

The background is a dark blue field with large, overlapping geometric shapes in red, orange, and green. Scattered throughout are various medical icons: colorful capsules (red, yellow, green, blue), a large blue syringe on the right, and several small vials or bottles in blue, orange, and green. The title is prominently displayed in the upper half.

PHARMACOLOGY *and the* **NURSING PROCESS**

**Lilley
Aucker
Albanese**

PHARMACOLOGY *and the* NURSING PROCESS

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A NOTE TO THE READER:

The author and publisher have made every attempt to check dosages and nursing content for accuracy. Because the science of pharmacology is continually advancing, our knowledge base continues to expand. Therefore we recommend that the reader always check product information for changes in dosage or administration before administering any medication. This is particularly important with new or rarely used drugs.

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PHARMACOLOGY
and the
NURSING PROCESS

Preface

INTRODUCTION

Pharmacology and the Nursing Process provides the most up-to-date, clinically relevant information on pharmacology and nursing in an appealing, understandable, and practical format. This text's accessible size, readable writing style, and full-color design are ideal for today's busy nursing student. A unique approach to the study of pharmacology is taken by presenting study skills content that will help students understand and learn the particularly demanding subject of pharmacology. The text begins with Chapter 1: Study Skills. In addition, each part begins with a Study Skills Brief, which features a discussion of researched and proven study skills and applies that discussion to content in the part. Students are therefore encouraged to use research-based study skills to enhance their study of the subject of pharmacology.

MARKET RESEARCH

This text has incorporated many suggestions by focus group participants in the early 1990s. These focus groups, composed of nursing instructors from two-, three-, and four-year degree programs in Chicago, Philadelphia, and Los Angeles, assessed changes that have occurred in the teaching of pharmacology and determined what was needed to better teach pharmacology to nursing students. Based on faculty descriptions of their courses and students, these general recommendations were made:

- Accommodate the reading styles and abilities of the growing number of non-traditional nursing students.
- Increase the use of tables, illustrations, graphs, and other visually-oriented approaches.
- Utilize color to increase interest and highlight important drug interactions and processes.

We have taken a truly collaborative approach with this new text. The concerns raised by faculty in market research have been addressed, as have several additional improvements suggested by faculty who served as reviewers or consultants, either formally or informally, throughout the manuscript's development, and by the authors and editors of this text.

ORGANIZATION

The book includes 55 chapters presented in 11 parts organized by body system. The seven concepts chapters in Part 1 lay a solid foundation for the subsequent drug units and address the following topics:

- Study skills applied to learning pharmacology
- The nurse's role in pharmacotherapeutics
- Pharmacologic principles
- Neonatal, pediatric, and geriatric considerations related to pharmacology
- Legal, ethical, and cultural considerations
- Math calculations
- Photo atlas of medication administration techniques

Parts 2 through 11 present pharmacology and nursing management in a traditional *body systems/drug function framework*. This accepted approach facilitates learning by grouping functionally related drugs and drug groups. It provides an effective means to integrate the content into medical-surgical or adult health nursing courses or for teaching pharmacology in a separate course.

The 48 drug chapters in these parts constitute the main part of the book. Drugs are presented in a *consistent format*, with an emphasis on drug groups and key similarities and differences among the drugs in each group. Each chapter is subdivided into two discussions, beginning with a complete, clear discussion of pharmacology, followed by a comprehensive yet succinct discussion of the nursing process. *Pharmacology* is presented for each drug group in a consistent format:

- Mechanism of action
- Drug effects
- Therapeutic uses
- Side effects
- Contraindications (when appropriate)
- Toxicity/management of overdose (when appropriate)
- Interactions
- Dosages

Drug group discussions are followed by *Drug Profiles*, or brief narrative capsules of individual drugs in the class or group with pharmacokinetics tables for each drug. *Key drugs*, or prototypical drugs within a class,

are identified with a ↓ symbol for easy identification. These individual drug profiles are followed by *Nursing Process* discussions, which relate to the entire drug group and are also covered in a functional, six-step nursing process format of:

- Assessment
- Nursing diagnosis
- Planning
- Outcome criteria
- Implementation
- Evaluation

Each nursing process section provides a *Patient Teaching Tips* box that summarizes key points to cover in educating the patient about uses and effects of drugs within a given group. Because the role of the nurse as patient educator will continue to grow in importance, we have given an emphasis to this key content.

