



| Medical College Admission Test

Testing Academic Competencies with the 2015 MCAT® Exam:

An Overview of What Admissions Officers Need to Know

A Better Test for Tomorrow's Doctors

Inside:

- A description of the academic competencies that will be tested and why they are important
- A look at the new test questions
- Detail about the ways in which fairness concerns guide test development and analysis

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Association of American Medical Colleges

www.aamc.org/mcat2015/admins

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For more information about the MCAT2015 exam, please see the MCAT2015 website: www.aamc.org/mcat2015

Overview

When the 2016 application cycle opens in the summer of 2015, you and your admissions colleagues will see the first applications from candidates who have taken the 2015 MCAT exam. These brave applicants will have taken an exam for which there were few available practice materials, no information from friends who already tested, and little information about the score levels that will be competitive. These test takers and their advocates will know less about the test and how to prepare for it than candidates who test later in the year.

Similar to these test takers, admissions committee members will have only preliminary information about the new exam and new scores when the application cycle opens. This is because the 2015 exam will test new academic competencies, scores will be reported on new scales, and the score reports will provide new information.

The goal of this guide is to help build a foundation for using the new MCAT scores in 2016 selection. This guide describes the competencies the new exam will test and why they are important. It describes what the new scores will tell you about applicants and provides examples of the kinds of questions applicants will answer. More important, this guide discusses fairness issues and efforts to ensure the new test is fair to racial/ethnic minority and economically disadvantaged test takers. The guide ends with an appendix that describes the evidence base for the new exam.

This guide is a companion to the guide and video titled, *The New Score Scales for the 2015 MCAT Exam: An Overview of What Admissions Officers Need to Know* (www.aamc.org/mcatscorescale), which provides a detailed description of the new score scales and makes suggestions for using new scores in 2016 selection. If you have questions about either guide, please do not hesitate to contact us:

You can reach us by phone at 202-828-0899 or email at mcat2015@aamc.org. We will be happy to provide additional information about the exam content, the new score scales, tools for admissions committee members, and available test results and validity data.

Why is the 2015 MCAT® exam better than the current test?

The 2015 MCAT exam is designed to help medical school admissions committees select students who are academically prepared for the curriculum they will begin in 2016. The blueprints for the new exam are organized around the academic competencies described by seminal reports like the *Scientific Foundations for Future Physicians* (www.aamc.org/scientificfoundations) and *Behavioral and Social Science Foundations for Future Physicians* (www.aamc.org/socialsciencefoundations). They target concepts that medical school faculty and residents recently rated as important to entering students' success.

The 2015 exam shifts the focus from testing what applicants know to testing how well they use what they know. It focuses on the outcomes of learning by asking test takers to apply what they have learned. The new exam asks test takers to use their knowledge of the natural, behavioral, and social sciences to solve problems that call for scientific reasoning.

The new exam asks applicants to show that they can think and learn like scientists. In today's information age, it is no longer possible for physicians to memorize all the information they need to make informed clinical decisions. Instead, future physicians will need to know where to find credible information, how to evaluate it, and how to translate it into high-quality care. The new MCAT blueprints recognize this by emphasizing scientific reasoning and analysis skills, asking test takers to reason about research designs and results, and asking test takers to interpret data and draw conclusions from them.

The new exam blueprints also recognize that scientists and physicians increasingly work across disciplinary boundaries, solving problems by bringing together theories, methods, and findings from different fields. The exam asks applicants to solve scientific problems that call on concepts from biology, chemistry, physics, biochemistry, psychology, and sociology. It asks them to show they can solve complex problems by integrating concepts from different disciplines.

The 2015 exam includes a brand new test section, which recognizes the critical roles behavioral and sociocultural factors play in health and illness. It aligns with behavioral and social sciences curricula that recognize tomorrow's physicians need to understand how behavior interacts with biological factors to influence health outcomes and how social inequities impact patients' health.

In testing applicants' competencies in the natural, behavioral, and social sciences, and on the successor to the current Verbal Reasoning section of the MCAT exam, the 2015 exam uses the most current science on cognitive processing to test applicants' skills comprehending and analyzing what they read, drawing inferences from text and data, and solving scientific problems.

The quantitative and qualitative research that supports the definition and development of the 2015 MCAT exam is strong. The data that were gathered during blueprint development and the ways in which they were used to build the new exam are described in Appendix 1.

Because it balances testing in the natural sciences with testing in the behavioral and social sciences and the new reasoning section, the 2015 exam communicates the value that medical school admissions committees place on broad preparation for medical school, and it reinforces the diversity of interests and preparation that committee members look for in their applicants.

How will the 2015 MCAT exam help admissions committees make decisions about applicants?

The 2015 MCAT exam is designed to help you and your admissions colleagues:

- Identify candidates with the competencies that medical school faculty and residents recently rated as most important to entering students' academic success.
- Identify applicants who are academically prepared for the curriculum they will begin in 2016.
- Use a common metric to evaluate the academic preparation of applicants with different course-taking histories and from institutions with different curricula and grading standards.
- Predict your students' academic performance in medical school and on licensing exams.

Used in combination with information about applicants' course completion, grades, grade trends, institutional selectivity, research experience, and other academic information, the 2015 scores will help paint a picture of applicants' academic preparation.

Because the new exam includes more questions than the current exam, the individual section scores will be more reliable than current section scores. They will offer better information about applicants' strengths and weaknesses across the test sections and in relation to your curriculum requirements and goals.

The companion guide on the new score scales for the 2015 MCAT exam, mentioned earlier, provides more detail about the information that 2015 scores will provide and how they can be used with other data to build an entering class that meets the academic, clinical, service, and research missions of your medical school.

What competencies will the 2015 MCAT exam test?

As we mentioned, the blueprints for the new exam are organized around the competencies described in reports about the *Scientific Foundations for Future Physicians* and *Behavioral and Social Science Foundations for Future Physicians*. In describing the most important competencies, these reports emphasize deep knowledge of central concepts in the natural, behavioral, and social sciences, and describe the ways in which students should be prepared to demonstrate them.

The 2015 MCAT exam includes three test sections in the natural, behavioral, and social sciences:

- Biological and Biochemical Foundations of Living Systems
- Chemical and Physical Foundations of Biological Systems
- Psychological, Social, and Biological Foundations of Behavior

The new exam includes a fourth section:

- Critical Analysis and Reasoning Skills

Testing in the Natural Sciences

In the natural sciences, the 2015 exam tests five competencies that mirror those described in the *Scientific Foundations for Future Physicians* report. These are shown in Figure 1. At most colleges and universities, students learn the concepts that support these competencies in year-long introductory courses in biology, organic chemistry, inorganic chemistry, physics, and first-semester biochemistry. Figure 1 shows the supporting concepts for each of the five competencies. It also shows how the five competencies lay the foundation for learning important parts of the medical school curriculum.

