



# COMLEX-USA

A Comprehensive Guide to Preparing For Your Medical Board Examinations

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## OVERVIEW

### WHAT IS THE PURPOSE OF MEDICAL BOARD EXAMINATIONS?

First and foremost, the purpose of board examinations is to protect the public, especially patients, from incompetent physicians by assessing a standard minimal level of competence in the knowledge, skills, and attitudes of physicians-in-training.

### WHAT ARE LUCOM'S POLICIES REGARDING THE COMLEX-USA?

LUCOM and the National Board of Osteopathic Medical Examiners (NBOME) requires that a student must be currently enrolled and in good academic standing at LUCOM to take the COMLEX Level 1, Level 2-CE and PE portions of the NBOME. All students are required to pass COMLEX Level 1 and both components of COMLEX Level 2 examinations (CE and PE) of the NBOME to graduate from LUCOM. A student may take the COMLEX Level 1 and Level 2 examinations of the NBOME any time the examination is offered after a student becomes eligible.

Please refer to the [LUCOM Student Handbook](#) for the full description of LUCOM's policies regarding the COMLEX-USA examinations.

### WHY IS IT IMPORTANT THAT YOU TAKE THE EXAMS SERIOUSLY AND DO YOUR BEST?

Passing COMLEX Level 1, Level 2-CE, and Level 2-PE is a graduation requirement for all LUCOM students. While a passing score of 400 is all that is required, LUCOM students are encourage to aim for above 500, preferably much higher, to optimally position themselves for residency.

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### **COMLEX LEVEL 1 SCORES ARE USED TO SCREEN RESIDENCY APPLICANTS**

Although the primary intent of Board examinations is to protect the public, residency programs are increasingly using Board scores to screen applicants. Many residency programs have "cut scores" below which they will not consider an applicant for an interview; therefore, performance on COMLEX can be a limiting factor in obtaining a desired residency position. The extent to which residency programs utilize board scores varies. To best position oneself to be a competitive candidate, it is important to obtain as high a score as possible.

## NRMP DATA REGARDING THE MATCH & MEDIAN COMLEX LEVEL 1 SCORES

### 2018 Summary Statistics on U.S. Osteopathic Senior Match Results

Specialty	Mean COMLEX-USA Level 1 score	Mean COMLEX-USA Level 2-CE score	Mean USMLE Step 1 score	Mean USMLE Step 2 CK score
Anesthesiology	571	602	227	239
Child Neurology	547	572	229	237
Dermatology	614	686	237	254
Diagnostic Radiology	613	640	239	247
Emergency Medicine	569	621	229	241
Family Medicine	506	537	217	233
General Surgery	613	666	238	248
Internal Medicine	554	588	226	239
Internal Medicine/Pediatrics	549	598	234	245
Interventional Radiology	626	690	234	243
Neurological Surgery	621	529	252	252
Neurology	552	592	227	239
Obstetrics and Gynecology	568	621	226	241
Orthopaedic Surgery	680	680	252	249
Pathology	558	573	223	238
Pediatrics	526	564	223	239
Physical Medicine and Rehabilitation	535	568	223	235
Psychiatry	514	543	224	237

Source: NRMP Data Warehouse.

## COMSAE

COMSAE is a self-assessment exam intended as an education resource and preparation aid for the COMLEX-USA Exam series. Osteopathic students and residents use the three-phase Comprehensive Osteopathic Medical Self-Assessment Examination (COMSAE) to prepare to take a COMLEX-USA cognitive examination.

COMSAE Phase 1	Scientific understanding of the mechanisms of these clinical situations
COMSAE Phase 2	Concepts and principles necessary for making appropriate medical diagnoses
COMSAE Phase 3	Concepts and principles necessary for making appropriate patient management decisions

COMSAE is not intended to predict performance on any of the COMLEX-USA examinations. However, candidates who have taken a timed COMSAE prior to taking their first COMLEX-USA cognitive examination at the corresponding level demonstrate greater performance, on average, relative to candidates who did not take a timed COMSAE prior to their first COMLEX-USA examination.

LUCOM student-doctors are required to take COMSAE exams twice: once in January and once in June of their OMS-II year. A third COMSAE may be required if the student is not able to be released to take the COMLEX Level 1 exam.

## EXAM FACTS

Each COMSAE examination consists of 200 questions presented in a format and structure similar to COMLEX-USA cognitive examinations.

Exam Disciplines:

- Emergency Medicine
- Family Medicine
- Internal Medicine
- Obstetrics and Gynecology
- Pediatrics
- Psychiatry
- Surgery

There are different forms, or versions, for COMSAE phase exams. For Phase 1, which corresponds to COMLEX Level 1, there are two forms (D and E) that must be administered by a COM. The other forms (A, B, and C) can be purchased and self-administered by individual students.

Students can take these self-administered COMSAE forms timed or untimed. LUCOM recommends that students take the COMSAE timed when testing their readiness to take a COMLEX-USA examination. When assessing how best to approach test items, it is recommended that students take the COMSAE untimed.

## COMLEX LEVEL 1

### DESCRIPTION OF THE EXAM

COMLEX stands for Comprehensive Osteopathic Medical Licensure Examination. According to the NBOME, "The COMLEX-USA Level 1 is a problem- and symptom-based assessment, administered in a time-measured environment that integrates the foundational and basic biomedical sciences and other areas of medical knowledge relevant to solving clinical problems and promoting and maintaining health in providing osteopathic medical care to patients." It should be noted that COMLEX Level 1 is specifically geared toward knowledge and clinical problem-solving skills that would be acquired during the first two years of medical school.

For a thorough description of the exam, refer to the [NBOME COMLEX Bulletin of Information](#).

## FOUNDATIONAL & BASIC BIOMEDICAL SCIENCES

- Anatomy
- Behavioral Science
- Biochemistry
- Health Promotion and Disease Prevention
- Microbiology
- Osteopathic Principles
- Pathology
- Pharmacology
- Physiology

## EXAM FACTS

COMLEX Level 1 is given over a single 8-hour day divided into a 4-hour morning session and a 4-hour afternoon session separated by an optional 40-minute lunch period. The lunch break does not count against your time, but any unused time will not be added to your total exam time.

Each 4-hour session is composed of four 1-hour blocks of 50 questions (400 questions over the course of the day). The testing center provides one 10-minute mid-morning break and one 10-minute mid-afternoon break. These breaks are optional and do count against your total time.

Students are often tempted to skip the breaks or lunch period and push through the exam non-stop, beginning to end, but this is not recommended.

Students can advance through the 50-question blocks at their own pace; however, there is no ability to return to a previous block of questions after advancing to the next.

It is highly recommended that students familiarize themselves with the testing format by exploring the resources provided on the NBOME website.

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## VERY USEFUL NBOME RESOURCES

[Test Day Tips](#)

[COMLEX Test Blueprint](#)

COMLEX Practice Exams (use to gain familiarity with the computer-based testing):

- [New COMLEX-USA Level 1 for exam dates after May 2019](#)
- [COMLEX-USA Level 1 for exam dates before May 2019](#)

## EXAM SCORING

For the COMLEX-USA computer-based cognitive examinations, the number of items answered correctly (the raw score) is converted to a standard score for the purposes of reporting results and providing a pass-fail designation.

Each test question contributes equally to the candidate's score. A passing score for all COMLEX-USA Levels is based solely on the candidate's performance on the total examination, not on a candidate's performance in individual content areas.

Standard deviation (approximately)	85
Mean Score First-Time Candidates (approximately)	520
Minimum Passing Score	400

According to the NBOME, exam score reports become available in the student's account at "View Score Report" approximately 4 to 6 weeks after the exam date.