Each part begins with a *Study Skills Brief* that presents a study skills topic, such as time management, note taking, studying, and test taking, and relates it to the unit being discussed. This unique approach to teaching pharmacology is intended to aid those students who find pharmacology difficult and to provide a tool that may prove beneficial in their entire nursing school careers. Coverage of this study skills content is limited to Chapter 1 and the beginning of each part so that instructors who choose not to require their students to read this material can readily eliminate it. However, this arrangement of content may be very beneficial to those faculty teaching pharmacology through an integrated approach, as it helps the student identify key context and concepts. This arrangement also facilitates locating the content for either required or optional reading.

FEATURES

This book features numerous *pedagogic features* that prepare the student for important content to be covered in each chapter and encourage review and reinforcement of that content. Pedagogy that begins each chapter includes:

- Learning objectives
- Chapter outline
- Glossaries of key terms with pronunciations, definitions, and page-number references

Each chapter concludes with *Take Home Points* that summarize key points subdivided by key topic, drug group, or nursing management, and *Critical Thinking Activities* that provide a variety of exercises to address different learning needs or styles. These exercises include critical thinking questions, multiple-choice questions, NCLEX-review questions, detailed case studies, and minicases.

Special topics have been highlighted for emphasis. *Special-emphasis boxes* include:

- Cultural implications
- Legal and ethical implications
- Research issues
- Home health, issues
- Lifespan considerations, with separate boxes on neonatal, pediatric, and geriatric issues

COLOR

This is the first full-color pharmacology text for nursing students. Faculty suggested that color be used in both a functionally and visually appealing manner to more fully engage students in this typically demanding yet important content. We have used *full color throughout* to:

- Highlight important content
- Illustrate how drugs work in the body in over 95 newly developed anatomic and drug process color figures
- Improve the visual appearance of the content to make it more engaging and appealing to today's more visually sophisticated reader

We believe the use of color in this approach will significantly improve students' involvement and understanding of pharmacology.

ANCILLARY PACKAGE

A carefully prepared ancillary package is available to instructors who adopt *Pharmacology and the Nursing Process*. These materials can significantly assist teaching and learning. The package and its features are:

INSTRUCTOR'S RESOURCE MANUAL AND TEST BANK INSTRUCTOR'S MANUAL SECTION

- Chapter Overview
- Key Terms
- Chapter Outline
- Teaching Strategies
- Worksheet Answers
- Answers to the Text's Critical Thinking Activities
- How to Teach Pharmacology in an Integrated Curriculum
- Disorders Index

A duplication of the disorders index in the text, for your convenience

TEST BANK SECTION

- Over 300 NCLEX-type questions, coded for cognitive level

**PHARMACOLOGY
STUDY MANUAL**

- Study skills chapter
 - Reinforces study skills discussed in the text
 - Allows practice in analyzing tests and applying test-taking strategies
- Worksheets from the *Instructor's Resource Manual*
- Perforated and three-hole punched for convenience

**TRANSPARENCY
ACETATE PACKAGE**

- Contains 36 completely updated color illustrations
- Includes approximately 10 medication administration illustrations in full color

**PHARMACOLOGY NEWSLETTER:
MOSBY'S PHARMACOLOGY
UPDATE**

- A biannual publication of new drugs, drug news, feature articles, *and more!*

**PHARMACOLOGY
LECTURE VIDEO**

- Discusses the *Five Rights of Drug Administration*
- Available to qualified adopters

We hope that we have provided the best teaching tools to help instructors' use their time most effectively both inside and outside the classroom. Our goal is to provide the resources needed to encourage student participation in the learning process and reinforce key content related to nursing pharmacology.

Acknowledgments

As mentioned earlier, this book has been truly a collaborative effort. We wish to thank the following instructors who provided input on an on-going basis throughout the development of this project: Donna Babao, RN, MSN; Pam Blake, RN, BSN, MSN; Sherry Currie, MSN; Janet Hicks Keen, RN, MS(N), CEN, CCRN; Lori A. Martell, PhD; Kathryn Moore, MEd; Mike Otto, PharmD, BCPS; Carolyn Smith Powell, ADN, BSN, MSN; Carol Ruscin, RN, BS, MSN; Sandra Mason Spengler, RN, BSN, MSN; Janice Traylor, MEd, MS, RN; Thomas Worms, MSN; and Bonnie Young, RN, MSN.