Figure 1. Natural Sciences Competencies

Biological and Biochemical Foundations of Living Systems Section			Chemical and Physical Foundations of Biological Systems Section	
Competency #1	Competency #2	Competency #3	Competency #4	Competency #5
Biomolecules have unique properties that determine how they contribute to the structure and function of cells, and how they participate in the processes necessary to maintain life.	Highly organized assemblies of molecules, cells, and organs interact to carry out the functions of living organisms.	Complex systems of tissues and organs sense the internal and external environments of multicellular organisms, and through integrated functioning, maintain a stable internal environment within an ever-changing external environment.	Complex living organisms transport materials, sense their environment, process signals, and respond to changes using processes that can be understood in terms of physical principles.	The principles that govern chemical interactions and reactions form the basis for a broader understanding of the molecular dynamics of living systems.
1A. Structure and function of proteins and their constituent amino acids	2A. Assemblies of molecules, cells, and groups of cells within singular cellular and multicellular organisms	3A. Structure and functions of the nervous and endocrine systems and ways in which these systems coordinate the organ systems	4A. Translational motion, forces, work, energy, and equilibrium in living systems	5A. Unique nature of water and its solutions
1B. Transmission of genetic information from the gene to the protein	2B. The structure, growth, physiology, and genetics of prokaryotes and viruses	3B. Structure and integrative functions of the main organ systems	4B. Importance of fluids for the circulation of blood, gas movement, and gas exchange	5B. Nature of molecules and intermolecular interactions
1C. Transmission of heritable information from generation to generation and the processes that increase genetic diversity	2C. Processes of cell division, differentiation, and specialization		4C. Electrochemistry and electrical circuits and their elements	5C. Separation and purification methods
1D. Principles of bioenergetics and fuel molecule metabolism			4D. How light and sound interact with matter	5D. Structure, function, and reactivity of biologically relevant molecules
			4E. Atoms, nuclear decay, electronic structure, and atomic chemical behavior	5E. Principles of chemical thermodynamics and kinetics

How these Competencies Lay the Foundation for Learning in Medical School

Building Block #1	Building Block #2	Building Block #3	Building Block #4	Building Block #5
With these building blocks, medical students will be able to learn how the major biochemical, genetic, and molecular functions of the cell support health and lead to disease.	With these building blocks, medical students will be able to learn how cells grow and integrate to form tissues and organs that carry out essential biochemical and physiological functions.	With these building blocks, medical students will be able to learn how the body responds to internal and external stimuli to support homeostasis and the ability to reproduce.	With these building blocks, medical students will be able to utilize core principles of physics to learn about the physiological functions of the respiratory, cardiovascular, and neurological systems in health and disease.	With these building blocks, medical students will be able to utilize core principles of human chemistry to learn about molecular and cellular functions in health and disease.

The 2015 exam asks test takers to show they can use these competencies and supporting concepts to solve problems by demonstrating four scientific reasoning skills; specifically, the new exam asks test takers to demonstrate:

- *Knowledge of scientific concepts and principles* by showing understanding of scientific principles and by identifying the relationships between closely related concepts
- *Scientific reasoning and problem solving* by reasoning with scientific principles, theories, and models and by analyzing and evaluating scientific explanations and principles
- *Reasoning about the design and execution of research* by demonstrating understanding of important concepts in scientific research and by reasoning about ethical issues in research
- *Data-based and statistical reasoning* by interpreting patterns in data presented in tables, figures, and graphs and by reasoning about data and drawing conclusions from them

Test takers are asked to use the four scientific reasoning skills to demonstrate they can work with the competencies and concepts. Among the research methods and statistics concepts applicants need to demonstrate are basic probability, measures of central tendency, measures of variability, confidence intervals, statistical significance levels, graphical presentation of data, hypothesis formulation, independent and dependent variables, hypothesis testing, and reporting research results. At most colleges and universities, students learn these concepts in introductory biology, chemistry, physics, and biochemistry courses and labs, as well as in introductory psychology and sociology courses.

The kinds of questions that applicants will answer on the 2015 MCAT exam are shown in the section of this guide beginning on page 7.

Testing in the Behavioral and Social Sciences

The conceptual framework for the Psychological, Social, and Biological Foundations of Behavior section of the 2015 MCAT exam follows the same format as the natural sciences tests. The blueprints are organized around five competencies and related concepts, which test takers are asked to demonstrate by using the four scientific reasoning skills just described. The new Psychological, Social, and Biological Foundations of Behavior section tests whether applicants have the foundation for learning about the human and social aspects of medicine in medical school. At most colleges and universities, students learn the competencies and supporting concepts in introductory psychology, sociology, and biology courses.

The five competencies and supporting concepts are shown in Figure 2, which also shows how these competencies provide the building blocks for learning in medical school about the impact of behavioral and sociocultural factors on illness and health outcomes.

Figure 2. Behavioral and Social Sciences Competencies

Psychological, Social, and Biological Foundations of Behavior Section				
Competency #6	Competency #7	Competency #8	Competency #9	Competency #10
Biological, psychological, and sociocultural factors influence the ways that individuals perceive, think about, and react to the world.	Biological, psychological, and sociocultural factors influence behavior and behavior change.	Psychological, socio-cultural, and biological factors influence the way we think about ourselves and others, as well as how we interact with others.	Cultural and social differences influence well-being.	Social stratification and access to resources influence well-being.
6A. Sensing the environment	7A. Individual influences on behavior	8A. Self identity	9A. Understanding social structure	10A. Social inequality
6B. Making sense of the environment	7B. Social processes that influence human behavior	8B. Social thinking	9B. Demographic characteristics and processes	
6C. Responding to the world	7C. Attitude and behavior change	8C. Social interactions		
How these Competencies Lay the Foundation for Learning in Medical School				
Building Block #6	Building Block #7	Building Block #8	Building Block #9	Building Block #10
With these building blocks, medical students will be able to learn about the ways in which cognitive and perceptual processes influence their understanding of health and illness.	With these building blocks, medical students will be able to learn how behavior can either support health or increase risk for disease.	With these building blocks, medical students will be able to learn how to communicate and collaborate with patients and other members of the health care team.	With these building blocks, medical students will be able to learn about the ways in which patients' social and demographic backgrounds influence their perceptions of health and disease, the health care team, and therapeutic interventions.	With these building blocks, medical students will be able to learn about the ways in which social and economic factors can affect access to care and the probability of maintaining health and recovering from disease.

The next section of this guide includes questions from the Psychological, Social, and Biological Foundations of Behavior section that ask test takers to use the four scientific reasoning skills to demonstrate they can use the competencies and concepts to solve problems in the behavioral and social sciences.

