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in

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# **Clinical Laboratory Science**

**[COMPLETE REVIEW]**

**Fourth Edition**

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## **WE DEDICATE THIS BOOK**

To my mother, Josephine; my sister, Eva; and my nieces, Christine and Karen, for their support, love, and understanding.

*Anna P. Ciulla*

To my wife, Terri, whose love, support, and encouragement helped make this book possible.

*Donald C. Lehman*

and

To all the clinical laboratory professionals who contribute their expertise daily as members of the healthcare team and to all current clinical laboratory science students and those who will follow.

# Contents

*Preface / v*

*Acknowledgments / vi*

*Certifying Agencies / vii*

*Contributors / viii*

*Reviewers / x*

*Introduction / xiv*

**1 Clinical Chemistry / 1**

Color Plates following page 222

**2 Hematology / 229**

**3 Hemostasis / 373**

**4 Immunology and Serology / 421**

**5 Immunohematology / 495**

**6 Bacteriology / 615**

**7 Mycology / 753**

**8 Parasitology / 785**

**9 Virology / 833**

**10 Molecular Diagnostics / 865**

**11 Urinalysis and Body Fluids / 907**

**12 Laboratory Calculations / 959**

**13 General Laboratory Principles, Quality Assessment, and Safety / 987**

**14 Laboratory Management / 1035**

**15 Education and Research / 1065**

**16 Computers and Laboratory Information Systems / 1087**

**17 Self-Assessment Test / 1103**

**Index / I-1**

# Preface

*SUCCESS! in Clinical Laboratory Science: Complete Review, Fourth Edition*, is designed as an all-in-one review and summary of the major clinical laboratory science content areas generally taught in an academic program. It is developed to help examination candidates prepare for national certification or state licensure examinations. It is also a resource for practicing clinical laboratory scientists wanting a “refresher.” The excellent reception received by the first three editions of the book spurred the writing of this fourth edition. Educators and students alike have commented that the strength of the book is the paragraph explanations that accompany each answer. The explanations help users of the book to augment their knowledge or clear up misunderstandings.

To enhance the fourth edition and to make it more valuable to users, a concise outline of each content area is incorporated as a new feature. The outlines are not intended to replace discipline-specific textbooks, but the outlines will provide a quick review of important material. Color plates of 60 full-color pictures are included to provide the user with experience in answering questions based on a color photograph. Additionally, a revised 200-question self-assessment test and a 100-question self-assessment test on the Companion Website are included as mechanisms for final evaluation of one’s knowledge, thus allowing for the identification of one’s strengths and weaknesses while there is still time to improve.

The book contains more than 2000 multiple choice questions that cover all the areas commonly tested on national certification and state licensure examinations. The questions are based on current clinical laboratory practice, and case study questions are incorporated to hone problem-solving skills. The paragraph rationales expand upon the correct answer, and matching puzzles on the Companion Website provide an alternate means to assess recall knowledge. Overall, this book provides the essential components needed in an effective clinical laboratory science examination review book. We hope that you find this book and the accompanying Companion Website useful, and we wish you success with the examination and with your career as a clinical laboratory professional.

# Acknowledgments

This book is the end product of the labor and dedication of a number of outstanding professionals. The editors would like to acknowledge these individuals for their invaluable assistance in completing this project. The editors greatly appreciate the efforts of the contributing authors who worked so diligently to produce quality materials. A note of recognition and appreciation is extended to Karen A. Keller, Mary Ann McLane, and Linda Sykora, who allowed use of their color slides, as well as a special acknowledgment to Elmer W. Koneman, MD, Professor Emeritus, University of Colorado School of Medicine and Medical Laboratory Director, Summit Medical Center, Frisco, CO for use of color slides from his private collection. The editors are also most grateful for the technical assistance of Raelene E. Maser, PhD, MT(ASCP), Associate Professor, Department of Medical Technology, College of Health Sciences, University of Delaware, Newark, DE; Michael J. Healy, MS, MT(ASCP)SBB, Director of Laboratory Management, Blood Bank of Delmarva, Newark, DE; and Michelle A. Parent, PhD, MT(ASCP), Assistant Professor, Department of Medical Technology, College of Health Sciences, University of Delaware, Newark, DE.

# Certifying Agencies

Information pertaining to certification examinations, education and training requirements, and application forms may be obtained by contacting the certifying agency of your choice. The following is a list of the certification agencies that service clinical laboratory professionals.