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Linda would like to thank her husband Les, for his constant support and words of encouragement, and

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Finally, to those who teach, although your work may seem to go unnoticed or unappreciated, your impact will always be remembered in the accomplishments of your students. Your inspiration and motivation shapes the future.

We welcome comments from instructors and students who use this book so that we may continue to make improvements and be responsive to your needs in future editions. Please send any comments you may have in care of the publisher.

Linda Lane Lilley, RN, MS
Robert S. Aucker, PharmD
Joseph A. Albanese, RPh, PhD

PART 1

PHARMACOLOGY BASICS: STUDY SKILLS BRIEF

This section will offer some specific examples for selected chapters in Part 1 to help you apply the study techniques and strategies from Chapter 1.

PURR, CHAPTER 1

Before beginning to apply the PURR text study model a quick overview of the steps might be useful. (For a more detailed explanation see Chapter 1.) The plan consists of four steps that will help to make you an active reader and an effective learner.

- **P** stands for Plan. This step is a prereading operation. Look at chapter objectives, chapter outline, and glossary, and read only the highlighted segments of the chapter body. As you do this you should be turning these elements into a series of questions. These questions will be essential in the next step.
- **U** stands for Understand. This is the second step, and the one in which concentrated learning and study take place. Read the chapter carefully and thoughtfully. Use the information gathered in the

Plan step to activate your brain. The questions you generated in Plan are those that you are attempting to answer as you read.

- **R** The first R is for Rehearse. Practice what you have learned in the first

two steps. Ask questions aloud. Attempt to answer those questions aloud. The idea is to practice what

you have learned soon after the reading. This reinforces learning and helps to identify what you will need to return to for mastery.

- **R** The second R (and final step) is Review. Within 24 to 48 hours after going through the P, U, and R steps, you must review material. Mastery, whether it is in a skill such as ice skating or an intellectual process such as learning nursing pharmacology, takes review and more review. In the PURR model, Review is the final step and should be repeated as often as needed. Review is done in the same way as rehearsal with the addition of some rereading. Ask questions, attempt to answer the questions, and when an answer is not forthcoming or is vague and unclear, then reread the needed portions of the text.

Plan

As you begin to work with individual chapters, consider how the first step in the PURR system can be used to help you set a purpose and become an active learner.

Chapter 2, Objectives

Consider Objective 1. *List the four phases of the nursing process.*

Now turn the objective into a question.

Objective 1 as a question: *What are the four phases of the nursing process?*

Now move to Objective 2 and make it a question. *What is/are the function and/or purposes of the nursing process?* Note that this question relates directly to Ob-

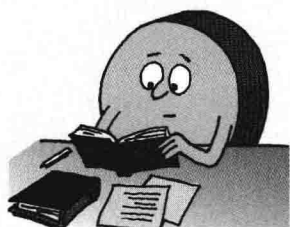


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jective 1. By putting Objective 2 into a question format you will begin to expand and extend on the focus of the first objective and you will begin to focus on active learning with a clear purpose.

Move to the Chapter 2 outline. You should notice that the outline contains the answer to your first question. The four topic headings (Assessment, Nursing Diagnoses, Planning, and Implementation) are the four phases of the nursing process. In almost no time you have begun to learn from the chapter and to achieve the objectives set out for you. This is the value of using PURR as a technique for study. The questions focus your attention on the concepts, facts, and terms which are stressed by the author.

When you begin to read Chapter 2 you will discover that the four phases are repeated as topic headings and you have the Objective 2 question to focus your reading. Begin now to develop the habit of applying this strategy to the objectives in every chapter assigned before you begin to read. Remember to look at the chapter outline at this point as well. It is amazing how much can be learned by using the text structures provided.