Testing Critical Analysis and Reasoning Skills

The final section of the 2015 exam is the Critical Analysis and Reasoning Skills test. It improves on the current Verbal Reasoning test by using the latest science in cognitive processing to test how well applicants comprehend, analyze, and evaluate what they read, draw inferences from text, and apply arguments and ideas to new situations.

It also improves on the Verbal Reasoning test by drawing source material from a wide range of humanities and social science disciplines. While the current Verbal Reasoning test includes passages from the natural sciences, the Critical Analysis and Reasoning Skills test does not. The new exam gives increased attention to passages about population health, studies of diverse cultures, ethics, and philosophy. It focuses on these disciplines with the notion that drawing attention to them will encourage applicants to read broadly and familiarize themselves with the issues and arguments these disciplines raise. The questions on the Critical Analysis and Reasoning Skills test do not rely on specific background knowledge in the humanities and social sciences. Test takers get all the information they need to answer the questions in the accompanying passages.

An example of how the new exam measures analysis and reasoning skills appears in the next section of the guide.

A more complete description of the 2015 exam, along with more than 100 example questions, appears in *The Official Guide to the MCAT Exam (MCAT2015), Fourth Edition* (www.aamc.org/officialmcatguide2015).

How will the 2015 MCAT exam test the competencies needed by entering medical students?

In this section of the guide, we provide examples of questions for each of the four test sections. For the natural, behavioral, and social science sections, the examples show how applicants have to use their scientific reasoning skills to solve problems that rely on the ten competencies and their supporting concepts. For each example, a passage provides the context for the questions. Some questions also rely on information presented in tables, charts, or graphs.

For each of the four sections, we show a question that is easy for most MCAT test takers to answer, a question that is medium in difficulty for most test takers, and a question that is hard for most test takers. Each question includes an explanation of the things that test takers need to know and do to get the question right.

Example: Biological and Biochemical Foundations of Living Systems

The myocellular transmembrane Na^+ gradient is important for proper cellular function. During septic shock, disruption of Na^+ homeostasis often occurs and leads to decreased membrane potential and increased intracellular Na^+ . It has been found that failure of cellular energy metabolism is a common symptom in septic patients who do not respond to therapeutics. Because normal intracellular levels of Na^+ are maintained by the Na^+K^+ ATPase, it is important to understand how metabolic energy production is linked to cation transport.

Researchers are interested in whether the energy used for ion transport is derived from glycolysis or oxidative phosphorylation. This information would provide a better understanding of myocellular damage that occurs during critical illness. Experiments were conducted to evaluate the effects of glycolytic inhibition on cellular Na^+ and K^+ concentrations and lactate production in rat skeletal myocytes.

Rat skeletal muscle fibers were extracted and incubated in normal media (control), glucose-free media ($\text{G}(-)$), and glucose-free media with various concentrations of the glycolytic inhibitor iodoacetate (IAA). IAA directly prevents the formation of 1,3-bisphosphoglycerate. After one hour in the media, the muscle tissues were assayed for intracellular Na^+ and K^+ content and lactate production. Cellular viability was determined by measuring the amount of lactate dehydrogenase (LDH) released, as LDH release is an indicator of cell death. The results are displayed in Figure 1.

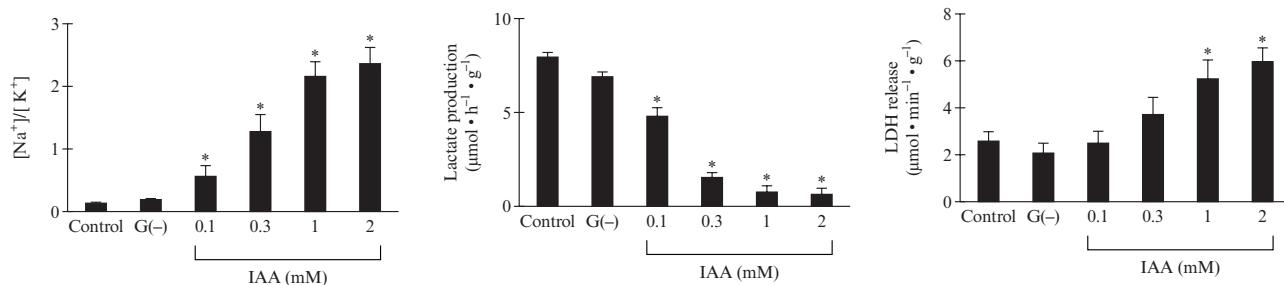


Figure 1 Effects of glycolytic inhibition on intracellular Na^+ and K^+ content and lactate production with cellular viability measured by LDH release. (Note: The * indicates $p < 0.05$ versus control.)

The researchers also examined the effect disruption of oxidative phosphorylation had on Na^+ and K^+ content. Inhibition of oxidative phosphorylation was caused by carbonyl-cyanide *m*-chlorophenylhydrazone (CCCP), an ionophore that allows protons to move freely through membranes. No correlation between Na^+ and K^+ content and oxidative phosphorylation was found.

Adapted from: Okamoto K, Wang W, Rounds J, Chambers EA, Jacobs DO. ATP from glycolysis is required for normal sodium homeostasis in resting fast-twitch rodent skeletal muscle. *The American Journal of Physiology-Endocrinology and Metabolism*. 2001 Sept;281(3):E479-88.

Question 1. The researchers chose a concentration of 0.3 mM IAA as the working concentration for any additional studies instead of 1 mM or 2 mM. What is the likely reason for this?

- A) The lower concentration of IAA gave the largest Na^+ response.
- B) Higher concentrations induced significant cytotoxicity.
- C) The solubility of IAA was not high enough.
- D) The researchers were trying to mimic control conditions as closely as possible.

Along with other questions on the exam, this question asks test takers to demonstrate their mastery of Competency #2. It asks them to apply their understanding of the ways in which highly organized assemblies of molecules, cells, and organs interact to carry out the functions of living organisms. This question asks test takers to reason about the design and execution of research using their knowledge of cytotoxicity and cell lysis. To answer this question, test takers have to know that conducting an experiment where the level of IAA is cytotoxic to the cells (when compared to control conditions) will not help them understand the role of glycolysis in establishing ion concentration gradients, as these cells will lose membrane integrity and undergo lysis. Therefore, the experimental design should not use an IAA concentration that results in significantly increased cell lysis. **B is the correct answer to this question.**

This question is easy for most test takers

Question 2. The information in the passage suggests that glycolysis:

- A) is important for maintaining normal Na^+ and K^+ levels in skeletal muscle.
- B) facilitates membrane permeability in skeletal muscle.
- C) impedes the function of the Na^+K^+ ATPase in skeletal muscle.
- D) is regulated by the Na^+K^+ ATPase in skeletal muscle.