**American Society for Clinical Pathology  
Board of Registry (ASCP/BOR)**  
33 West Monroe Street, Suite 1600  
Chicago, IL 60603  
312-541-4999  
E-mail: *bor@ascp.org*  
Web site: *http://www.ascp.org*

**National Credentialing Agency for  
Laboratory Personnel, Inc. (NCA)**  
P.O. Box 15945-289  
Lenexa, KS 66285  
913-895-4613  
E-mail: *nca-info@goamp.com*  
Web site: *http://www.nca-info.org*

**American Medical Technologists (AMT)**  
10700 West Higgins Road, Suite 150  
Rosemont, IL 60018  
847-823-5169 or 800-275-1268  
E-mail: *MT-MLT@amt1.com*  
Web site: *http://www.amt1.com*

**American Association of Bioanalysts (AAB)**  
906 Olive Street, Suite 1200  
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314-241-1445  
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Web site: *http://www.aab.org*

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# Introduction

If you are currently preparing for a Clinical Laboratory Science/Medical Technology certification or licensure examination, or if you are a practicing clinical laboratory professional who wants to “brush up” on clinical laboratory information, then this is the review book for you. ***SUCCESS! in Clinical Laboratory Science: Complete Review, Fourth Edition*** is a comprehensive text containing content outlines and more than 2000 questions with paragraph explanations accompanying each answer. Unique to this book is an outline of each content area that concisely summarizes important information. The question and rationale format not only tests your knowledge of the subject matter but also facilitates additional learning. Color plates of 60 full-color pictures are included to help you prepare for national examinations in as realistic a manner as possible. In this edition are a 200-question self-assessment test and a 100-question self-assessment test on the Companion Website. Both assessments will assist you in determining your mastery of the material while allowing computer practice for those examinations that are offered as computerized testing. Also included on the Companion Website are sets of matching puzzles and case studies to assess your knowledge in a less formal manner.

## ORGANIZATION

The book is organized into 17 chapters corresponding to the areas tested on clinical laboratory science/medical technology certification examinations. The chapters are as follows:

1. Clinical Chemistry
2. Hematology
3. Hemostasis
4. Immunology and Serology
5. Immunohematology

6. Bacteriology
7. Mycology
8. Parasitology
9. Virology
10. Molecular Diagnostics
11. Urinalysis and Body Fluids
12. Laboratory Calculations
13. General Laboratory Principles, Quality Assessment, and Safety
14. Laboratory Management
15. Education and Research
16. Computers and Laboratory Information Systems
17. Self-Assessment Test

As you can see, each chapter represents a specific content area in the clinical laboratory field, with the last chapter being a self-assessment test. Some of the chapters are further divided into subsections to facilitate study of major topics within these disciplines. The chapters are organized as follows: outline, questions, and answers with paragraph explanations. A list of references is located at the end of each chapter for further review. The last chapter is a 200-question self-assessment test that should be used to determine overall competency upon completion of the previous chapters.

The Companion Website has three types of assessment tools including a 100-question self-assessment test to assist you in preparing for computerized national examinations. In addition, matching puzzles are available to help you to review major points associated with each content area. To further synthesize important material, case studies in clinical chemistry, hematology, immunology and serology, immunohematology, and microbiology are included.

## QUESTIONS

The style of the questions used adheres to that prevalent in most certification examinations. Each chapter contains questions in a multiple choice format with a single answer. In some cases, a group of two or more questions may be based on a case study or other clinical situation. Questions are divided among three levels of difficulty: Level 1 questions test recall of information, level 2 questions test understanding of information and application to new situations, and level 3 questions test problem-solving ability. Each of the multiple choice questions is followed by four choices, with only one of the choices being completely correct. Although some choices may be partially correct, remember that there can only be one best answer.

## HOW TO USE THIS BOOK

The best way to use *SUCCESS! in Clinical Laboratory Science: Complete Review, Fourth Edition* is to first read through the outline. If you find that some of the material is not as fresh in your memory, go to a textbook or recent class notes to review the area in more detail. Then work through short sections of the questions at a time, reading each question carefully and

recording an answer for each. Next, consult and read the correct answers. It is important to read the paragraph explanations for both those questions answered correctly as well as for those missed, because very often additional information will be presented that will reinforce or clarify knowledge already present. If you answer a question incorrectly, it would be wise to consult the references listed at the end of the chapter.