For more information on Score Interpretation, visit the [NBOME Scoring Principles](#) website.

## WHAT RESOURCES ARE AVAILABLE FOR COMLEX LEVEL 1 PREPARATION?

There are too many COMLEX and USMLE resources for any one person to utilize; don't feel compelled to collect them all. Instead, explore what is available and select those that cover the topics *you* need to learn in a way that grabs *your* attention. Listen to others' recommendations, but base your decisions on factors relevant to you, such as your learning style preferences (visual, verbal/written words, auditory) and weak content areas, etc. If a respected peer recommends some great pathology lectures, but you are not a good auditory learner, then that may not be the best resource for you. Attempting to study from too many sources can lead to bouncing around, lack of focus, and important topics falling through the cracks.

For an extensive list of resources, refer to the [Appendix](#) of this document.

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## COMMERCIAL REVIEW COURSES: PROS AND CONS

Will you be better served by taking a commercial review course or by independent study? The "pros" of self-study are that it's cheaper, flexible, and more likely to reflect your own "style." The "cons" are more complicated. Furthermore, your own style may be sub-optimal when preparing for board

exams. **One good clue: how was your academic performance during the first two years of medical school?**

If you had poor academic performance or if you tend to be disorganized, have a hard time sticking to a schedule, or procrastinate, then a commercial review course is a viable option. On the other hand, if you are an organized, disciplined student who has earned strong grades, then independent study is more likely to be a good fit.

If you are leaning toward a commercial review course, take your time to select the right one. Some programs are fairly rigid in terms of when you can or cannot finish things; other programs allow you to work at your own pace, i.e. do more when you have time and do less when you are busy. Also be aware that the best outcomes come from programs that devote some time to teaching test-taking skills. Evaluate carefully all programs and their features, and beware of scare tactics (e.g. if you buy today, you'll get this price, but if you wait until tomorrow, the price will double).

In the past, LUCOM students have used [Kaplan Test Prep](#), [Doctors in Training \(DIT\)](#) and [Becker](#).

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## REVIEW BOOKS AND RESOURCES

Any/all review books for COMLEX Level 1 and USMLE Step 1 are potential candidates, and there are many to choose from. To reiterate a previous point, you need to select review books, or other resources such as flashcards, multimedia, etc. *that work for you*. Ask around and explore before you buy.

The following list is not extensive and, if you find a resource that you believe would benefit other students, please contact the Academic Support and Success Center.

Resource	Type	Description	Cost
First Aid for the USMLE	Book	<p>A complete framework for the USMLE Step 1 preparation, annually updated.</p> <ul style="list-style-type: none"> <li>• 1300+ must-know topics with mnemonics to focus your study</li> <li>• 1200+ color photos and illustrations</li> <li>• Rapid review section for efficient last minute preparation</li> </ul>	Dependent on vendor and format of purchase
OMT Review by Savarese	Book	A comprehensive review in osteopathic medicine.	Dependent on vendor

		<ul style="list-style-type: none"> <li>The gold standard OMM review book</li> </ul>	and format of purchase
Pathoma	Book/Online Content	<p>Fundamentals of Pathology is a medical course and Step 1 review.</p> <ul style="list-style-type: none"> <li>High-yield outline format covering all major topics in pathology</li> <li>Integrated review with key concepts from associated disciplines</li> </ul>	<p>Free Access for basic study tools</p> <p>Pathoma Pro starts at \$84.95</p>
SketchyMedical	Online Content	<ul style="list-style-type: none"> <li>SketchyMicro: 100+ review cards; 900+ quiz questions</li> <li>SketchyPath: 150+ review cards; 1500+ quiz questions</li> <li>SketchyPharm: 100+ review cards; 1000+ quiz questions</li> </ul>	<p>Micro: \$99.99-\$159.99</p> <p>Path: \$119.99-199.99</p> <p>Pharm: \$99.99-\$159.99</p>
Boards and Beyond	Books/Online Content	Contains modules and videos for numerous topics covered on Level 1 and Step 1. After you complete the videos, take the quizzes to test yourself. There are also companion books that contain slides used in the videos.	Prices vary for length of access, ranging from \$19-\$249

### QUESTION BANKS (QBANKS)

<a href="#">Kaplan Test Prep</a>	<ul style="list-style-type: none"> <li>COMLEX and USMLE Qbank</li> <li>5000+ questions</li> <li>Video lecture series</li> <li>OMM lecture series</li> <li>1 diagnostic exam used to create a detailed study plan</li> <li>2 full-length USMLE simulated exams</li> <li>1 full-length COMLEX simulated exam taken during ethics course</li> <li>Mobile companion app</li> <li>References to FirstAid, MedEssentials, and Pathoma</li> </ul>	<p><b>For just the COMLEX Level 1 Qbank:</b></p> <p>12 months: \$129 18 months: \$209 24 months: \$279</p> <p><b>For the Level 1 + Step 1 Qbank:</b></p> <p>1 month: \$149 12 months: \$289 18 months: \$369 24 months: \$439</p>
<a href="#">COMBANK</a>	<ul style="list-style-type: none"> <li>Assess strengths and weaknesses with analytics</li> <li>Active learning methods to develop problem-solving skills</li> <li>Additional OMM</li> </ul>	<p>1 month: \$169 3 month: \$209 6 month: \$309 1 year: \$409</p>

	<ul style="list-style-type: none"> <li>• Learn to think like a test-writer</li> </ul>	
<a href="#">usmleRx</a>	<ul style="list-style-type: none"> <li>• Companion to First Aid with explanations that tie directly to facts in <i>First Aid for the USMLE Step 1</i></li> <li>• 2500+ USMLE-style questions written by high-scoring students</li> <li>• Tests are customizable by difficulty, general principles, and systems</li> <li>• Both tutorial and timed testing modes</li> <li>• Detailed performance feedback</li> </ul>	<p>1 month: \$119  3 months: \$169  6 months: \$249  12 months: \$339  24 months: \$449</p>
<a href="#">UWorld</a>	<ul style="list-style-type: none"> <li>• Assess students' basic science knowledge with 2000+ high quality, unrepeated multiple choice board-type questions by real-life physicians</li> <li>• Detailed explanation and educational objective for each question with excellent illustrations and charts that are easy to read and interpret</li> <li>• Board simulated interface software features (highlight, strike-out annotation, searchable lab values, calculator, mark/flag items, etc.)</li> <li>• Suspend and resume a test at any time at your convenience with 24-hour account web access</li> <li>• External references to medical journal abstracts</li> <li>• Mobile companion app available for iOS and Android based devices</li> </ul>	<p>30 days: \$249  90 days: \$349  180 days: \$399  360 days: \$499  2 years: \$749</p>

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**SUGGESTED TIMELINE FOR PREPARATION—OMS-II**

## December

Start to look into/purchase resources that fit your learning style preferences.



## January

FOCUS ON YOUR  
COURSEWORK.

Start toying with your study materials. Identify general weaknesses in your knowledge base.

The January COMSAE will allow you to become familiar with the target and provide an initial self-assessment.



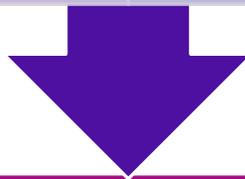
## February ⇨ Mid-May

FOCUS ON YOUR  
COURSEWORK.

Finalize study materials/resources you will be using.

Supplement studying for current courses with your resources.

Limit the amount of questions you do each week.



## May ⇨ Test Day

You should now be very comfortable with your prep materials.

Create and enact a specialized study plan and follow through on it.

Use practice tests and self-administered COMSAE forms to provide additional self-assessment.