This question is of medium difficulty for most test takers

Along with other questions on the exam, this question asks test takers to demonstrate their mastery of Competency #1. It calls on their understanding of the unique properties of biomolecules that determine how they contribute to the structure and function of cells and how they participate in the processes necessary to maintain life. This question asks test takers to reason about data using their knowledge of glycolysis. To get this question right, test takers have to recognize that the data trend in Figure 1, which shows increasing concentration of IAA results in a higher ratio of the concentration of Na^+ to K^+ than observed in the control sample, must be correlated with the role of IAA in the disruption of glycolysis. This is further supported by the drop in lactate production shown in Figure 1 at higher concentrations of IAA, because IAA prevents the formation of NADH, which is used when pyruvate is reduced to lactate. The combination of the proposed role of IAA and the results from Figure 1 should lead test takers to the conclusion that glycolysis is important to the Na^+K^+ ATPase and, therefore, important to the maintenance of the concentration ratio of Na^+ to K^+ . **A is the correct answer to this question.**

Question 3. If the effects of IAA treatment in nerve cells are the same as those observed in myocytes, which feature of an action potential would be most affected by IAA treatment?

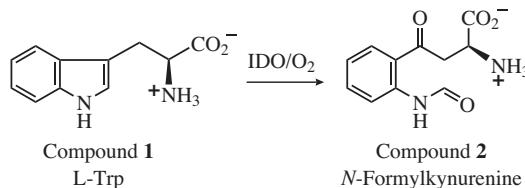
- A) Initiation of depolarization
- B) Rising phase of depolarization
- C) Falling phase to undershoot
- D) Return to resting potential

This question is hard
for most test takers

Along with other questions on the exam, this question asks test takers to demonstrate their mastery of Competency #3. It asks them to apply their understanding of the ways in which complex systems of tissues and organs sense the internal and external environments of multicellular organisms, and through integrated functioning, maintain a stable internal environment within an ever-changing external environment. This question asks test takers to combine their scientific reasoning and problem-solving skills with their knowledge of the role of the Na^+K^+ ATPase in the recovery of the nerve cell resting potential after an action potential. To get this question right, test takers have to use information from the passage about the effect of IAA treatment to reason about the way in which inhibition of glycolysis by IAA will affect the cellular concentration of ATP. This question asks test takers to propose a hypothesis about which portion of an action potential would be affected by IAA treatment. **D is the correct answer to this question.**

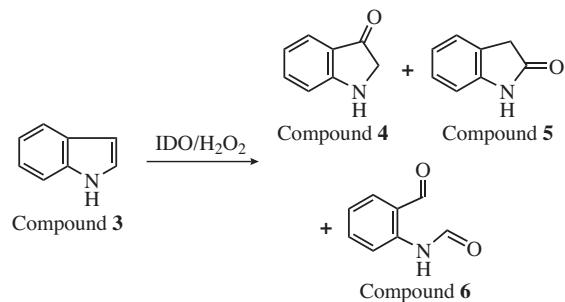
Example: Chemical and Physical Foundations of Biological Systems

The heme enzyme indoleamine 2,3 dioxygenase (IDO) catalyzes Reaction 1, the first and rate-determining step of L-tryptophan (Compound **1**) metabolism, and is an important enzyme of the human immune system.



Reaction 1

The IDO-catalyzed oxidation of Compound **1** by H_2O_2 does not occur. However, researchers have recently discovered that IDO-catalyzed oxidation of indole (Compound **3**) by H_2O_2 (Reaction 2) does occur.



Reaction 2

Under the conditions employed, the number of catalytic turnovers appeared to stop at roughly 100, on average. A plot of the concentration of Compound **3** that was oxidized versus the concentration of H_2O_2 employed, at two different initial concentrations of IDO, gave the results shown in Figure 1.

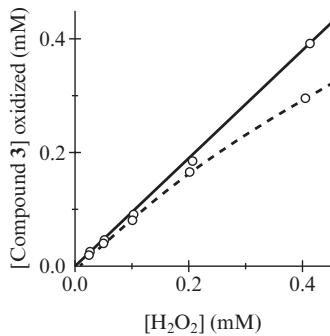


Figure 1 Stoichiometry of IDO-catalyzed oxidation of Compound **3** by H_2O_2 at 1 μM (dashed line) and 10 μM (solid line) IDO

Aerobic oxidation of Compound **3** in the presence of ^{18}O -labeled $\text{H}_2^{18}\text{O}_2$ resulted in the formation of ^{18}O -labeled oxidation products (Table 1).

Table 1 Isotopic Composition of Compound **3** Oxidation Products Using $\text{H}_2^{18}\text{O}_2$

Product	Percentage of ^{18}O incorporated (%)	
	Mono- ^{18}O	Di- ^{18}O
Compound 4	100	—
Compound 5	100	—
Compound 6	60	40

The formation of Compound **6** does not appear to be the result of a sequential oxidation process. Isotopically labeled Compound **4** does not exchange ^{18}O for ^{16}O in water over 3 hours, but Compound **6** completely loses its' ^{18}O label in unlabeled water over the same time period.

Adapted from: Kuo HH, Mauk AG. Indole peroxygenase activity of indoleamine 2,3-dioxygenase. *Proceedings of the National Academy of Sciences of the United States of America*. 2012;109(35):13966–71.

Question 1. The progress of Reaction 2 can be monitored by observing what change to the IR spectrum of the product mixture?

- A) Appearance of a broad peak at 3400 cm^{-1}
- B) Disappearance of a broad peak at 3400 cm^{-1}
- C) Appearance of a sharp peak at $1700\text{--}1750\text{ cm}^{-1}$
- D) Disappearance of a sharp peak at $1700\text{--}1750\text{ cm}^{-1}$

This question is easy for most test takers

Along with other questions on the exam, this question asks test takers to demonstrate their mastery of Competency #4. It asks them to apply an understanding of the ways in which complex living organisms transport materials, sense their environment, process signals, and respond to changes using processes that can be understood in terms of physical principles. It asks test takers to combine their scientific reasoning and problem-solving skills with their knowledge of infrared spectroscopy. To get this question right, test takers have to understand the structural differences between the products and reactants of Reaction 2 and apply the scientific model of the differences in IR absorbance of various functional groups to the experiment described in the passage. Recognition of the presence of additional carbonyl groups in the products of the reaction should lead test takers to conclude that the appearance of a peak between $1700\text{--}1750\text{ cm}^{-1}$ in the IR spectrum will provide the most effective way to monitor product formation. **C is the correct answer to this question.**

Question 2. The following kinetic parameters were obtained for the IDO-catalyzed oxidation of Compound **3** by H_2O_2 in the presence of L-Trp.