VOCABULARY DEVELOPMENT

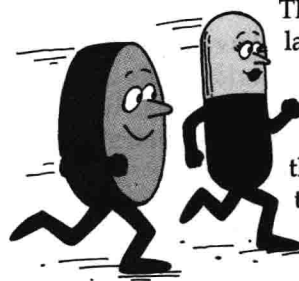
Objective 1 makes an important point. "Define common terms used in pharmacology." Success depends

heavily on knowledge of the "language." The objective makes it clear that this chapter contains a number of terms that the author views as important to be mastered. This is only Chapter 3 and now is the time to begin

to really apply yourself to mastering the language of this content. Look at the glossary. There are four terms that share the common element of "pharmaco-." While each of these four words will have different meanings, they will also have something in common. *Pharmaco-* is an example of a group word. No matter what prefixes, group words, and/or suffixes are added to it, a part of the meaning of any word containing *pharmaco-* will be drug or medicine. Look up *pharmaco-* in any dictionary and you will find drug or medicine to be the definition. (I used *The American Heritage Dictionary*.) Of course, you already knew that, but it is always ben-

eficial to start working on a new technique with something that is familiar. Look at the four words which begin *pharmaco-* and consider the rest of the word.

-dynamics -genetics -gnosy -kinetics
What do each of these word parts mean? The meaning of *pharmacodynamics* is simply the combination of the meaning of *pharmaco-* and *-dynamics*. The definition, according to the glossary is, "The study of the biochemical and physiologic interactions of drug action." You could simply memorize this definition which would seem to accomplish Objective 1. But memorization does not always equal understanding. Let's try another approach. What does "dynamics" mean.



Think about the word and relate it to your own experience and background. It appears to deal with movement or action. After looking it up in the dictionary, I find that all the meanings given seem to relate in some fashion to the idea of motion and/or action.

A simplistic definition of *pharmacodynamics* would be drugs in action. Certainly this is not a technical or medical definition, but it contributes a great deal to an understanding of the definition provided in the glossary. This is the object of learning vocabulary. Do not memorize words without understanding. Apply a little thought and relate the term and definition in a way that makes the meaning personal for you. When you do that you will find that you understand the glossary definition better, and your ability to retain the meaning will be significantly improved. This means that the test item that asks you to select the definition for *pharmacodynamics* from a list of similar definitions will be much easier, because you will remember action and movement and look for the choice which best represents that concept.

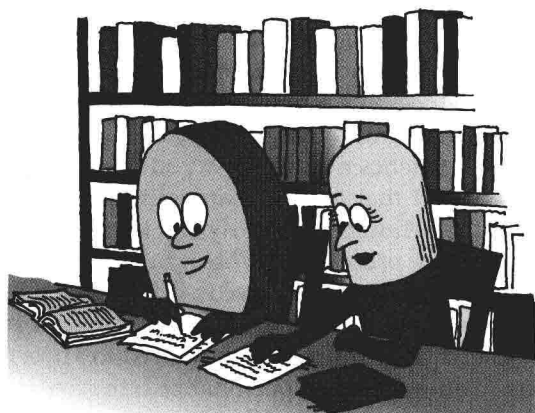
Apply this same strategy to genetics. You already know what genetics means. Now you must determine how to connect that to the meaning in the text. After you have the definitions of *gnosy* and *kinetics*, you can apply the same procedure. When you have done this to all four words you will discover that you will not need to spend a great amount of time trying to memorize esoteric (look it up, it's a fun word to know) definitions. You will have personalized the meanings. Those meanings will stay with you much more readily than those learned by rote memorization. By the way, do you know what *biochemical* and *physiologic* mean? These terms are used in the glossary definition of *pharmacodynamics*. You need to know what they mean to fully understand *pharmacodynamics*.

Chapter 1

Study Skills

INTRODUCTION

What to study? When to study? How much to study? How to study? In the best of worlds every student would have all the skills necessary to be effective in all academic areas. Unfortunately, many students do not know how to study effectively or have developed techniques that work well in some circumstances but not in others. The purpose of this chapter is to introduce you to the steps to follow in learning text and maintain focus on the appropriate material. Extensive study skills covering time management, note-taking, mastering the text, preparing for and taking examinations, and developing vocabulary are presented in the *Study Skills Manual* that accompanies the text. These tools are important to any student, but in a challenging technical area such as nursing and pharmacology, they become even more valuable. The techniques described here and in the *Study Skills Manual* will not necessarily make learning easy, but they will help you to achieve your goals as a student.