## HOW SHOULD YOU PREPARE FOR COMLEX LEVEL 1?

Preparing for COMLEX is *project management 101*. Getting ready for the exam is a temporary endeavor that is bounded in time—it has a beginning and an end date. Successful preparation includes:

- Determining needs (e.g. what skills need to be developed? What content needs to be learned?)
- Setting goals
- Planning
- Identifying and managing resources
- Anticipating and mitigating obstacles
- Creating a realistic timeline with checkpoints
- Performing activities/tasks necessary to achieve the goals (e.g. studying material, doing practice questions)
- Evaluating progress toward the goal (e.g. taking practice tests)
- Making adjustments to the plan as needed
- Maintaining motivation and commitment to the desired outcome (e.g. achieving a score over 500)

Avoid common mistakes when preparing for Level 1:

- PASSIVE study methods
- INSUFFICIENT practice with board-style questions
- MEMORIZING as opposed to understanding the material
- INAPPROPRIATE test day strategies
- MISREADING or misinterpreting questions

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### SELF-ASSESSMENT

An initial step to successful preparation is self-assessment (obtaining a performance baseline). This serves three useful purposes:

1. It will help you determine your study priorities (i.e. identify needs). By comparing your baseline assessment with the COMLEX Blueprint you can ensure that you spend an adequate amount of time on the “right” material.
2. It will help you to identify needed resources, such as purchasing review books that cover specific “weak” content areas (e.g. microbiology, pathology, or pharmacology).
3. Determining your baseline performance will allow you to better gauge whether or not your study plan is working. You should see an improvement

in performance over time. This will allow you to make a more objective determination of progress.

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### COMSAE-PHASE 1

COMSAE stands for Comprehensive Osteopathic Medical Self-Assessment Examination. These practice tests are provided by the NBOME for use by students to gauge their knowledge and problem-solving skills and develop familiarity with the COMLEX format to aid in preparation for the real thing. Question banks, such as UWorld and COMBANK, can also be used to self-assess baseline performance and progress over time.

It is a LUCOM requirement that all students must sit for two (possibly more) COMSAE exams prior to being eligible for COMLEX Level 1. The first COMSAE exam will be administered in January of OMS-II. This will be used to identify students' weak areas to aid them in preparation. The second COMSAE will be administered in June of the same year. Scores on the second COMSAE exam will be used in the predictive model to allow students to be released to take the COMLEX Level 1 exam.

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### USING YOUR RESULTS TO GUIDE YOUR REVIEW

- Compare *your* performance in each area with its relative weight on the Level 1 exam (% of questions).
- If your score is “poor” or “borderline” in areas with high percentages of Qs consider these HIGH PRIORITY items for your review.
- Because the majority (75%) of COMLEX Qs test your knowledge of scientific mechanisms, if your score is “poor” or “borderline” in any basic science discipline (anatomy, physiology, biochemistry, microbiology, pathology, pharmacology, behavioral science, OMM), review that discipline thoroughly.

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### CREATING A STUDY SCHEDULE

The next critical step in successful preparation is creating a realistic and detailed study schedule. Make a study schedule and stick to it, but also revise as necessary if the plan does not seem to be working. For example, if your scores on practice tests do not seem to be increasing over time or if you are unable to maintain the pace that you set for yourself.

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### CRAM FIGHTER

Cram Fighter is a tool used to create a study schedule from your study resources (First Aid, COMBANK, UWORLD, etc.). You can specify study hours so you know

exactly what to do EVERY day. And, if you fall behind, you can readjust your study schedule automatically with the click of a button.

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## STUDYING FOR COMLEX

The key to mastering the material ultimately lies with learning it, both in terms of being able to recall detailed information, but also, perhaps more importantly, being able to *apply* the information to answer specific questions posed on the exam.

- Begin by LEARNING the material well the first time as you study for your course exams—try to avoid “cram and dump” study methods by adopting a “deep approach” to learning. **Remember, preclinical academic performance is an important predictor of COMLEX Level 1 performance.**
  - [Improving long-term retention and recall](#)
  - [How to study detailed information](#)
- Develop your problem-solving and critical thinking skills alongside your content knowledge. COMLEX requires you to understand underlying principles and concepts so you can utilize your critical thinking skills to reason through the questions. COMLEX questions have a reputation for being more “vague” than USMLE so a solid knowledge base is essential for success. There may be more than one *possible* answer, but *only one best* answer.
- First Aid, SketchyMedical, and Pathoma are resources used for board prep, but they can also be incorporated into your study routine during your medical school coursework. Many students annotate First Aid with course-based information, thereby creating a customized COMLEX study aid.
- As you advance through your courses, you can also supplement your course materials with Q-bank questions (e.g., Kaplan, COMBANK). This will not only begin to build familiarity with board style questions, but also many students find it a useful approach for their courses. **YOUR FIRST PRIORITY, HOWEVER, IS TO FOCUS ON COURSE CONTENT.** *If you are struggling to stay caught up and learn the material presented in the course, do not be distracted by spending your limited time with board review materials.*
- Study *smarter*, not longer. The QUALITY of your study time is more important than the quantity. Spending 10 hours a day passively reading study guides or old notes is much less effective than spending half that amount of time in active study.
  - Explain concepts out loud to a study partner.
  - Create concept maps that center on a clinical presentation.

- Do as many practice questions as you can. Doing practice questions allows you to apply the materials as opposed to just memorizing it.
- When doing practice questions, make sure you can explain why the right answers are right and the wrong answers are wrong. Analyze your results by trying to determine what went wrong.
- If there are other study methods that work for you, use them—there's no one right way. That said, don't simply try to memorize facts.

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### TEST-TAKING TIPS

- Develop your multiple-choice test-taking skills. Learn how to approach multiple-choice questions and get lots of PRACTICE. Some people seem to instinctively know how to answer multiple-choice questions correctly while others struggle. There are skills that you can learn to help you answer these kinds of test questions.
- Don't make the mistake of avoiding practice questions until you "feel" you can get them right. Now is not the time for performance anxiety. Getting questions wrong will help you learn, especially if you pay attention to what you get wrong and why you got it wrong.
- Know how to approach vignette styled multiple choice questions:
  - **ASSEMBLE** key clues into a mental "snapshot" of the patient.
  - **DETERMINE** precisely what is being asked.
  - **TAKE** time to think, recall, and anticipate possible answers.
  - **COMPARE** the options to your anticipated answer.
  - **MARK** the option(s) that best match.
  - **RULE OUT** options that don't account for all findings.
  - **SELECT** the best answer.
- Low performers on multiple-choice tests often focus on the answer choices rather than on the stem of the question. This is a very inefficient approach and one that tends to result in more mistakes. The answer is in the stem—read the stem carefully.

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### KEEPING ANXIETY AT BAY

It is quite normal to be anxious about taking COMLEX; it is, after all, a high stakes, gateway exam. But, passing the exam is achievable for all medical students. That said, if your "fight or flight" response is not allowing you to focus on preparation, then you will need to confront your anxiety and seek help.

If you are dealing with stress and/or anxiety, please refer to the Stress Management resources on the [ASSC website](#) or contact an Academic Counselor.

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## TAKE CARE OF YOURSELF WHILE PREPARING

Now is not the time to give up on self-care. In fact, quite the contrary, COMLEX preparation is the perfect time to develop or maintain healthy habits. Eating a balanced diet, exercising, and sleeping are not only good for you, they can also reduce stress AND help you learn and retain information. In addition, maintaining relationships with family and friends is also important during this stressful time—you will need a good support network. The key is incorporating these things into your study schedule—actually block out periods of time for meals, for exercise, for socializing, and for sleep.