This question is of medium difficulty for most test takers

[L-Trp], μM	$k_{\text{cat}}, \text{s}^{-1}$
0	1.3
2	0.34
5	~ 0

Based on these data, what effect does L-Trp have on the reaction?

- A) L-Trp oxidizes Compound **3** directly.
- B) L-Trp is oxidized instead of Compound **3**.
- C) L-Trp does not interact with the enzyme.
- D) L-Trp inhibits the enzyme.

Along with other questions on the exam, this question asks test takers to demonstrate their mastery of Competency #5. It asks them to use the principles that govern chemical interactions and reactions and demonstrate a broad understanding of the molecular dynamics of living systems. This question asks test takers to reason about data using their knowledge of enzyme kinetics. To get this question right, test takers have to understand what the decreasing values of k_{cat} in the presence of higher concentrations of L-Trp mean with respect to the kinetics of IDO-catalyzed indole oxidation. The k_{cat} is representative of the rate of product turnover, which means that the enzyme produces less product in the presence of L-Trp. Combing this trend in the data with knowledge of enzyme kinetics should lead test takers to the conclusion that L-Trp is inhibiting the reaction. **D is the correct answer to this question.**

Question 3. Which experiment can be used to show that Compound **6** is not formed sequentially from either Compound **4** or Compound **5**?

- A) Conduct the reaction of Compound **4** with Compound **5**, and identify the products.
- B) Oxidize Compound **4** and Compound **5** with IDO/H₂O₂, and identify the products.
- C) Reduce pure Compound **6** without added catalyst, and identify the products.
- D) Conduct the reaction of Compound **2** with H₂O₂ without added catalyst, and identify the products.

This question is hard
for most test takers

Like the last question, this question asks test takers to demonstrate their mastery of Competency #5. Drawing from principles that govern chemical interaction and reactions, this question asks test takers to reason about the design and execution of research using their knowledge of the way that enzymes catalyze reactions. To get this question right, test takers have to know how researchers can be sure that Compound **6** is not formed from either Compound **4** or Compound **5** in a sequential enzyme mechanism. Enzymes are not used up during catalysis, so any experiment that includes just Compound **4** or just Compound **5** would determine if either is also a substrate for IDO-catalyzed conversion to Compound **6**. Having both compounds in solution with IDO adds unnecessary complexity to the interpretation of the experimental results. Examining the products of IDO-catalyzed reduction of Compound **6** does not give the necessary direct evidence, as Compound **6** could be sequentially reduced to Compound **3**. **B is the correct answer to this question.**

Example: Psychological, Social, and Biological Foundations of Behavior

In Study 1, a study on stereotype threat, a group of men and women were randomly assigned to take a standardized math assessment under three different conditions. The conditions differed in terms of the information that was given to the participants before they started working on the task. The problem-solving group was told that the math assessment was a problem-solving task. The math assessment group was told that their scores were going to be used to study gender differences in mathematical ability. The teaching intervention group was given the same information as the math assessment group, but they also were instructed on what stereotype threat is and how it may affect performance. Figure 1 summarizes the results of this study.

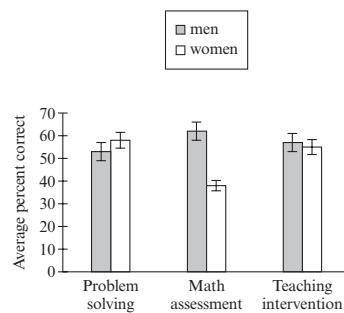


Figure 1 Average percent correct on the math assessment by group

Anxiety has often been considered an explanation for stereotype threat. Study 2 was conducted to explore the role of anxiety on cognitive performance. Participants were required to memorize lists of target words. During the training phase, before each target word was presented to them, the participants were asked to read a sentence out loud. Half of the participants read sentences containing words that triggered self-doubt, and the other half read sentences containing words that triggered self-confidence. In the retrieval phase, the participants were asked to report as many of the target words as they could remember. The participants remembered more words under the self-confidence condition than the self-doubt condition. As part of the design of Study 2, the researchers also measured electrical skin conductance and salivary cortisol levels. They found that the participants in the self-doubt condition had higher levels of skin conductance and cortisol than those in the self-confidence condition.

Adapted from: Schmader T. Stereotype threat deconstructed. *Current Directions in Psychological Science*. 2010;19(1):14-18.

Question 1. The effect of stereotype threat was observed in the performance of:

- A) the women in the problem-solving group.
- B) the men in the teaching intervention group.
- C) the women in the math assessment group.
- D) both the men and women in the teaching intervention group.

This question is easy for most test takers

Along with other questions on the exam, this question asks test takers to demonstrate their mastery of Competency #8. It asks them to apply their understanding of the ways in which psychological and sociocultural factors influence the way we think about ourselves and others, as well as how we interact with others. This question asks test takers to reason about data and statistics using their knowledge of stereotype threat. To get this question right, test takers have to use information from the passage and graph to decide which observation allows researchers to draw conclusions about the effect of stereotype threat. The graph shows lower performance among women compared to men in the Math Assessment condition (shown as a significant difference, using the error bars). **C is the correct answer to this question.**

Question 2. Which statement best explains women's performance in the teaching intervention group compared to the math assessment group?

- A) Women in the teaching intervention group attributed their anxiety to situational factors, and thus their performance was better than women in the math assessment group.
- B) Women in the teaching intervention group attributed their anxiety to dispositional factors, and thus their performance was better than women in the math assessment group.
- C) Women in the teaching intervention group were informed about stereotype threat, and thus their performance was worse than women in the math assessment group.
- D) Women in the teaching intervention group were reminded of gender stereotypes, and thus their performance was worse than women in the math assessment group.

This question is of medium difficulty for most test takers

Like the last question, this question asks test takers to demonstrate mastery of Competency #8. It asks test takers to combine their scientific reasoning and problem-solving skills with their knowledge of attributional processes. To get this question right, test takers have to evaluate which explanation best accounts for the findings in Study 1. Using the graph, they should conclude that women's performance in the teaching intervention group is better than women's performance in the math assessment group. Test takers have to recognize that in both conditions, gender stereotypes are activated. The question requires test takers to decide which statement provides the best explanation of the different findings across conditions. Test takers should conclude that, among the listed explanations, the most likely one is that women in the teaching intervention group attribute test-related anxiety to a situational factor. **A is the correct answer to this question.**

Question 3. Which statement presents the most likely explanation for why the researchers in Study 2 collected skin conductivity information? The researchers collected this information to determine whether:

This question is hard for most test takers

- A) the independent variable had the intended effect on the participants.
- B) the independent variable had an effect on the dependent variable.
- C) the self-doubt words caused stereotype threat whereas the self-confidence words did not.
- D) the self-doubt words were more effective than the self-confidence words.

