opposite types to each other.

I hope this book has helped you become a more effective learner.

In closing, I want to say that it has been fulfilling and exciting for me to pull together and organize the contents of hundreds of conversations that I have had with medical students over the past 35 years. They each taught me a little more with every visit until I had learned enough to compose this book. Along the way, I learned that everyone is doing the best they can with what they've got, and they are always excited when they discover how to do better. I also learned that telling "what" is only part of teaching and that showing "how" completes the cycle. The only thing more exciting than learning ways to improve yourself is helping someone else to do the same. So, if you have found my teaching here useful, please teach it to someone else.

Epilogue

Bernell K. Dalley, Ph.D.

I have been involved in the teaching of medical students for more than 20 years. This experience has included a large number of hours spent in academic and personal counseling of individual students in the throes of the medical school curriculum. I have also served on the medical school admissions council at Texas Tech University Health Sciences Center for more than 20 years. It never ceases to amaze me how homogenous these groups of students appear on application forms in terms of grades, admissions test scores, and other yardsticks used to predict success in medical school. Yet in my experience counseling students, especially those who are experiencing academic experiencing difficulty, I have learned how misleading such "objective" data can be as predictors for success in a demanding curriculum.

Commonly expressed concerns articulated by students in academic difficulty include statements such as, "I don't know how I can spend any more time studying! I am getting by on four or five hours of sleep a night now!" or "When my partner and I were reviewing before the exam, I knew the material better than he/she did, but I did worse on the exam!" Basically, I believe these students are sincere in such statements because they are, for the most part, highly motivated. And, lab partners have often confirmed that a classmate performing poorly seemed to have a better grasp of the information than they did.

Upon hearing laments such as this, my initial response is to say to those students who are not succeeding despite maximum effort, "well, if you can't work harder, then we must figure out a way for you to work smarter." I must admit to feeling some helplessness, even as the words are uttered. Nevertheless, we typically talk about effective use of laboratory time and improving concentration when dealing with reading assignments. We discuss modifying approaches of study, modifying study memory aids, etc. With those who claim to know the material yet seem unable to demonstrate their knowledge on examinations, I counsel them about test-taking skills. In neither case am I entirely happy with the kinds of assistance I offer.

When Dr. Pelley first began talking to me about this book, I realized talking that there are concrete methods for making more effective use of time, and there are study methods based on learning style that provide the means for success even in a demanding curriculum.

I became associated with this project because I have a desire for students to be successful in this accelerated environment; experience tells me the kinds of insights provided in this book will help students become SuccessTypes. Academic failure often causes you to question your ability to be successful. Then you must battle not only the material but also the worry and loss of confidence that interfere with concentration, making a bad situation worse. It is not hard to conclude, then as the proverb goes, that "an ounce of prevention is worth a pound of cure." If you can gain insight into how you learn and how better to be successful in an overstuffed curriculum, then it cannot help but enhance your educational process.

I have discovered in the course of developing my part of this book that I share at least some of the type preferences frequently found in individuals at risk. I also discovered, as I wrestled with developing the anatomy exercises and examples contained in this book, that such insight and training would have been of immense benefit to me as I moved through my own graduate education. One might rightfully argue that I didn't need such training because I was successful, but I would counter that it is difficult to measure reward versus effort after the fact. I assert that my own education would have been more beneficial and pleasant had I been privy to the information and skills development available in this book. To that end, I wish all who take the trouble to "invest" in this book all the best in your endeavors

Appendix A

Descriptions of the 16 Types

Reproduced with permission from *Descriptions of the Sixteen Types* by Gordon D. Lawrence, Ph.D., Center for Applications of Psychological Type, Inc., 1993.

ENTJ

Intuitive, innovative **ORGANIZERS**; analytical, systematic, confident; push to get action on new ideas and challenges. Having extraverted **THINKING** as their strongest mental process, ENTJs are at their best when they can take charge and set things in logical order. They value:

- Analyzing abstract problems, complex situations
- Foresight; pursuing a vision
- Changing, organizing things to fit their vision
- Putting theory into practice, ideas into action
- Working to a plan and schedule
- Initiating, then delegating
- Efficiency; removing obstacles and confusion
- Probing new possibilities
- Holding self and others to high standards
- Having things settled and closed
- Tough-mindedness, directness, task focus
- Objective principles; fairness, justice
- Assertive, direct action
- Intellectual resourcefulness
- Driving toward broad goals along a logical path
- Designing structures and strategies
- Seeking out logical flaws

ESTJ

Fact-minded practical **ORGANIZERS**; assertive, analytical, systematic; push to get things done and working smoothly and efficiently. Having extraverted **THINKING** as their strongest mental process, they are at their best when they can take charge and set things in logical order. They value:

- Results; doing, acting
- Planned, organized work and play
- Common sense practicality
- Consistency; standard procedures
- Concrete, present-day usefulness
- Deciding quickly and logically
- Having things settled and closed
- Rules, objective standards, fairness by the rules
- Task-focused behavior
- Directness, tough-mindedness
- Orderliness; no loose ends
- Systematic structure; efficiency
- Categorizing aspects of their life
- Scheduling and monitoring
- Protecting what works

ISFP

Observant, loyal **HELPERS**; reflective, realistic, empathic, patient with details. Shunning disagreements, they are gentle, reserved, and modest. Having introverted **FEELING** as their strongest mental process, they are at their best when responding to needs of others. They value:

- Personal loyalty; a close, loyal friend
- Finding delight in the moment
- Seeing what needs doing to improve the moment
- Freedom from organizational constraints
- Working individually
- Peace-making behind the scenes
- Attentiveness to feelings
- Harmonious, cooperative work settings
- Spontaneous, hands-on exploration
- Gentle, respectful interactions
- Deeply-held personal beliefs
- Reserved, reflective behavior
- Practical, useful skills and know-how
- Having their work life be fully consistent with deeply-held values
- Showing and receiving appreciation

INFP

Imaginative, independent **HELPERS**; reflective, inquisitive, empathic, loyal to ideals; more tuned to possibilities than practicalities. Having introverted **FEELING** as their strongest mental process, they are at their best when their inner ideals find expression in helping people. They value:

- Harmony in the inner life of ideas
- Harmonious work settings; working individually
- Seeing the big picture possibilities
- Creativity; curiosity, exploring
- Helping people find their potential
- Giving ample time to reflect on decisions
- Adaptability and openness
- Compassion and caring; attention to feelings
- Work that lets them express their idealism
- Gentle, respectful interactions
- An inner compass; being unique
- Showing appreciation and being appreciated
- Ideas, language and writing
- A close, loyal friend
- Perfecting what is important

ESFJ

Practical **HARMONIZERS**, workers-with-people; sociable, orderly, opinionated; conscientious, realistic, and well tuned to the here and now. Having extraverted **FEELING** as their strongest mental process, they are at their best when responsible for winning people's cooperation with personal caring and practical help. They value:

- An active, sociable life, with many relationships
- A concrete, present-day view of life
- Making daily routines into gracious living
- Staying closely tuned to people they care about so as to avoid interpersonal troubles
- Talking out problems cooperatively, caringly
- Approaching problems through rules, authority, standard procedures
- Caring, compassion, and tactfulness
- Helping organizations serve their members well
- Responsiveness to others, and to traditions
- Being prepared, reliable in tangible, daily work
- Loyalty and faithfulness
- Practical skillfulness grounded in experience
- Structured learning in a humane setting

ENFJ

Imaginative **HARMONIZERS**, workers-with-people; expressive, orderly, opinionated, conscientious; curious about new ideas and possibilities. Having extraverted **FEELING** as their strongest mental process, they are at their best when responsible for winning people's cooperation with caring insight into their needs. They value:

- Having a wide circle of relationships
- Having a positive, enthusiastic view of life
- Seeing subtleties in people and interactions
- Understanding others' needs and concerns
- An active, energizing social life
- Seeing possibilities in people
- Thorough follow-through on important projects
- Working on several projects at once
- Caring and imaginative problem solving
- Maintaining relationships to make things work
- Shaping organizations to better serve members
- Sociability and responsiveness
- Structured learning in a humane setting
- Caring, compassion, and tactfulness
- Appreciation as the natural means of encouraging improvements

INTP

Inquisitive **ANALYZERS**; reflective, independent, curious; more interested in organizing ideas than situations or people. Having introverted **THINKING** as their strongest mental process, they are at their best when following their intellectual curiosity, analyzing complexities to find the underlying logical principles. They value:

- A reserved outer life; inner life of logical inquiry
- Pursuing interests in depth, with concentration
- Work and play that is intriguing, not routine
- Being free of emotional issues when working
- Working on problems that respond to detached intuitive analysis and theorizing
- Approaching problems by reframing the obvious
- Complex intellectual mysteries
- Being absorbed in abstract, mental work
- Freedom from organizational constraints
- Independence and non-conformance
- Intellectual quickness, ingenuity, invention
- Competence in the world of ideas
- Spontaneous learning by following curiosity and inspirations

ISTP

Practical **ANALYZERS**; value exactness; more interested in organizing data than situations or people; reflective, cool, and curious observers of life. Having introverted **THINKING** as their strongest mental process, they are at their best when analyzing experience to find the logical order and underlying properties of things. They value:

- A reserved outer life
- Having a concrete, present-day view of life
- Clear, exact facts; a large storehouse of them
- Looking for efficient, least-effort solutions based on experience
- Knowing how mechanical things work
- Pursuing interests in depth, such as hobbies
- Collecting things of interest
- Working on problems that respond to detached, sequential analysis and adaptability
- Freedom from organizational constraints
- Independence and self-management
- Spontaneous hands-on learning experience
- Having useful technical expertise
- Critical analysis as a means to improving things

ESTP

REALISTIC ADAPTERS in the world of material things; good-natured, easy going; oriented to practical, first-hand experience; highly observant of details of things. Having extraverted **SENSING** as their strongest mental process, they are at their best when free to act on impulses, responding to concrete problems that need solving. They value:

- A life of outward, playful action, in the moment
- Being a troubleshooter
- Finding ways to use the existing system
- Clear, concrete, exact facts
- Knowing the way mechanical things work
- Being direct, to the point
- Learning through spontaneous, hands-on action
- Practical action, more than words
- Plunging into new adventures
- Responding to practical needs as they arise
- Seeing the expedient thing and acting on it
- Pursuing immediately useful skills
- Finding fun in their work and sparking others to have fun
- Looking for efficient, least-effort solutions
- Being caught up in enthusiasms

ESFP

REALISTIC ADAPTERS in human relationships; friendly and easy with people, highly observant of their feelings and needs; oriented to practical, first-hand experience. Extraverted **SENSING** being their strongest mental process, they are at their best when free to act on impulses, responding to needs of the here and now. They value:

- An energetic, sociable life, full of friends and fun
- Performing, entertaining, sharing
- Immediately useful skills; practical know-how
- Learning through spontaneous, hands-on action
- Trust and generosity; openness
- Patterning themselves after those they admire
- Concrete, practical knowledge; resourcefulness
- Caring, kindness, support, appreciation
- Freedom from irrelevant rules
- Handling immediate, practical problems, crises
- Seeing tangible realities; least-effort solutions
- Showing and receiving appreciation
- Making the most of the moment; adaptability
- Being caught up in enthusiasms
- Easing and brightening work and play

INFJ

People-oriented **INNOVATORS** of ideas; serious, quietly forceful, and persevering; concerned with work that will help the world and inspire others. Having introverted **INTUITION** as their strongest mental process, they are at their best when caught up in inspiration, envisioning and creating ways to empower self and others to lead more meaningful lives. They value:

- A reserved outer life; spontaneous inner life
- Planning ways to help people improve
- Seeing complexities, hidden meanings
- Understanding others' needs and concerns
- Imaginative ways of saying things
- Purposeful, independent, academic learning
- Reading, writing, imagining; academic theories
- Being restrained in outward actions; purposeful
- Aligning their work with their ideals
- Pursuing and clarifying their ideals
- Taking the long view
- Bringing out the best in others through appreciation
- Finding harmonious solutions to problems
- Being inspired and inspiring others

INTJ

Logical, critical, decisive **INNOVATORS** of ideas; serious, intent, very independent, concerned with organization; determined, often stubborn. With introverted **INTUITION** as their strongest mental process, they are at their best when inspiration turns insights into ideas and plans for improving human knowledge and systems. They value:

- A restrained, organized outer life; a spontaneous, intuitive inner life
- Conceptual skills, theorizing
- Purposeful, independent, academic learning
- Skepticism; critical analysis; objective principles
- Originality, independence of mind
- Intellectual quickness, ingenuity
- Non-emotional tough-mindedness
- Freedom from interference in projects
- Working to a plan and schedule
- Seeing complexities, hidden meanings
- Improving things by finding flaws
- Probing new possibilities; taking the long view
- Pursuing a vision; foresight; conceptualizing
- Getting insights to reframe problems

ENTP

Inventive, analytical **PLANNERS OF CHANGE**; enthusiastic and independent; pursue inspiration with impulsive energy; seek to understand and inspire. Extraverted **INTUITION** being their strongest mental process, they are at their best when caught up in the enthusiasm of a new project and promoting its benefits. They value:

- Conceiving of new things and initiating change
- The surge of inspirations; the pull of emerging possibilities
- Analyzing complexities
- Following their insights, wherever they lead
- Finding meanings behind the facts
- Autonomy, elbow room, openness
- Ingenuity, originality, a fresh perspective
- Mental models and concepts that explain life
- Fair treatment
- Flexibility, adaptability
- Learning through action, variety, and discovery
- Exploring theories and meanings behind events
- Improvising, looking for novel ways
- Work made light by inspiration