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## COMLEX LEVEL 1 FAQ

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### *ARE TESTING ACCOMMODATIONS AVAILABLE FOR COMLEX?*

Yes, requests must be made directly to the NBOME following the procedure described [here](#). Requests should be made 4-6 months prior to the anticipated test date.

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### *HOW DO I KNOW IF I AM READY TO TAKE THE EXAM?*

**Readiness to sit for the exam is best gauged by the COMSAE.** LUCOM students take the COMSAE twice: once in January and once in June of their OMS-II year. The COMSAE in January should be used to identify a student's weakest areas (i.e., pathology, microbiology, etc.). The COMSAE in June is used in the predictive model which will either release a student to take COMLEX Level 1 or require that the student retake the COMSAE exam prior to taking COMLEX Level 1.

Another factor that can help gauge your readiness is how well you've been performing on your Qbank questions. As your exam approaches, you want to shift from tutor mode to timed un-tutored mode focusing on un-attempted mixed-blocked questions. By simulating the COMLEX exam (50 questions in a block) you can review your performance and identify your weak areas. When you've identified your weak areas, you can make a plan for your final study time to ensure that you are feeling comfortable and confident on your exam day.

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### *SHOULD I DO RANDOM (MIXED) SETS OF PRACTICE QUESTIONS OR QUESTIONS THAT ALL COME FROM THE SAME SUBJECT AREA (DISCIPLINE OR SYSTEM)?*

The answer is both. Completing questions from a single subject area can be helpful, especially if used as a post-test after you've reviewed the related material. However, the real exam is a random mix of questions—you won't know what type of question is next. If you know that all questions are going to be about physiology or will all cover the cardiovascular system you've already narrowed your focus—your brain is primed to think about things a certain way. When these context clues are gone, as they are on the real exam, things get more challenging because you are completely reliant on each question, as a stand-alone question, to provide the cues and clues you need to answer the question. The random nature of the exam adds another layer of stress, but one that you can prepare for. Like everything else in life, the more you practice, the better, and more used to it, you become.

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### *WHAT IS THE BEST WAY TO USE MY QBANK?*

There are many ways to approach practice questions. You should consider using all of them as you prepare. The main reasons to do practice questions are:

1. **To learn content.** This is often done by using the “tutorial” function of the Qbank software. Blocks of questions can be discipline or system-based or mixed.
2. **To ID weak areas.** As you complete questions, especially those answered incorrectly, make note of problem areas. Most Qbanks are capable of generating a performance breakdown as well.
3. **To monitor progress.** Taking “practice exams” on a regular basis can help you determine if you are improving over time. In turn, this information will allow you to evaluate your study strategy and methods—is what you are doing working or might you need to make adjustments? To be as accurate as possible, you should take these practice exams under simulated testing conditions (timed at about 1 minute per question, closed book “no peeking”, and a RANDOM mix of questions from all subjects) and you must try to keep these conditions the same each time you take a practice exam.
4. **To develop test-taking skills.** Like any other skill-set, improving your test-taking ability takes deliberate practice. So, in addition to identifying your weak content areas, you should also analyze your performance in terms of how you approach questions.
  - Do you tend to overthink/read too much into the question?
  - Do you second-guess yourself?

- Do you read too quickly or skim and miss important details?
- Do you jump to premature conclusions before you've read the entire question?
- Do you focus too much on the answer options and all but ignore the question stem?

It is particularly important for you to pick apart questions you got wrong when you were very confident in your answer selection, as this suggests a test-taking “process” or cognitive error as opposed to a simple lack of content knowledge.

5. **To develop endurance and stamina.** An 8-hour exam is exhausting and people react differently. Some crash during the afternoon session, but this can potentially be mitigated by eating the right kind of lunch, such as foods that provide sustained energy as opposed to a quick burst followed by a crash. Just as a runner gradually builds up to his target mileage, as a test-taker, you need to gradually increase the number of questions and time of your practice tests, culminating about 10-14 days before your test date with a “mock” 6- to 8-hour exam day. Pay attention to your body—when do you get sleepy? How might you use this information on test day to improve your performance? What foods should you eat? How much water should you drink? Should you bring medication for headaches? Keep in mind that just as marathoners stop distance running a couple weeks prior to a marathon, you must not take a long practice exam within a week of your test date or you may be too fatigued on test day.

Also, remember, you will never see any of these practice questions again on the real test. There is no value in repeating the same questions over and over again, which mainly promotes memorization of those specific questions. Instead, keep in mind that anything that seems unfamiliar in a practice question—whether it is information provided in a question stem or in any of the foils—is something you may need to know to answer a different question on the real exam, so review it, learn it, and remember it.

## COMLEX LEVEL 2-CE

### DESCRIPTION OF THE EXAM

Much of the information provided about COMLEX Level 1 is also applicable to the Level 2-Cognitive Evaluation (CE). A similar clinical problem-symptom based approach is used in both Level 1 and Level 2. However, the primary difference is what type of information the Level 2-CE exam emphasizes. On Level 1, 75% of the questions test scientific understanding of mechanisms because the exam is

designed to test the knowledge and cognitive skills that would normally be acquired during the first two years of medical school. This is not the case for Level 2, which emphasizes History and Physical Examination, Health Promotion and Disease Prevention, and Diagnostic Technologies and Management. This is because the COMLEX Level 2 is designed to test the knowledge and skills that would normally be acquired during the Clerkship portion of medical school. Rather than basic sciences, the discipline areas on Level 2 are medical specialties, represented by the core rotations: Family Medicine, Internal Medicine, Emergency Medicine, Pediatrics, OB/Gyn, Surgery, Psychiatry, and OMM.

### TEST BLUEPRINT

Adequate preparation should begin with an understanding of what you will be tested on. As with Level 1, students should become familiar with the [test blueprint](#).

### WHEN SHOULD YOU TAKE COMLEX LEVEL 2-CE?

LUCOM does not mandate a date by which students must take COMLEX Level 2-CE; however, passing Level 2-CE and PE is a graduation requirement. Most students take the exams at some point during their 3<sup>rd</sup> year, most in May or June following their last rotation. Students are required to take and pass the CE of Level 2 prior to the start of audition rotations in July for OMS IV. For more information about LUCOM's policies regarding COMLEX Level 2-CE, please refer to the [LUCOM Student Handbook](#).

### HOW SHOULD YOU PREPARE FOR LEVEL 2-CE?

Preparation for Level 2-CE begins with your first rotation, just as preparation for Level 1 began with the first course of the first semester. Be as engaged as possible in all rotations, regardless of your level of interest in that specialty. Try to learn as much as possible from patient encounters and from the attending physicians, residents, and other medical students with whom you interact. Try to read a little every day about the cases you've seen. Study in earnest for your COMAT exams.

As with Level 1, it is useful to gauge your baseline performance, either by taking a version of COMSAE Phase 2 or by creating a practice test using your Qbank of choice. It is also important to be familiar with the test blueprint, create a study schedule, identify key resources, do practice questions, and assess your progress with practice tests.

## RECOMMENDED RESOURCES FOR LEVEL 2-CE

Most of the resources for COMLEX Level 2 are the same as those used to prepare for USMLE Step 2.

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### REVIEW BOOKS

- First Aid for USMLE Step 2 CK
- USMLE Step 2 Secrets—case-based (clinical vignettes with Q&A) review
- First Aid Cases for the USMLE Step 2—case-based (clinical vignettes with Q&A) review
- OMT Review by Savarese—the gold standard OMM Review book

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### QBANKS

- [UWorld](#)
- [COMQUEST](#)
- [COMBANK](#)

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### COMSAE PHASE 2

- [COMSAE Phase 2: Appropriate Diagnoses & Management for Various Clinical Problems](#)

For a more extensive list of resources, refer to the [Appendix](#) of this document.