Along with other questions on the exam, this question asks test takers to demonstrate mastery of Competency #7. It requires an understanding of the ways in which biological, psychological, and sociocultural factors influence behavior and behavior change. This question asks test takers to reason about the design and execution of research using their knowledge of the biological bases of behavior. To get this question right, test takers have to determine why an added measure was included as part of the research design in Study 2. They have to recognize that the independent variable in Study 2 (self-confidence versus self-doubt) is intended to manipulate participants' anxiety levels and that the measures of electrical skin conductance and salivary cortisol levels can be used as a physiological check for the successful manipulation of the independent variable. Test takers should recognize that as anxiety levels increase, so do conductance and salivary cortisol levels. **A is the correct answer to this question.**

Example: Critical Analysis and Reasoning Skills

A predetermined covenant of confidentiality characterizes the physician-patient relationship. Possession of contraband in prison is illegal. But suppose that during a routine medical examination, a prison physician notices that Prisoner A has drugs and paraphernalia. Should the physician report the crime, or should confidentiality prevail?

Professional communications between physicians and patients are statutorily protected as confidential. A routine physical examination is part of the confidential communication, like information obtained by taking a medical history and data entered in the patient's health record. Health professionals have an interest in maintaining confidentiality so that patients will feel comfortable in revealing personal but necessary information. Prisoners do not possess full constitutional rights to privacy, but they generally retain rights to privacy when there is a special relationship between communicants, such as the physician-patient relationship. In fact, respect for confidentiality is particularly important in a prison hospital setting in which patients feel distrust because physicians often are employed by the incarcerating institution.

Clinical autonomy for health professionals in the prison setting is essential for good medical practice. Physicians working in prisons also retain the privilege of confidential interactions with patients, although the prison authorities may try to pressure doctors to supply information. Even if physicians are employed by the prison, their first responsibility is to their patients. The circumstances in which to give privileged information to prison authorities remains the physician's decision.

The finding that contraband detected during an examination has the appearance of drugs and paraphernalia, like all results of the examination, is privileged information to be treated confidentially. The right to privacy supersedes a duty to report the discovery because there is no imminent threat to others. In contrast, a weapon harbored by a prisoner represents an imminent threat to other prisoners and prison staff. Thus, upon discovering a sequestered weapon during the course of a routine examination, the physician has a "duty to warn." According to case law, when the physician believes that a significant threat of harm exists, the duty to warn takes precedence over the patient's right to privacy.

The case of Prisoner A raises the issue of the point at which to draw the line between the duty to protect the public and the duty to protect patients' privacy. Although legal guidelines can assist the physician in making the choice, the health professional must rely on a guiding principle of the medical profession: Where no danger to others exists, patients come first.

The possibility of discovering contraband during routine examinations of prisoner patients reinforces the need for informed consent at several stages. First, prisoner patients should be evaluated and treated only after they provide informed consent, unless they are incompetent. Before an X-ray is taken, they should be informed that it can demonstrate metal and other foreign bodies, and their agreement to the procedure should be obtained. Second, if a concealed weapon is discovered during a routine examination, the prisoner patient should be informed that the discovery will be reported and given the opportunity to surrender the weapon to authorities before more forcible means are taken to remove it. If Prisoner A is harboring drugs and a needle, drug use is quite possibly contributing to A's health problem. It is the physician's responsibility to educate A about the potential harm of drug use.

Adapted from: Levine C, ed. *Cases in Bioethics: Selections from the Hastings Center Report*. St. Martin's Press; 1989.

Question 1. Which of the following conclusions about physician confidentiality can be inferred from the passage?

- A) It is more likely to be assumed in a private setting than in a prison.
- B) It is especially important when patients are incompetent to give informed consent.
- C) It is threatened by the use of invasive diagnostic tools such as X-rays.
- D) It is an aspect of a constitutional right that is lost by prisoners.

This question is easy for most test takers

Along with other questions on the exam, this question asks test takers to demonstrate that they can comprehend and draw inferences about what they read. Test takers do not need bioethics knowledge to get this question right. All of the information they need to answer the question is included in the passage. The passage says that patients may distrust physicians who work for incarcerating institutions. Test takers have to infer that patients would be more likely to trust that physicians in non-institutional or private settings would maintain confidentiality.

A is the correct answer to this question.

Question 2. The author argues that a routine examination is part of the confidential communication between a patient and a physician, and that the clinical autonomy of the physician is essential for good medical practice in prisons. These beliefs imply that:

- A) if the quality of medicine practiced in a prison declines, a physician has violated the confidentiality of a routine examination.
- B) if all physicians in a prison refuse to reveal information about prisoners obtained during routine examinations, the physicians in that prison have clinical autonomy.
- C) if all physicians who conduct routine examinations in a prison respect their patients' confidentiality, the quality of medicine practiced in the prison is high.
- D) if a physician is required to reveal information about a prisoner obtained during a routine examination, the quality of medicine practiced in the prison suffers.

This question is of medium difficulty for most test takers

Along with other questions on the exam, this question asks test takers to analyze and evaluate what they read. To get this question right, test takers have to synthesize the author's claims in order to identify some logical conclusions. They have to conclude that the quality of medical care will suffer if clinical autonomy is absent. **D is the correct answer to this question.**

Question 3. Which of the following claims, if assumed to be true, would most weaken the argument made for the special importance of the physician-patient covenant within prisons?

- A) Prisoners understand that X-rays will detect hidden weapons.
- B) Prisoners assume that physicians are independent of the institution.
- C) Prison officials often question physicians about prisoners.
- D) Prisoners often misunderstand their constitutional rights.

This question is hard for most test takers

Along with other questions on the exam, this question asks test takers to make a judgment about the impact of new information on arguments made in the passage. This question makes a number of claims about prisoners' understanding of their constitutional rights and the health care they will receive in prison. To get this question right, test takers have to identify which of the claims most weakens one of the central tenets of the passage. Test takers have to recognize that the physician-patient covenant is less critical to good care in prisons where physicians practice independently of the institution. **B is the correct answer to this question.**

Will the 2015 MCAT exam be fair to racial/ethnic minority and economically disadvantaged applicants?

Concerns about fairness were important considerations in designing the 2015 MCAT exam. They helped shape the blueprints for the new exam, and they are integral to the development and analysis of test questions for the new exam. They also guide analyses of student results on the exam.

Developing the blueprints for the new exam

Concerns about fairness played a critical role in developing the new exam blueprints. As we have already mentioned, the Psychological, Social, and Biological Foundations of Behavior section gives special attention to cultural differences and social justice. It tests the ways in which social stratification and access to resources influence well-being. Test questions ask about prejudice and bias, stereotypes, discrimination, culture, social groups, demographic structures, spatial inequality, and health care disparities.