ENFP

Warmly enthusiastic **PLANNERS OF CHANGE**; imaginative, individualistic; pursue inspiration with impulsive energy; seek to understand and inspire others. With extraverted **INTUITION** as the strongest mental process, they are at their best when caught in the enthusiasm of a project, sparking others to see its benefits. They value:

- The surge of inspirations; the pull of emerging possibilities
- A life of variety, people, warm relationships
- Following their insights wherever they lead
- Finding meanings behind the facts
- Creativity, originality, a fresh perspective
- An optimistic, positive, enthusiastic view of life
- Flexibility and openness
- Exploring, devising, and trying out new things
- Open-ended opportunities and options
- Freedom from the requirement of being practical
- Learning through action, variety, and discovery
- A belief that any obstacles can be overcome
- A focus on people's potentials
- Brainstorming to solve problems
- Work made light and playful by inspiration

ISFJ

Sympathetic **MANAGERS OF FACTS AND DETAILS**, concerned with people's welfare; stable, conservative, dependable, painstaking, systematic. Having introverted **SENSING** as their strongest mental process, they are at their best when using their sensible intelligence and practical skills to help others in tangible ways. They value:

- Preserving, enjoying the things of proven value
- Steady, sequential work yielding reliable results
- A controlled, orderly outer life
- Patient, persistent attention to basic needs
- Following a sensible path, based on experience
- A rich memory for concrete facts
- Loyalty; strong relationships
- Consistency, familiarity, the tried and true
- First-hand experience of what is important
- Compassion, kindness, caring
- Working to a plan and schedule
- Learning through planned, sequential teaching
- Set routines, common sense options
- Rules, authority, set procedures
- Hard work, perseverance

ISTJ

Analytical **MANAGER OF FACTS AND DETAILS**; dependable, conservative, systematic, painstaking, decisive, stable. Having introverted **SENSING** as their strongest mental process, they are at their best when charged with organizing and maintaining data and material important to others and to themselves. They value:

- Steady, systematic work that yields reliable results
- A controlled outer life grounded in the present
- Following a sensible path, based on experience
- Concrete, exact, immediately useful facts, skills
- Consistency, familiarity, the tried and true
- A concrete, present-day view of life
- Working to a plan and schedule
- Preserving and enjoying things of proven value
- Proven systems, common sense options
- Freedom from emotionality in deciding things
- Learning through planned, sequential teaching
- Skepticism; wanting to read the fine print first
- A focus on hard work, perseverance
- Quiet, logical, detached problem solving
- Serious and focused work and play

Appendix B

Works Cited, Recommended Resources (by chapter), and Web Sites.

Works Cited

1) Bjork, R. A. Information-processing analysis of college teaching. Educational Psychologist, 1979, **14**: 15-23.
2) Bransford, J. D., and Johnson, M. K. Contextual prerequisites for understanding: Some investigations of comprehension and recall. Journal of Verbal Learning and Verbal Behavior, 1972,**61**: 717-726.
3) McCaulley, M. H. Application of the Myers-Briggs Type Indicator to medicine and other health professions (Monograph 1), 1978, Gainesville, FL: Center for Applications of Psychological Type.

Recommended Resources

Chapter 1, *Getting off to a good start.*

Where to take the MBTI

1) The Center for Application of Psychological Type in Gainesville, Florida, or the Association for Psychological Type International (see under Chapter 4 resources) may be able to assist you.
2) If you are enrolled at a college or university, the Office of Student Affairs or a college-sponsored counseling service should have professional staff on hand that are qualified to administer and interpret the Myers-Briggs Type Indicator.
3) Many members of the clergy are qualified to administer and interpret the Myers-Briggs Type Indicator as a part of their role in marriage counseling.
4) A practicing counseling psychologist should be able to help you in identifying your type.

Chapter 2, *The SuccessTypes Concept: Why is Psychological type relevant?*

1) Myers, I. B., and McCaulley, M. H. MBTI Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator, Consulting Psychologists Press, 1985.

The contribution of each mental function to learning and academic performance is illustrated with research data in Chapter 8, "Uses of Type in Education." This chapter has additional information on the performance of students in other fields such as business, engineering, and law.

Chapter 3, *Psychological types: Which of the preferences best describes you?*

1) Lawrence, G. *People Types and Tiger Stripes*, Center for Applications of Psychological Type, Inc., 1995.

This book is one of the most thorough and approachable treatments of psychological type available. It is loaded with very important cautions and explanations in the use of type theory. It is the reference I turn to first.