## COMLEX LEVEL 2-PE

### DESCRIPTION OF THE EXAM

The COMLEX Level 2-Performance Exam (PE) must be taken on or before December 31 of the OMS-IV year at LUCOM. If on an alternative degree completion plan, timing of the COMLEX Level 2-PE examination will be assigned by the Office of Clinical Education for the student but should occur no later than five months before expected graduation.

For more information about LUCOM's policies regarding COMLEX Level 2-CE, please refer to the [LUCOM Student Handbook](#).

During this clinical skills exam, students encounter 12 standardized patients (SP) over the course of a 7-hour day. Examinees have 14 minutes for each patient encounter and 9 minutes to complete an electronic SOAP Note. The skills evaluated fall under two domains:

- Biomedical/Biomechanical Domain:

- Osteopathic Principles and/or Osteopathic Manipulative Treatment
- History-taking and Physical Examination Skills
- Integrated Differential Diagnosis and Clinical Problem-Solving
- Documentation and Synthesis of Clinical Findings (SOAP note format)
- Humanistic Domain
  - Physician-Patient Communication
  - Interpersonal Skills
  - Professionalism

## TEST BLUEPRINT

Adequate preparation should begin with an understanding of what you will be tested on. Students should become familiar with the [test blueprint](#).

## HOW IS THE COMLEX LEVEL 2-PE GRADED?

Students must pass BOTH the Biomedical/Biomechanical *and* the Humanistic Domains to pass the Level 2-PE. As outlined on the [NBOME website](#), candidates' history-taking and physical examination skills are documented by the SP portraying the patient immediately following the encounter, as are doctor-patient communication, interpersonal skills, and professionalism. Completed e-SOAP Notes and OMT skills (via a secured electronic recording process) are rated by NBOME trained and approved osteopathic physician examiners.

Pass or fail results are reported as the overall examination outcome reflecting the osteopathic medical profession standard for undergraduate students preparing for graduation and also for each of the two examination domains.

## WHY DO STUDENTS FAIL THE COMLEX LEVEL 2-PE?

Unsuccessful students typically:

1. Lack insight into how they will be graded—namely by the SPs
2. Do not understand that the exam is about process, not content
3. Rely almost exclusively on using a PE board book to prepare

Whatever the reason, the net result is that most students fail because they do not perform a [patient-centered](#) history and physical—e.g., they don't look at the patient, their body language is closed off, they fail to develop rapport, they don't convey empathy—and the SPs (rightly) assign a low score.

It is worth noting that students rarely demonstrate gross deficits in the biomedical/biomechanical domain, yet this is often the focus of exam preparation.

## FAILURE IS A “RED FLAG”

Take this exam seriously! Failure of this portion of the COMLEX is a “red flag” to residency program directors, even if scores on the cognitive exams are good (i.e., COMLEX Level 1 and Level 2-CE). Although you should do everything in your power to not fail the exam, at the same time, you must not be intimidated. This exam evaluates skills you practice and hone every time you interact with a patient. While on your rotations, be observant of how your preceptors treat patients and how patients react to your preceptors.

## APPENDIX

### RESOURCES FOR COMLEX LEVEL 1 & COMLEX LEVEL 2-CE

The following list of resources may be useful in your COMLEX exam preparation. **This is NOT a comprehensive list, and should not be used as a checklist and/or manual for being successful on COMLEX exams. LUCOM does not endorse any specific resource, product, or strategy.** Students are encouraged to research resources on and off this list for the COMLEX preparation. In deciding the resources to use, look first at what may work best for your needs as a Learner.

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### COMLEX LEVEL 1

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#### QUESTION BANKS

- COMBANK
  - Characteristics:
    - Access Strengths and weaknesses with analytics
    - Active learning methods to develop problem-solving skills
    - Additional OMM
    - Learn to think like a test-writer
  - Price (as of February 2019):
    - 1 month: \$169
    - 3 month: \$209
    - 6 month: \$309
    - 1 year: \$409
- UWorld
  - Characteristics:
    - Access students' basic science knowledge with 2000+ high quality, unrepeated multiple choice board-type questions by real-life physicians
    - Detailed explanation and educational objective for each question with excellent illustrations and charts that are easy to read and interpret
    - Board simulated interface software features (highlight, strike-out annotation, searchable lab values, calculator, mark/flag items, etc.)
    - Suspend and resume a test at any time at your convenience with 24-hour account web access
    - External references to medical journal abstracts
    - Mobile companion app available for iOS and Android based devices

- Price (as of February 2019):
  - 30 days: \$249
  - 90 days: \$349
  - 180 days: \$339
  - 360 days: \$499
  - 2 years: \$749
- Kaplan Medical
  - Characteristics:
    - COMLEX and USMLE Qbank
    - 5000+ questions
    - Video lecture series
    - OMM lecture series
    - 1 diagnostic exam used to create a detailed study plan
    - 2 full-length USMLE simulated exams
    - 1 full-length COMLEX simulated exam taken during ethics course
    - Mobile companion app
    - References to FirstAid, MedEssentials, and Pathoma
  - Price (as of February 2019):
    - For just the COMLEX Level 1 Qbank:
      - 12 months: \$129
      - 18 months: \$209
      - 24 months: \$279
    - For Level 1 and Step 1 Qbank:
      - 1 month: \$149
      - 12 months: \$289
      - 18 months: \$369
      - 24 months: \$439
- Doctors in Training COMLEX Level 1 Bundle
  - Characteristics:
    - Primer video series designed to prepare you with high yield USMLE Step 1 information for Part 1 and Part 2 of the course
      - 50 Primer videos cover a broad range of high yield review topics
      - Downloadable PDF Study Guides
      - Access through the date of your USMLE Step 1 or COMLEX Level 1 exam, available promptly after purchase
    - Part 1 Questions and Video Answers
      - 34 sets of 10 short answer questions three times a week

- High yield study questions are paired with concise video answers provided by physician educators
- Access through your USMLE Step 1 or COMLEX Level 1 exam date
- Part 2 Videos
  - Focused high yield videos, 70-75 hours, incorporating active learning principles and dynamic MD educators
  - The course contains more than 800 images, illustrations, charts, graphs, animations, and pathology slides, plus more than 50 Right Brain Bonuses
  - A high yield Part 2 study guide corresponding to the videos containing study questions, notes, diagrams, study hints, and quizzes
  - 60 days of access
- OMM Addition
  - 14 days of access to over 5 hours of video
  - Videos featuring specific topic instruction as well as review and technique demonstration on live patients and skeletal models
  - End-of-session quizzes to increase long-term retention
- Price (as of February 2019):
  - \$975
- [usmleRx](#)
  - Characteristics:
    - Companion to First Aid with explanations that tie directly to facts in First Aid for the USMLE Step 1
    - 2500+ USMLE-style questions written by high-scoring students
    - Tests are customizable by difficulty, general principles, and systems
    - Both tutorial and timed testing modes
    - Detailed performance feedback
  - Price (as of February 2019):
    - 1 month: \$119
    - 3 months: \$169
    - 6 months: \$249
    - 12 months: \$339
    - 24 months: \$449

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## BOOKS, STUDY TOOLS, AND OTHER RESOURCES

- [NBOME Practice Tests](#)
- [SketchyMedical](#)