Similarly, the Critical Analysis and Reasoning test highlights passages about population health, studies of diverse cultures, ethics, and philosophy. As we have already explained, applicants do not need to study these disciplines to do well on this section, but reading in these areas before testing is likely to help applicants familiarize themselves with the issues and arguments these disciplines raise.

The architects of the new exam also considered the availability of courses on targeted competencies as a fairness issue. Before introducing new concepts, blueprint designers checked course offerings at minority-serving and underresourced colleges and universities to ensure students have access to the needed courses. The designers also surveyed faculty at these institutions to learn about the content of their courses, and they examined data on students' course-taking behaviors to learn whether students at these institutions complete the needed classes. These analyses of course offerings, course content, and course taking at minority-serving and underresourced institutions guided the blueprints for the new exam.

Another prominent fairness issue in designing the new exam was that of testing time. Although each of the sections of the new exam includes more questions than sections of the current exam, they also allow for more testing time. In fact, the design of the new test gives examinees more working time per question than on the current exam. Test takers will have more time to review passages, read questions, and decide on their answers. This additional processing time is likely to be especially useful for English-language learning candidates and individuals with disabilities.

Finally, as previously mentioned, the 2015 MCAT exam balances testing in the natural sciences with testing in the behavioral and social sciences and critical analysis and reasoning. The hope is that this balance will help diversify the physician workforce by making the exam and medical school application more attractive to individuals from more varied academic and demographic backgrounds.

Verifying that the new exam measures the competencies reflected in the blueprints

MCAT exam researchers reviewed several lines of evidence to verify that the new exam measures the competencies needed by entering medical students. In 2013 and 2014, test takers tried out questions for the 2015 exam. Researchers compared test takers' scores on the new questions to their undergraduate majors and course-taking histories in biochemistry, psychology, and sociology. They reviewed scores for test takers from minority-serving and underresourced institutions, and for Hispanic, African-American, and white test takers, and for males and females. They also reviewed scores for test takers who received fee assistance and those who did not. The score patterns for students from different backgrounds and different experiences helped determine that the new test questions measure academic preparation rather than factors that could contribute unfairly to group differences.

We also asked baccalaureate and medical students to comment on passages and questions from the Psychological, Social, and Biological Foundations of Behavior section of the new exam. These students provided rich commentary on the topics tested, how the content compared to material they studied as undergraduates, and which topics might be distracting because of their focus on potentially sensitive sociocultural issues. Reviewing this qualitative feedback helped the test developers hone in on the competencies of interest, minimizing unrelated material that might be distracting to test takers from different backgrounds.

Writing and testing questions for the new exam

Test developers work hard to ensure that questions are fair to racial/ethnic minorities and test takers with disabilities. They focus on fairness in a number of ways.

- Question writers, editors, and reviewers all receive rigorous training and feedback to ensure test takers have equal opportunities to show what they can do.
- Questions are reviewed for possible bias by reviewers from varied racial/ethnic backgrounds.
- When new questions are tried out, results are examined separately for Hispanic, African-American, and white test takers, and for males and females to ensure none contribute unfairly to group differences.
- Questions that show large group differences are examined for possible bias and are dropped if bias is evident.
- Appropriate accommodations are provided to individuals with disabilities or health-related needs; these accommodations include extra testing time, distraction-free administrations, and paper test forms.

Contacting us

This guide is a companion to the guide and video titled *The New Score Scales for the 2015 MCAT Exam: An Overview of What Admissions Officers Need to Know* (www.aamc.org/mcatscorescale), which provides a detailed description of the new score scales and makes suggestions for using new scores in 2016 selection. If you have questions about either guide, please do not hesitate to contact us:

You can reach us by phone at 202-828-0899 or email at mcat2015@aamc.org. We will be happy to provide additional information about the exam content, the new score scales, tools for admissions committee members, and available test results and validity data.

Appendix: What is the evidence base for the 2015 MCAT exam

The blueprints for the 2015 MCAT exam rest on a broad evidence base. They reflect advice from expert panels and recommendations from national reports about the academic competencies entering medical students need to be prepared for academic success in medical school. The blueprints take into account feedback provided by participants at more than 90 outreach events and data from more than 2,700 surveys completed by faculty and administrators from U.S. and Canadian medical schools and baccalaureate institutions. They also were informed by analyses of test takers' work on the current MCAT exam and by course-taking data from medical school applicants.

The qualitative and quantitative data that were gathered and the ways in which they were used to design blueprints for the new exam are described in Appendices 1 and 2.

Appendix 1

The Qualitative Evidence Base for the MCAT2015 Exam*

	Recommendations from expert panels	Findings from national reports and the broader literature	Input from MCAT stakeholders
Data collected	<p>The following expert panels provided important input to the MR5 Committee:</p> <ul style="list-style-type: none"> • Scientific Foundations for Future Physicians Committee • Behavioral and Social Science Foundations for Future Physicians Committee • Holistic Review Project Advisory Committee 	<p>National reports in natural and social sciences education informed the MR5 Committee's work, including</p> <ul style="list-style-type: none"> • <i>Scientific Foundations for Future Physicians</i>² • <i>Behavioral and Social Science Foundations for Future Physicians</i>¹¹ • <i>Vision and Change in Undergraduate Biology Education—A Call to Action</i>⁴ • <i>A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas</i>⁵ • <i>Science, College Board Standards for College Success</i>⁶ • <i>Improving Medical Education: Enhancing the Behavioral and Social Science Content of Medical School Curricula</i>¹² <p>The committee's work was additionally informed by the broader literatures on</p> <ul style="list-style-type: none"> • Medical school admissions • Racial and ethnic group differences in academic achievement • Bias in testing • Stereotype threat • Test speededness • Predictive value of MCAT scores 	<p>MR5 Committee members solicited input on the current and future MCAT exams at 90 events attended by baccalaureate and medical school stakeholders. Participants included</p> <ul style="list-style-type: none"> • Prehealth advisors and baccalaureate faculty • Medical school administrators and faculty • Medical students • Members of disciplinary societies and higher education associations <p>Participants described what they liked and did not like about the current exam, what they wanted the future exam to do, and what they thought about the MR5 Committee's (then) current thinking.</p>
How data were gathered	The MR5 Committee and the three expert panels reported progress at panel and committee meetings from 2008 to 2011. The expert panels' reports also informed the MCAT review.	Between 2008 and 2011, MR5 Committee members studied national reports and selected literature reviews.	MR5 Committee members and AAMC staff tracked themes in stakeholders' input between 2008 and 2011 and reported and discussed them at the 10 committee meetings.
How samples were selected	The MR5 Committee included two members each from the three expert panels.	MR5 Committee members, expert panel members, outside experts, and interested stakeholders identified the national reports and literatures of greatest significance.	MR5 Committee members, expert panel members, outside experts, and interested stakeholders identified meetings and conferences of greatest interest. Committee members and AAMC staff organized sessions at these events. They also responded to invitations from organizers of additional events.
How data were used	The data informed decisions about the quantitative data to collect, the extant data to analyze, and the disciplines to test.		