There is some good news and some bad news about PURR. The bad news is that it requires your going through every chapter four times. I can hear the screams at this point, but hang on because the good news is that you are not going to actually *read* the chapter four times. You are only going to *go through* it four times. Only one of those times is a slow, careful, intensive reading. The other trips through the chapter are much quicker. In fact, the first time you go through the chapter should only take 5 or 10 minutes. Each time you go through the chapter, you are processing the information in distinctly different ways. The PURR approach will really enhance your learning, and if you use it from the first assignment on, I know you will find in the end that it takes you less time to learn what you must than you were spending before you adopted the PURR approach.

Prepare

Reading the text, like any complex process, is not something to leap into without thought and planning. *Pharmacology and the Nursing Process* is organized to really help you learn the material, but you have to take advantage of what the authors have done for you to facilitate this. Preparing to read means setting goals and objectives for your own learning, but the tools you need to do this are already in place. Look at the opening pages of any chapter in the text and you will see a standard structure.

Every chapter begins with a **title**. Learn to use the title as the first step in preparing to learn. Chapter 4 is entitled "Neonatal, Pediatric, and Geriatric Considerations." This instantly identifies what the chapter is about. Don't immediately start reading; instead think about the title for a few seconds. Are there any unfam-

PURR

PURR is a handy mnemonic device representing a four-step process that will lead to mastery of material, and these steps are to:

- Prepare
- Understand
- Rehearse
- Review

miliar terms? If your answer is “no,” great!! If it is “yes,” then you already have some focus for your reading because you know you will need to learn this unfamiliar term, or terms, and its meaning.

The next feature of every chapter are the **objectives**. You need objectives for learning, and the authors have anticipated this. Read the objectives, *actively*. Don’t just look at the words, think about the objectives. Ask yourself the following questions: What do I already know about this material? How do these objectives relate to earlier assignments? How do they relate to objectives the instructor has given? The chapter objectives identify things you should be able to do after you have read the material. Don’t wait until you have read the chapter to start trying to respond. *Prepare* means getting the brain engaged from the very beginning. Studying the chapter objectives establishes a direction and purpose for your reading. This will enable you to maintain your concentration and focus while you read.

The **chapter outline** shows the major points to be covered. Study it and notice the major headings (topics) and the indented headings (subtopics). This is essentially a picture of the chapter, and using the picture is an essential step in preparing to read. As you read the chapter outline, turn the topic and subtopics into a series of questions that you want to be able to answer when you finish reading. Think about the objectives and how these headings relate to them. Finally, in the outline of chapters devoted to specific classes of agents, notice there are elements that are common to every one. The last two headings are always “Implementation” and “Evaluation.” This tells you that these are two common elements you will be expected to know at the end of every chapter. The minutes you spend *preparing* will pay off in a big way when you start to read.

The last feature in the opening pages of each chapter is the **glossary**. This is one of the most valuable tools the authors have provided. They know there are many terms to learn and are giving you a head start on learning them. Spend a few minutes with the glossary. Notice the terms that are also used in the chapter objectives and outline. Go back and look at the objectives and outline and think about what you have learned just from the glossary. As you study the glossary, look for shared root words, prefixes, or suffixes. If words share such common word elements, this means that these words also have a shared meaning. Learning the meaning of common word elements can really simplify the whole process of learning vocabulary. Perhaps you remember in grade school being told to “look for the little words in the big word.” This is essentially the same technique—one that worked then and one that will work now.

Now make a quick pass through the chapter or the

assigned pages from the chapter. Focus on the text conventions, which are described later in this chapter. Look for anything that stands out in the chapter, such as boldfaced text, boxed material, and tables. This provides a quick overview of the chapter, which will make the next steps in the PURR process much more effective and efficient.

Preparing makes the whole approach to learning an active one. It may not make the chapters the most exciting reading you will ever do, but it will help you to accomplish your personal learning objectives as well as those set by the authors.