- Type: Online Content
- Characteristics:
  - SketchyMicro: 100+ review cards; 900+ quiz questions
  - SketchyPath: 150+ review cards; 1500+ quiz questions
  - SketchyPharm: 100+ review cards; 1000+ quiz questions
- Price (as of February 2019):
  - Micro: \$99.99-\$159.99
  - Path: \$119.99-\$199.99
  - Pharm: \$99.99-\$159.99
- Picmonic
  - Type: Online Content
  - Characteristics:
    - Built by medical professionals
    - With powerful customization capabilities, your study resources become even more efficient, targeted and complete.
    - Everything you need to know to ace your exams through graduation, boards, certifications, and more.
    - 1,400 picmonics
    - 15,000 quiz questions
  - Price (as of February 2019):
    - Free limited access
    - 1 month (recurrent): \$24.99
    - 6 months: \$119.84 once
    - 12 months: \$179.88 once
    - 24 months: \$287.76 once
    - 48 months: \$479.52 once
- Pathoma
  - Type: Book/Online Content
  - Characteristics:
    - Fundamentals of Pathology is a medical course and Step 1 review.
    - High-yield outline format covering all major topics in pathology
    - Integrated review with key concepts from associated disciplines
  - Price (as of February 2019):
    - Free Access for basic study tools
    - Pathoma Pro starts at \$84.95
- Boards and Beyond
  - Type: Book/Online Content
  - Characteristics:

- Contains modules and videos for numerous topics covered on Level 1 and Step 1.
    - After you complete the videos, take the quizzes to test yourself.
    - There are also companion books that contain slides used in the videos.
  - Prices vary for length of access, ranging from \$19-\$249 (as of February 2019).
- Osmosis
  - Type: Online Content
  - Characteristics:
    - Comprehensive video coverage of pathology and physiology now available on Osmosis Prime with rapidly growing coverage of pharmacology and clinical reasoning
    - Flashcards powered by spaced repetition
    - Board-style questions to test and reinforce your knowledge
    - Customized study schedules
    - Integration with other study resources
    - Offline mode
  - Price (as of February 2019):
    - Free limited access
    - Prime access:
      - 1 year: \$299
      - 2 years: \$399
      - 4 years: \$599
- Osmosis Study Schedule
  - Type: Scheduler
  - Characteristics:
    - Zoom in and out to see daily, weekly, and monthly views of your schedule
    - Build multiple study schedules for your classes and exams
    - Keep track of class exam dates by adding them to your study schedule
    - Osmosis keeps your studying relevant by sending you practice questions and flashcards based on your study schedule for that day
    - The Osmosis study schedule aligns with your favorite resources, including First Aid, Pathoma, UWorld, SketchyMedical, and Picmonic
  - Price (as of February 2019):
    - Free limited access

- Prime access:
    - 1 year: \$299
    - 2 years: \$399
    - 4 years: \$599
- Cram Fighter
  - Type: Scheduler
  - Characteristics:
    - Cram Fighter generates a daily to-do list based on when you are taking your exam, which resources you are using, and how you want to study. Having a daily goal keeps you from getting overwhelmed.
    - Take the stress out of failing behind: Rebalance feature moves overdue tasks to future days to easily help you get back on track.
    - Warns you if your expected pace is significantly higher than the average student.
  - Price (as of February 2019):
    - 1 month (recurring): \$29
    - 3 month access: \$79 once
    - 4 month access: \$89 once
    - 5 month access: \$99 once
    - 12 month access: \$119 once
    - 2 year access: \$159 once
- First Aid for USMLE Step 1
  - Type: Book
  - Characteristics:
    - A complete framework for the USMLE Step 1 preparation, annually updated.
    - 1300+ must-know topics with mnemonics to focus your study
    - 1200+ color photos and illustrations
    - Rapid review section for efficient last minute preparation
  - Price depends on vendor and format of purchase
- OMT Review: A Comprehensive Review in Osteopathic Medicine
  - Type: Book
  - Characteristics:
    - A comprehensive review in osteopathic medicine.
    - The gold standard OMM review book
  - Price depends of vendor and format of purchase
- Rapid Review Pathology
  - Type: Book
  - Characteristics:

- Makes it easy for you to master all of the pathology material covered on the USMLE Step 1
  - Combines an updated outline format review of key concepts and hundreds of full-color images and margin notes, PLUS more than 400 USMLE-style online questions.
  - Price depends on vendor and format of purchase
- Clinical Microbiology Made Ridiculously Simple
  - Type: Book
  - Characteristics:
    - A brief, clear, thorough, and highly enjoyable approach to clinical microbiology, brimming with mnemonics, humor, summary charts and illustrations.
  - Price depends on vendor and format of purchase
- Board Review Series
  - Type: Book
  - Book Subjects:
    - Embryology
    - Pediatrics
    - Genetics
    - Biochemistry, Molecular Biology, and Genetics
    - Pharmacology
    - Microbiology and Immunology
    - Neuroanatomy
    - Behavior Science
    - Physiology
    - Gross Anatomy
  - Price depends on vendor and format of purchase

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## COMPLEX LEVEL 2-CE

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### QUESTION BANKS

- UWorld
  - Characteristics:
    - 2,300+ challenging Step 2 CK questions
    - In-depth explanations
    - Performance and improvement tracking
    - Flash cards
    - Customizable exams
  - Price (as of February 2019):
    - 30 days: \$249
    - 90 days: \$349

- 180 days: \$399
  - 360 days: \$499
  - 2 years: \$749
- COMQUEST
  - Characteristics:
    - Get immediate access to newly published, high quality COMLEX-style questions with explanations
  - Price (as of February 2019):
    - 1 month: \$109
    - 2 months: \$139
    - 3 months: \$159
    - 6 months: \$279
    - 1 year: \$369
- COMBANK
  - Characteristics:
    - 2000 COMLEX-style questions
    - Engineered to empower osteopathic medical students with the most realistic COMLEX experience
    - Computer-simulated environment
    - Hundreds of OMM items
  - Price (as of February 2019):
    - 1 month: \$169
    - 3 month: \$209
    - 6 month: \$309
    - 12 month: \$409
- Kaplan
  - Characteristics:
    - 2000+ exam-like questions in Step 2 CK Qbank
  - Price (as of February 2019):
    - 1 month: \$80
    - 12 months: \$160
- Doctors in Training
  - Characteristics:
    - 60 days of unlimited access to 50-55 hours of high yield online videos taught by DIT physician educators
    - High yield videos, skits, mnemonics, and quizzes to help keep your brain engaged
    - OMM Addition: 14-day, 18-video series that references the OMT Review
      - Technique demonstrations, slides, and visual aids
  - Price (as of February 2019):

- \$949

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## BOOKS, STUDY TOOLS, AND OTHER RESOURCES

- [NBOME Practice Tests](#)
- First Aid for USMLE Step 2 CK
  - Type: Book
  - Characteristics:
    - Co-written by students who excelled on the recent exam and reviewed by top faculty
    - Concise summaries of more than 1,000 commonly tested clinical topics for fast, high-yield study
    - Key Facts and mnemonics reinforce must-know concepts
    - Expert coverage of best initial steps in diagnosis and management
    - Updated Rapid Review section facilitates last-minute cramming
    - Hundreds of full-color photographs and illustrations
    - Revised study and test-taking strategies
    - A completely updated listing of top-rated review sources
  - Price depends on vendor and format of purchase
- OMT Review
  - Type: Book
  - Characteristics:
    - A comprehensive review in osteopathic medicine.
    - The gold standard OMM review book
  - Price depends on vendor and format of purchase
- USMLE Step 2 Secrets
  - Type: Book
  - Characteristics:
    - Learn the most important questions and answers with the proven format of the highly acclaimed Secrets Series®.
    - Master all specialty and subspecialty topics covered on Step 2.
    - Identify key facts in the "Top 100 Secrets."
    - Consult the book wherever you go thanks to a portable size that fits in your lab coat pocket.
    - Review material quickly and easily thanks to bulleted lists, algorithms, illustrations, and a new 4-color section featuring key pathologic and clinical images.