Lastly, you should take the 200-question self-assessment test as if it was the actual examination. Find a quiet place, free of interruptions and distractions, and allow yourself 3 hours and 30 minutes to complete the self-assessment test. Record your answers; then check the answer key. Review topic areas that seemed difficult. As final preparation, take 2 hours to complete the 100-question computerized test on the Companion Website. These tests will give you a more realistic evaluation of your knowledge and your ability to function within a time constraint. It is important that you are comfortable taking a test that is computerized, because several of the certifying agencies now use either computer-administered or computer-adaptive testing. So be sure to practice on the computer using the Companion Website. By the time you have worked through the outlines, the questions and rationales, the two self-assessment tests, case studies, and the matching puzzles, you will have gained a solid base of knowledge.

For students of clinical laboratory science/medical technology and clinical laboratory practitioners, this book has been designed to summarize important information, to test your knowledge, and to explain unfamiliar information through use of the paragraph explanations that accompany each question. Working through the entire book will make you aware of the clinical areas in which you are strong or weak. This review will help you gauge your study time before taking any national certification or state licensure examination. Remember, there is no substitute for knowing the material.

## TEST-TAKING TIPS

In addition to studying and reviewing the subject matter, you should also consider the following points:

1. Contact the Sponsoring Agency

Check the web site of the sponsoring agency that administers the examination and review the general information about the test, including:

- The outline of the test content areas
- The test question format
- Whether the test is computer based or to be done using paper and pencil
- If computer based, whether it is computer administered or computer adaptive
- The time allowed to complete the test and the number of test questions to expect
- The scoring policy

*Note:* Because certification examination requirements vary, it is important to read thoroughly all directions published by the sponsoring agency and to read

carefully the directions presented on the day of the examination. After completing the computerized examinations, most agencies permit you to return to previously answered questions and entered responses can be changed. In some cases the sponsoring agency allows you to skip a question and return to it at the end of the exam, whereas other agencies require that you select an answer before being allowed to move to the next question. So know the rules! Checking your answers is a very important part of taking a certification exam. During the exam, check the computer screen after an answer is entered to verify that the answer appears as it was entered.

## 2. Prepare before Examination Day

- Study thoroughly prior to taking the exam. Set up a study schedule that allows sufficient time for review of each area.
- Use this review book to help you to identify your strengths and weaknesses, to sharpen your test-taking skills, and to be more successful with multiple choice examinations.
- Know the locations of the test center and the parking facilities. If the area is unfamiliar to you, a visit to the site a week before the exam may help to prevent unnecessary anxiety on the morning of the test.
- Check your calculator (if one is allowed) for proper function and worn batteries. Some agencies allow a nonprogrammable calculator to be used during the exam.
- Get plenty of rest. Do not cram. A good night's sleep will prove to be more valuable than cramming the night before the exam.

## 3. On the Examination Day

- Eat a good breakfast.
- Take two types of identification with you—your photo identification and another form of identification, with both illustrating your current name and signature, as these are generally required—and your admission letter (if required by the agency).
- Take a nonprogrammable calculator (if one is allowed) to the test center. Most test centers do not permit any paper, pencils, or study materials in the testing area. In addition, electronic devices such as cell phones, pagers, etc. are not permitted in the test center.
- Allow sufficient time to get to the test center without rushing. Most agencies require that you be at the test center 30 minutes before the start of the exam.
- Wear a wristwatch in order to budget your time properly.
- Read the directions thoroughly and carefully. Know what the directions are saying.
- Read each question carefully. Be sure to answer the question asked. Do not look for hidden meanings.
- Take particular note of qualifying words such as “least,” “not,” “only,” “best,” and “most.”
- Rapidly scan each choice to familiarize yourself with the possible responses.
- Reread each choice carefully, eliminating choices that are obviously incorrect.

- Select the one best answer.
- Enter in the computer the correct response in accordance with the directions of the test center. For paper tests, mark your response next to the number on the answer sheet that corresponds to the number of the test question, being careful not to skip a number.
- Budget your time. If the test has, for example, 100 questions and 2 hours and 30 minutes are allowed for completion, you have approximately one minute and thirty seconds for each question.
- Above all, don't panic! If you "draw a blank" on a particular question or set of questions, skip it and go on unless the directions indicate that all questions must be answered when presented. At the end of the exam, if you are permitted, return to review your answers or to complete any skipped questions. Stay calm and do your best.

## KEYS TO SUCCESS ACROSS THE BOARDS

- Study, review, and practice.  
Keep a positive, confident attitude.  
Follow all directions on the examination.  
Do your best.

Good luck!