On-the-Run Action. Preparing is great to do during “found” time. It should not take more than 5 or 10 minutes. Time between classes, time spent waiting for the coffee water to boil, or any other small block of time that usually just slips away can be used to accomplish this step.



Understand

The time has now come to read the assignment. Go to your desk, the library, or wherever it is you have chosen for serious study. Reading the assignment is where all your preparation pays off. If you did the “Prepare” step earlier in the day, it is not a bad idea to spend a minute or two going through the chapter features again to get your focus. As you read the assignment, remember the chapter objectives and notice the chapter outline headings repeated in the body of the chapter. As you read, rephrase the headings as questions to help keep you focused on the task at hand. Because this is the first time you are really homing in on the concepts and the details, this is not the time to do any of the text notations. Read and, as you read, think. Terms from the glossary are repeated and their meanings often expanded and clarified in the body of the text. Pay attention to these terms as you read. Think about what they mean and how you would define them to someone else. Read for meaning. Read to *understand*. Don’t read just to get to the end of the assignment. That is a passive action. Ask yourself questions. Analyze, respond, and react as you read.

Often reading assignments are too long to be read with complete understanding in one session. If you find your concentration is flagging or you don't remember anything you read on the previous page, it is time to take a break. All too often students have only one objective—to finish the assignment. You might be able to force yourself to keep on reading, but you won't learn much. Mark your place and take a 5- or 10-minute break. Take a walk, read the daily comic strips, get a soda or a cup of coffee, and then go back to reading. When you come back to the assignment, spend the first 3 or 4 minutes reviewing. Look back at the previous chapter heading and think about what you were reading before the break. The chapter can be broken down into many small reading sessions, but it is critical that you don't lose sight of the chapter as a whole. Spending these minutes in review may seem like time that could be better spent continuing with the reading, but this quick review will save time in the long run.

There is no quick way to read a chapter. You won't find an "on-the-run action" for this step because it can't be done in this way. But, if you do the "Prepare" step first, you will be surprised at how much more easily you get the reading done and how much more learning you have achieved in the process.

Rehearse

Rehearsing is the third step in the process. It starts the process of consolidating your learning and establishing a basis for long-term memory. Rehearsal accomplishes two things. First, it helps you find out what you understand from the reading. Knowing what you know is really important. Second, it identifies what you don't understand, and this may be an even more important benefit. Knowing what you don't know before it comes to light during an exam is critical.

How to Rehearse. Everything you do in the "Prepare" and "Understand" steps comes into play in the "Rehearse" step. Rehearsal should begin with the features at the beginning of the chapter. Open the text to the beginning of the chapter. Start with the chapter title and begin to quiz yourself on what you have read. Compose three or four questions pertaining to the chapter title, and then try to answer them to your satisfaction. The questions you ask yourself should be

both literal, asking for specific information presented in the chapter, and interpretive, testing your comprehension of concepts and relationships. An example of a literal question using the Chapter 4 title might be: "What are the definitions of 'neonatal,' 'pediatric,' and 'geriatric'?" This question would help you determine whether you can satisfactorily define these terms in your own words. Asking and answering such questions as this always serves to move learning from short-term to long-term memory. Literal questions are very important to help you grasp the factual information and terminology contained in the reading assignment. However, it is also necessary to ask questions that stimulate thought about the concepts and the relationships between the facts and concepts presented in the chapter. An example of an interpretive question regarding the Chapter 4 title might be: "What is the most important concept pertaining to the use of drugs in neonatal, pediatric, and geriatric patients?" Sometimes you will find that, even though the question is interpretive, the authors have anticipated the question and the text does contain the direct answer to your question. Other times you will need to formulate your own response by pulling together bits and pieces of information from the entire reading assignment.

Once you have exhausted the question potential for the chapter title, move on to the chapter objectives. Use the same process here. Rephrase the objectives as questions and try to answer them. Remember the object of rehearsal is to reinforce what you have learned and to identify areas where you need to spend additional time (review).

Skip the chapter outline and go to the glossary. Cover the definitions and try to define each term in your own words. Or cover the term and on the basis of the definition name the term. Don't just memorize the definition, because you may find the information presented differently on an exam and you will then be unable to respond.