*The MCAT2015 exam is the version of the Medical College Admission Test that will be introduced in 2015. The MR5 Committee is the committee charged by the Association of American Medical Colleges with conducting the fifth comprehensive review of the MCAT exam (MR5). The committee reviewed the 1991 version of the exam and designed the blueprint for the new exam.

Appendix 2

The Quantitative Evidence Base for the MCAT2015 Exam*

	Surveys of medical school administrators	Surveys of medical school faculty, residents, and students	Surveys of baccalaureate faculty	Analyses of extant data
Data collected	<ul style="list-style-type: none"> Medical school admission officers and academic affairs officers described the disciplinary knowledge and academic skills they wanted entering students to have. Admission officers described the ways that they and their committees review applications and select students. 	<p>Medical school faculty, residents, and medical students completed surveys that described the natural science concepts that entering students need to know in order to succeed in medical school now and in the curriculum likely to be in place five years in the future. Surveys asked respondents to rate baccalaureate-level concepts in</p> <ul style="list-style-type: none"> Introductory biology (including genetics) General chemistry Organic chemistry Physics Biochemistry Cellular/molecular biology Research methods Statistics <p>Respondents rated concepts on a scale from 1 (not important) to 5 (extremely important); a "cannot rate" option also was available.</p>	<p>Baccalaureate faculty completed surveys about the natural science concepts that they cover in their current courses and expect to teach in the curriculum likely to be in place five years in the future. Surveys asked respondents to rate concepts in</p> <ul style="list-style-type: none"> Introductory biology (including genetics) General chemistry Organic chemistry Physics Biochemistry Cellular/molecular biology Research methods Statistics <p>Respondents rated the extent to which they cover concepts in their current curricula and likely future curricula on a scale from 1 (not covered) to 4 (covered in greater depth); a "cannot rate" option also was available.</p>	<p>MR5 Committee analyses of extant data examined</p> <ul style="list-style-type: none"> Medical student selection rates by MCAT scores and GPAs Medical school course prerequisites College and university course offerings Applicants' course taking The predictive validity of MCAT scores Differences by racial and ethnic group on MCAT, in testing time, and in the predictive validity of MCAT scores Possible advantages of different score-reporting options
How data were gathered	Online surveys were administered in 2008 and 2009. Response data were summarized with descriptive statistics. ^{13,14}	Online surveys were administered in fall 2009, and response data were summarized with descriptive statistics. ⁷ Inferential statistics were used to examine differences in importance ratings across the different respondent groups.	Online surveys were administered in winter 2009, and response data were summarized with descriptive statistics. ⁷ Inferential statistics were used to examine differences in coverage ratings across minority-serving and majority-serving institutions.	Between 2008 and 2011, committee members studied descriptive data and inferential statistics derived from a number of data sources, including AAMC's Data Warehouse, AAMC's Medical School Admissions Requirements 2009–2010, college and university Web sites, and the scientific literature.
How samples were selected	<p>Admission and academic affairs officers from all MD-granting medical schools in the United States and Canada that use MCAT were invited to participate, and 226 completed surveys. Respondents represented 141 medical schools. Response rates: 90% for admission officers, 70% for academic affairs officers.</p> <p>In another survey, 1,008 basic and clinical science faculty were invited to provide importance ratings for success in the curriculum likely to be in place five years in the future. Of the 841 (83%) who responded, the final analytic samples had response rates ranging from 80% to 88% across the disciplines. (Response data for faculty who reported a lack of confidence in their future ratings were omitted from the final samples.)</p>	<p>2,001 basic and clinical sciences faculty, medical students, and residents from all MD-granting medical schools in the United States and Canada that use MCAT were invited to complete surveys, and 1,300 (65%) responded, representing 114 medical schools and providing data about the importance of natural science concepts to success in the current curricula.</p> <p>For ratings of concept coverage in the future curriculum, 846 (83%) respondents were included in the final analytic sample. (Data for respondents who reported a lack of confidence in their future ratings were omitted from the final sample.) Across disciplines and institution types, the final sample represented between 12% and 53% of institutions. The median percentage of minority-serving institutions was 22%, and the median percentage of majority-serving institutions was 45%. Across disciplines, the response rates ranged from 43% to 61%, with the median at 53%.</p>	<p>1,599 biology, cellular/molecular biology, chemistry, biochemistry, and physics faculty from 121 minority-serving and 169 majority-serving institutions in the United States and Canada were invited to complete surveys. Minority-serving institutions were oversampled to ensure that there would be sufficient data on their curricula. 1,023 (64%) of invitees responded, representing 188 institutions.</p>	<p>Examinee, applicant, and medical student datasets included records from 2000 to 2009. Sample sizes ranged from 12,374 to 114,856. Course prerequisite data were examined for all MD-granting medical schools in the United States and Canada that use the MCAT exam. Course-offering data were examined for 121 minority-serving institutions and for 169 majority-serving institutions.</p>

(Appendix Continues)

Appendix 2, Continued

Surveys of medical school administrators	Surveys of medical school faculty, residents, and students	Surveys of baccalaureate faculty	Analyses of extant data	
How data were used	Data were used to decide which disciplines and concepts to test on the new exam and which to use as stimuli for testing examinees' critical analysis and reasoning skills.	Together, the medical school and baccalaureate data were used to identify concepts eligible for testing on the new MCAT exam. To be eligible, concepts had to meet eligibility criteria in both the medical school and baccalaureate datasets. To meet the medical school eligibility criterion, concepts had to have average importance ratings of 3.0 or higher for entering medical students' success in the future curriculum.	To meet the baccalaureate data criterion, concepts had to be covered at a minimal level (at a scale value of 2 or higher) at 50% or more of baccalaureate institutions in introductory sequences in biology, chemistry, physics, or first-semester biochemistry. For the vast majority of concepts, data about concept coverage at minority-serving institutions were statistically indistinguishable from data from other institutions.	Analyses informed decisions about the disciplines and concepts to test, the length of the exam, score-reporting scales, and other issues.

*The MCAT2015 exam is the version of the Medical College Admission Test that will be introduced in 2015. The MR5 Committee is the committee charged by the Association of American Medical Colleges with conducting the fifth comprehensive review of the MCAT exam (MR5). The committee reviewed the 1991 version of the exam and designed the blueprint for the new exam.



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