2) Myers, I. B., and Myers, P. B. *Gifts Differing*, Consulting Psychologists Press, Inc., 1980.

This is Isabel Myers' classic description of psychological type. The positive and supportive approach to the reader reflects her dedication to helping people feel better, not only about themselves, but about each other. This book and People Types and Tiger Stripes form the core of my reference library on type theory.

Chapter 4, *Putting it all together: Your type is greater than the sum of its parts.*

Catalogs offering books on communications, career strategies, team building, leadership, and religion can be obtained from:

1. The Center for Applications of Psychological Type, Inc.
   Gainesville, FL
   800-777-2278
   http://www.capt.org/
2. Consulting Psychologists Press, Inc.
   Palo Alto, CA
   800-624-1765
   http://www.cpp.com/

If you are looking for a way to get more actively involved in the applications of psychological type, you may want to consider a membership in the Association for Psychological Type International. You can reach them at http://www.aptinternational.org/.

Chapter 6, *Basic requirements for success on MCQs: Is your mind in gear?*

1) Adler, M., and Van Doren, C. *How to Read a Book*, Simon and Schuster, 1972.

This is a classic guide to reading different kinds of materials with a discussion of different levels of reading.

2) Zull, J., *The Art of Changing the Brain*, Stylus Publishing, 2002.

This book is currently the best and most accessible compilation of information on how the brain executes learning cycles based on Kolb's experiential model of learning. This sequence of experience, reflection, abstraction, and action correlates with the functional specialization of the different areas of the brain. The reader will emerge with an understanding of both long and short term memory and with a deeper understanding of how active learning is the only way to produce effective learning.

Chapter 7, *Concept maps develop both intuitive skills and sensing skills.*

1) Buzan, T. Use Both Sides of Your Brain, E. P. Dutton, 1983.

This is one of Tony Buzan's books on mindmapping. He emphasizes an application of knowledge about hemispheric specialization of the brain to memory, problem solving, and effective study.

Software for concept mapping.

The Institute for Human and Machine Cognition, http://www.ihmc.us/, is currently the "center of the concept mapping universe" since it was founded by Joseph Novak, the originator of the concept mapping method and its underlying theory. You will find a free downloadable concept mapping program, Cmap Tools (http://cmap.ihmc.us/), that is easy to use, yet highly sophisticated.

Source material for concept mapping examples and exercises

1) Pelley, J. *Biochemistry: Mosby's USMLE Step I Reviews*, Mosby—Yearbook, Inc., 1997.
2) Moore, N. *Anatomy: Mosby's USMLE Step I Reviews*, Mosby—Yearbook, Inc., 1997.
3) Burns, E., and Cave, M. *Histology and Cell Biology: Mosby's USMLE Step I Reviews*, Mosby—Yearbook, Inc., 1996.

These books are out of print, but they have been replaced with the Rapid Review Series, now in its second edition, published by Elsevier.

Chapter 10, *Time management can have built-in flexibility.*

1) Bliss, F. C. *Getting Things Done*, Bantam Books, Inc., 1976.

This is a very easy-to-read book with short, thought-provoking chapters. Bliss gets to the point quickly with entertaining examples and anecdotes.

Chapter 11, *How, do you cope with stress?... Your shadow knows.*

1) Quenk, Naomi. *Beside Ourselves*, Consulting Psychologists Press, Inc., 1993.

If you want to extend your understanding of stress beyond that in Chapter 11, this book is required reading. Naomi Quenk organizes the discussion around each psychological type and includes examples of the specific kinds of stress that trigger the fourth function in each of the different psychological types. Understanding your own stress response can be a good route toward overall type development.

2) Benson, H. *The Relaxation Response*, William Morrow and Company, Inc., 1975.

This book is a fundamental reference for those interested in coping with stress. It is an easy and interesting way to understand and cope with the physiologic response to stress. Benson provides a method for mental relaxation that I use every morning.

3) Provost, Judy A. *Work, Play, and Type*, Davies-Black Publishing, 1990.

Judy Provost expands the concept of developing all aspects of type through play. She shows how to take advantage of type theory to have more satisfaction at work and at play. I could have referenced this book under Chapter 12 as well since it is such a good treatment of the topic of type development.

Chapter 12, *The bigger picture: Why is SuccessTypes plural?*

1) Gallwey, W. T. *The Inner Game of' Tennis*, Bantam Books, Inc., 1974.

Don't let the title fool you! This book may have originally been written with tennis in mind, but it's really a book about the effect of your thinking on your performance in everyday life. You will find that the discussion will apply just as well to work- or school-related performance, or to performance in another sport. The last chapter is my favorite and it inspired my own approach to the last chapter of *SuccessTypes*.