Now proceed to the chapter or assigned pages. The chapter headings, the same headings as in the chapter outline, are the main tools for rehearsal. Apply the same question-and-answer technique used for the title and objectives to test what you may already know about the chapter content. Turn the headings into questions and answer them. Look at the text for bold-faced and italicized items, lists, and other text conventions. These too can become the basis for questions. The tables and diagrams should also be used for this purpose. Keep in mind the importance of asking both literal and interpretive questions. Some of the questions you ask yourself should also tie different topic headings together. Ask yourself how topic A relates to topic B.

As you proceed through the chapter, don't worry if you can't answer the questions you ask. As stated



earlier, one of the goals of the rehearsal process is to identify what you need to spend more time on. If you can give no response to a particular question, put a mark in the margin of the pertinent place in the text to remind yourself to come back and spend more time on this material, but move on at this point. Rehearsal should be a relatively quick procedure. Once you become accustomed to the PURR method, it should take no more than 15 or 20 minutes to rehearse 15 pages after doing the “Prepare” and “Understand” steps.



As you reach the end of the chapter, skim the “Implementation” and “Evaluation” sections. Make sure that the relationship between these sections and the information in the rest of the chapter is clear. If you have questions or concerns, note them in the margins and ask your instructor to clarify these points. Although the objective is to master the chapter content as an independent learner, sometimes it is essential to ask questions of the instructor to facilitate the process.

When to Rehearse. Ideally rehearsal should take place almost immediately after you finish reading the material. Take a 10- to 15-minute break, and then start the process. The longer the gap between reading and rehearsal, the more you will forget and the longer it will take to rehearse. If you are breaking a reading assignment down into smaller segments, do the rehearsal for each segment before you begin reading the new material. This helps to maintain the sense of continuity in the chapter. I know this seems like a lot of work to do in a study session, but with practice it will go quickly and you will be pleasantly surprised at the quality and quantity of your learning.

Review

The review aspect is the fourth and final step in the PURR process, and it is an essential step. No matter how well you have learned material in the preceding steps, forgetting will always occur. Reviewing is the only way to really store what you have learned in long-term memory. The good news is that, using the PURR model, the review can be done for small segments of material and can be done relatively quickly.

How to Review. The basic review process is essentially the same as the rehearsal process, with some limited rereading the one difference. When you cannot

immediately answer a question, read the pertinent material again. *This does not mean you should read the entire chapter again.* Often the answer to the question will pop into your mind after you’ve read only a few lines. When this happens, stop reading and go back to responding to your question. The idea is to reread only as much material as is necessary to make the answer clear. One or two words or one or two sentences may trigger personal recall, but it may also take two or three paragraphs for this to happen.

Frequency of Review. How many times should you review material in this way? This actually depends on many factors, such as the difficulty of the material, the length of the assignment, and your personal background. Only you can determine how often you need to review, but there are some guidelines that will help you decide this for yourself.

First, consider the difficulty of the material. If it is very complex, contains many new terms and difficult concepts, and seems difficult to grasp, then you should review very frequently. On the other hand, if the material is straightforward and you are able to relate it well to what you’ve already learned, then less frequent reviews will serve to keep the material in your memory.

Second, consider how well the review went. If you had difficulty answering many questions to your satisfaction or had to do a lot of rereading, you should schedule another review soon (a day or two later at most).

The success of each review session should be used to help you determine when to schedule another session. The review step is a means of monitoring the success of the learning process. If reviews go well, limited rereading is necessary, and you are able to give clear answers to your questions, this tells you that you can wait several days (four or five) before reviewing this material again. A so-so review, more extensive rereading, and poor answers indicate you should only let 2 or 3 days go by before reviewing the material again. If the review goes very poorly, you should plan to review the material again the next day. It is up to you to judge the success of each review and to decide how often you need to review. The nice thing about PURR is that it enables you to monitor your own success and to easily regulate the learning process.

Technique for Rehearsal and Review. Both rehearsal and review foster active learning, which helps you maintain interest in the material and strengthens your memory. For these benefits to occur, it is essential that the review and rehearsal processes be done orally. Simply talk aloud as you go through the material. Ask questions and give your answers out loud. This forces you to really think about the material. It helps you to organize it and to translate it into your own words. The object is not to memorize everything you have