- Apply tips, memory aids, and "secrets" gathered by Theodore X. O'Connell, MD, and used trusted by students to pass the boards.
    - Find information quickly with a second color highlighting chapter and section titles, legends, bullets and icons, and key terms.
    - Benefit from thorough revisions that ensure high-yield focus and most current overview of board-tested content.
  - Price depends on vendor and format of purchase
- First Aid Cases for the USMLE Step 2
  - Type: Book
  - Characteristics:
    - 300+ high-yield cases written by students who aced the exam
    - Cases emphasize board-relevant diseases and concepts
    - Open-ended active recall questions and answers teach you to work through cases and reinforce must-know facts and concepts
    - Two-column format for easy self-quizzing
    - 100+ images, diagrams, and tables complement the cases
    - Organized the same ways as First Aid for the USMLE Step 2 CK and First Aid Q&A for the USMLE Step 2 CK to facilitate parallel study
  - Price depends on vendor and format of purchase
- Cram Fighter
  - Type: Scheduler
  - Characteristics:
    - Cram Fighter generates a daily to-do list based on when you are taking your exam, which resources you are using, and how you want to study. Having a daily goal keeps you from getting overwhelmed.
    - Take the stress out of failing behind: Rebalance feature moves overdue tasks to future days to easily help you get back on track.
    - Warns you if your expected pace is significantly higher than the average student.
  - Price (as of February 2019):
    - 1 month (recurring): \$29
    - 3 month access: \$79 once
    - 4 month access: \$89 once
    - 5 month access: \$99 once
    - 12 month access: \$119 once

- 2 year access: \$159 once

## STUDY TIPS FOR IMPROVING LONG-TERM MEMORY RETENTION AND RECALL

Adapted from Michigan State University College of Osteopathic Medicine Office of Academic and Career Guidance. Retrieved from [http://com.msu.edu/Students/Academic\\_Guidance/Updated%20Online%20Academic%20Documents/long\\_term\\_retention\\_recall.pdf](http://com.msu.edu/Students/Academic_Guidance/Updated%20Online%20Academic%20Documents/long_term_retention_recall.pdf)

### **MYTH BUSTERS**

- **Myth:** When a teacher says “don’t memorize this” it means stop paying attention because this won’t be on the exam.
- **Reality check:** WRONG! What they almost always mean is that you should understand the information, not just memorize it for later regurgitation. More than likely, it WILL be on the exam!

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### **BUILDING A MEMORY**

On its journey through the three stages of the brain’s memory storage system—sensory, short-term (STM), and long-term (LTM)—a tremendous amount of information is filtered out. Your goal as a medical student is to select learning strategies that maximize retention and minimize loss of IMPORTANT information.

- What are the take home messages?
  - Pay attention to the learning task at hand and avoid distractions
  - Get 7-8 hours of quality sleep on a regular basis
  - Incorporate “active recall” into your study plan
  - Deliberately link new information to existing knowledge
  - Adopt a deep approach to learning

All perceived stimuli enter your memory storage system as “sensory memories.” Stimuli you **attend to** enter short-term memory (STM)—your attention signals the brain, “Hey that’s important!” Depending on what you do next, some STMs will be lost and some will enter long-term storage. In the absence of continuous rehearsal (e.g., repeating a phone number over and over again), anything you recall after 24-hours (and probably after a minute) is long-term memory (LTM). Even so, many common study methods create “weak” memories (neural networks) that render retrieval all but impossible after a short period of time (hence erroneously referred to as “short-term” memory). Imagine that forming a LTM is like wearing a path in a rug. The first time you walk across a rug you leave footprints, but after a short time they are no longer detectable (STM). However,

the more you traverse the same path (rehearsal), the deeper and more permanent the wear pattern becomes (LTM).

Sensory Memory	Process: Sensory Encoding	Short-Term Memory (STM)	Process: Consolidation	Long-Term Memory (LTM)
<p>A sensory buffer that briefly and accurately holds all <i>perceived</i> sensory stimuli - sight, sound, smell, taste, and touch – for less than a second.</p>	<p>Crucial first step in memory creation.</p> <p><b><u>Attention is essential: ignored information vanishes.</u></b></p> <p>Not all information makes it into STM.</p>	<p>Holds 7 +/- 2 items for less than a minute.</p> <p><u>Chunking</u> increases the <i>amount</i> of information that can be held in STM.</p> <p><u>Rehearsal</u> increases the <i>length of time</i> in STM and improves the chances of transfer to LTM.</p> <p><b>Poor STM can be a limiting factor in learning.</b></p>	<p>Stabilization process in the conversion of STM to LTM.</p> <p><b><u>Deep (slow-wave) sleep is essential to creating long-term memories.</u></b></p> <p>Not all STM become LTM (or at least not in a way that can be later retrieved).</p> <p>New LTM is linked to existing LTM via formation and strengthening of neural pathways.</p>	<p>Permanent storage. LTM's are distributed throughout the brain.</p> <p>Memory decay diminishes ability to access a memory at a future time.</p> <p><b>Accessing LTM's (e.g., recall) strengthens the neural networks.</b></p>

Source: <http://www.human-memory.net/processes.html>

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### HOW ARE LONG-TERM MEMORIES (LTM) STORED?

The brain has a complicated storage system for long-term memories. A LTM is distributed in a neural network (i.e., a group of neurons primed to fire together) with different aspects of an episodic memory stored in the visual cortex and associated sounds stored in the auditory complex.

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### HOW ARE MEMORIES RETRIEVED?

“Remembering” (accessing a stored memory) involves replicating the pattern of neural activity that occurred when the memory was originally formed. The relative ease or difficulty of memory retrieval is related to the “strength” of the neural connections (like the depth of wear pattern in a rug). Because memories are stored throughout the brain, retrieval involves reconstructing the memory, like putting together a jigsaw puzzle.

- Example: Imagine trying to remember someone’s name, but you can only recall that the person was female and her name began with the letter “B”. So you mentally run through all the female names you know that begin with the letter B. Alas, recollection finally comes from a different retrieval cue altogether, “Her name was Betty and I remember because we talked about how much we both liked the Flintstones when we were kids.”

To be readily accessible, a memory needs to have multiple, relevant retrieval cues. Study methods that improve long-term retention and subsequent access to a stored memory involve intentionally creating meaningful associations. In the example above, retrieval cues included: female category, name begins with the letter B, instance of discussing mutual fondness of the Flintstones, and Betty Rubble was a Flintstone’s character.

Two main processes are used to access memories: recognition and recall.

**RECOGNITION** involves comparing a current stimulus (e.g., a sight, sound, or smell) to something sensed in the past; it is a single step process and is generally faster and easier. **RECALL** involves directly accessing information in LTM, and is generally more difficult because there are no direct retrieval cues, thus the entire neural path must often be reconstructed.

When retrieved, information is pulled from LTM back into “working” STM and must undergo a process of reconsolidation, which can strengthen and even alter the memory.

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### *WHAT DOES IT MEAN TO “FORGET”?*

In the absence of pathology, the human brain is capable of storing LTMs permanently, but “memory decay” is a normal physiological process. Just as new neural connections can be made, old ones that haven’t been used in a while can be “pruned”—“use it or lose it.” Forgetting is either the result of poor initial encoding and/or faulty retrieval—without adequate retrieval cues, a memory might as well not exist. Forgetting happens rapidly at first, but slows as time progresses. **Re-studying information at spaced intervals staves off forgetting and improves long-term retention and retrieval.**

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### WHAT IS “ROTE LEARNING”?

Rote learning methods are based exclusively on repetition and rehearsal—the idea is that the more something is repeated the easier (and more quickly) it can be recalled.

#### **Is rote learning a good study method?**

In some situations, but **generally not**. Rote methods represent a surface approach to learning that are very useful for some learning tasks, such as memorizing a long list of random words or numbers. **Medical students often utilize rote learning to their detriment, and describe their learning process as memorizing the course material**. However, “memorizing” and *learning* are not synonymous. Of course, one must “remember” something in order to later recall it to answer a test question, but rote memorization creates LTM that are particularly devoid of context, associations, and meaning. Rote study techniques do not lead to GENUINE UNDERSTANDING and fail to produce retrieval cues required to recall and APPLY information in a novel context such as answering an unfamiliar or higher order exam question.

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### WHAT ARE ALTERNATIVES TO ROTE LEARNING?

Alternatives to rote learning include deep learning approaches: meaningful learning, associative learning, and active learning.

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## STUDY TIPS FOR IMPROVING LONG-TERM RETENTION AND RETRIEVAL

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### WHAT ARE SOME STUDY METHODS THAT PRODUCE DEEP LEARNING?

- I. **Link new information to things you already know** (“elaborative rehearsal”). Access to memories is greatly improved when the information being learned is meaningful. To aid in recall, **study methods should involve deliberate creation of logical, intuitive, and even fanciful associations of existing knowledge**. Make sense of new information and develop an organizational scheme/framework. Information you understand rarely needs to be “memorized” using rote techniques.
  - **What to do:**
    - Use your own words to rephrase definitions/descriptions
    - Think of familiar examples—things that YOU can relate to
    - Use familiar acronyms, acrostics, analogies, codes, musical jingles and rhymes
    - Relate new information to knowledge from other courses (past or present) or to life experiences

- Think about how the information relates to the medical “big picture”: What is the clinical/practical significance? Why are you learning this? What is the impact on/relationship to patient diagnosis and treatment?
  - Create concept maps
- II. **Actively participate in your own learning** (“generation effect”). Retention and recall are improved when you actively participate in the creation of your own knowledge.
- **What to do:**
    - Create your own summaries, study guides, diagrams, charts, etc.
    - Ask and answer your own questions
    - Use your whole brain, not just your left hemisphere. Play around with information until some outstanding feature suggests a memory “hook”, such as a mnemonic, picture, pattern, rhyme, or story; the more emotive (funny, disgusting, etc.), the better.

NOTE: As a medical student, you probably don’t have time to do this for all your course material. However, the learning benefits of the creation process are undeniable. In the interest of efficiency, reserve self-generated memory enhancing study materials primarily for concepts that YOU find difficult or for trying to remember very detailed information that YOU are struggling with. While sharing student-created study aids is sometimes helpful, it may not be in a way that YOU will remember the information.

- III. **Create both a visual and verbal memory for the same information** (“dual coding”).
- **What to do:**
    - Associate words with pictures
      - Use your own words to describe a picture/figure/diagram
      - Translate a written passage into a drawing or diagram
    - Examples of specific memorization techniques that employ imagery include the method of loci and journey method
- IV. **Whenever possible, study in an environment that is similar to the testing environment** (“state- & context dependent memory”). Recall is enhanced when the environmental context is similar during both the encoding (learning) and recall phases, and is one reason why studying in a quiet place is generally preferable to a noisy one.
- V. **Spread studying out over several days, rather than cramming** (“distributed effort”). Say you’re going to spend 10 hours studying a particular topic, it is

more effective to spend that time as 10 one-hour sessions, or 5 2-hour sessions or even 2 5-hour sessions. This is why it is so very important to review every day. **Obviously, you cannot review everything every day, but make sure you frequently review the things that are most challenging to you.**

- VI. **Avoid multitasking when learning difficult or dense material.** Research has found that although multitasking does not impact recall, it is extremely detrimental to the encoding process. Multitasking divides attention, takes up valuable short-term memory space, and negatively impacts LTM formation.
- VII. **Review information you're trying to memorize right before you go to sleep.** Deep sleep plays an important role in memory consolidation. This is a good time to spend a few minutes reviewing a chart or going through some flash cards. To further enhance your memory, try to recall the information shortly after you wake up.
- VIII. **Self-quiz frequently by recalling information from your memory.** Every time you access a memory, you strengthen it. So, not only does self-quizzing help you identify your areas of weakness, it also helps you retain the information for later recall by strengthening the neural connections.

Reference:

Tigner RB (1999). "Putting Memory Research to Good Use" *College Teaching*, 47(4) 149.

## STUDY TIPS: HOW TO STUDY DETAILED INFORMATION

Adapted from Michigan State University College of Osteopathic Medicine Office of Academic and Career Guidance. Retrieved from [http://com.msu.edu/Students/Academic\\_Guidance/Updated%20Online%20Academic%20Documents/Studying%20Detailed%20Information.pdf](http://com.msu.edu/Students/Academic_Guidance/Updated%20Online%20Academic%20Documents/Studying%20Detailed%20Information.pdf)

### **MYTH BUSTERS**

- **Myth:** Details aren't important; what matters most is truly understanding concepts and principles.
- **Reality Check:** WRONG! Details are important, but all details are not equally important in every context—that is the trick. You need to understand concepts and general principles to make sense of and apply the details. It's the details that make the difference between a right and wrong diagnosis.

There are two types of students—those who like details and those who don't, but in medical school BOTH types may struggle remembering details. Why? *Volume.*

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## DETAIL-ORIENTED PEOPLE

**Detail-oriented people** dive in headfirst and focus their attention on committing all the details to memory, often at the expense of understanding the “big picture.” In many contexts, this serves them well, but in medical school, the sheer volume of information that must be committed to memory may be overwhelming and unmanageable. As a detail-oriented student, you may find that your normal study routine of systematically and methodically going through the information from beginning to end has you simply running out of time before you’ve memorized it all.

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### WHAT SHOULD DETAIL-ORIENTED PEOPLE DO?

If you derive pleasure from learning the specifics—facts and data—you need to make an extra effort to give the information meaning and to look for patterns.

- Take a step back and look for the underlying structure of what you’re learning, i.e., how the information is organized.
- Try the [SQR3 study method](#).
- Chunk and categorize information to decrease the load on your short-term memory.
- Take some time to think about the information and to make meaningful associations in your long-term memory, which will aid in recall and help you think through test questions even if you can’t recall the specifics.

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## BIG-PICTURE THINKERS

**Big-picture thinkers** tend to intensely dislike “the details”; what matters most to them are meaning, interconnectedness, and underlying patterns. As a big-picture thinker, you may find yourself “zoning out” when a lecture or reading assignment focuses on the specifics. You may have latched onto the notion that as long as you *understand* the concepts you’ll do fine. You may have found yourself thinking after an exam that the questions were “nit-picky” and tested your knowledge of useless facts/trivia.

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### WHAT SHOULD BIG-PICTURE THINKERS DO?

- Be mindful of details and allocate the appropriate amount of time to memorizing them.
- Your “big picture” thinking is of great value in coming up with ways to chunk and categorize the information to make it more manageable.
- Your big challenge is getting over your aversion to memorizing facts and data—sometimes it’s necessary.
- [Using Memory Effectively](#)

- While studying, pay attention to when you get fidgety, frustrated, sleepy, or when you start flipping pages looking for something interesting. These may be clues that the material is detail-oriented.

Rather than skimming, skipping, or flying through the material, this is your signal to slow down and spend more, not less, time learning it.

Adapted from Michigan State University College of Osteopathic Medicine  
Academic and Career Guidance