



Tomorrow's Doctors, Tomorrow's Cures®

MR5

Ratings of the Importance of Natural Sciences, Research Methods, and Statistics Topics on the MR5 Content Surveys (Draft)

Prepared for the MR5 Advisory Committee
Summer 2010

Description of the Natural Sciences, Research Methods, and Statistics Surveys

Background

The AAMC is in its second year of a multi-year review of the MCAT exam. The MR5 committee is tasked with reviewing the MCAT exam and recommending changes that are likely to increase MCAT's value to medical school admissions committees. This review (MR5) is the fifth time that the MCAT exam has been reviewed since it was first administered in 1928. In standardized testing, periodic reviews of examinations are considered a best practice and are particularly important in fields with rapidly-changing knowledge bases.

The committee is likely to vet its recommendations for the new test in fall 2011. The earliest a new test could be introduced is 2014.

In conducting the review, committee members are gathering input on the current and future tests through surveys and other information-gathering activities. They recently surveyed medical school faculty, residents, and medical students to learn which concepts entering students need to know in order to succeed in medical school. Content surveys in the natural sciences, research methods and statistics were administered in the first round of data collections. Respondents were asked which concepts are important for students to know when they enter medical school in order to succeed in the current and likely future medical school curriculum.

The data presented in Tables 1-7 are preliminary results from the MR5 surveys of medical school respondents. The following text provides a brief description of the administration plan, survey content and response scale, description of the sample, results, and next steps.

Administration Plan

All medical schools in the United States and Canada that use the MCAT exam were invited to participate in the surveys (n = 143). MCAT staff contacted the Dean of each medical school and asked him/her to nominate a point of contact (POC) for data collection. The POCs were asked to nominate survey respondents to make judgments about the importance of entry-level concepts.

The POC was asked to nominate one basic science faculty, one clinical science faculty, one experienced resident, and one fourth-year medical student to complete each of six disciplinary surveys. POCs were asked to select nominees who are knowledgeable about the current curriculum and involved in discussion about curriculum reform the medical school, in their disciplines, and in medical education generally. MCAT staff contacted each nominee directly via email with an invitation to complete the survey.

Survey content and response scale

The survey asked respondents to rate content in the following disciplines: Biology, General and Organic Chemistry, Physics, Biochemistry, Cell and Molecular Biology, Research Methods, and Statistics. Genetics topics were included with the content in several disciplines. Each disciplinary survey included a list of topics. Survey respondents were instructed to rate the degree to which students' knowledge of these topics, at the time of entrance into medical school, is likely to be important for mastery of the schools' current curriculum. Faculty respondents also made ratings about importance to the school's likely future curriculum.

Importance ratings were made on a 5-point Likert-type scale ranging from not important (1) to extremely important (5).

Description of the Sample

The final samples reasonably represent medical schools with respect to public and private institutions and U.S. and Canadian institutions. The percentages of medical schools with at least one completed survey per discipline (out of 143) ranged from 60 to 80 percent across the different surveys. The overall response rate (i.e., the number of respondents who completed at least one topic rating divided by the total number invited) was 65 percent for the natural sciences and 74 percent for research methods and statistics.

Results

Mean importance ratings for the disciplinary surveys appear in Tables 1-7. Also shown are the topics that overlap with the entering competencies recommended by the AAMC-HHMI Scientific Foundations for Future Physicians (SFFP) committee.

Next Steps

Baccalaureate faculty completed surveys in spring 2010 that describe their treatment of these topics in introductory and advanced courses. These data, along with a myriad of other data, including data about medical school prerequisites and applicants' course taking, will be considered in the MR5 committee's final recommendations for the future exam.

Table 1. Mean Importance Ratings for Biology Topics (1 of 2)

Topic	Mean for the Current Curriculum ^{1,2} ,3,4	Mean for the Future Curriculum ^{1,2} ,3,4	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Molecular Biology and Genetics				
Enzyme Structure and Function	3.41	3.58	0.17	√
Control of Enzyme Activity	3.27	3.30	0.03	√
Basic Metabolism	3.48	3.59	0.11	√
DNA Structure and Function	3.94	4.27	0.33	
DNA Replication	3.31	3.67	0.36	
Repair of DNA	3.13	3.44	0.31	
Recombinant DNA and Biotechnology	3.04	3.75	0.71	
Genetic Code	3.61	3.85	0.24	√
Transcription	3.39	3.71	0.32	√
Translation	3.32	3.63	0.31	√
Control of Gene Expression in Prokaryotes	2.23	2.51	0.28	√
Eukaryotic Chromosome Organization	2.71	3.00	0.29	
Control of Gene Expression in Eukaryotes	2.99	3.33	0.34	√
Genetics - Mendelian Concepts	3.85	3.92	0.07	√
Genetics - Meiosis & Other Factors Affect. Gen. Var.	3.65	3.84	0.19	√
Genetics - Analytic Methods	2.48	2.75	0.27	
Cellular Biology				
Cell Theory	2.46	2.63	0.17	
Fungi	2.60	2.69	0.09	
Virus Structure	3.25	3.30	0.05	
Viral Life Cycle	3.14	3.27	0.13	
Prokaryotic Cell - Classification and Structure	3.13	3.15	0.02	√
Prokaryotic Cell - Growth and Physiology	3.00	3.08	0.08	√
Prokaryotic Cell - Genetics	2.63	2.66	0.03	√
Eukaryotic Cell - Nucleus	3.46	3.57	0.11	√
Eukaryotic Cell - Membrane-Bound Organelles	3.66	3.70	0.04	√
Eukaryotic Cell - Plasma Membrane	3.75	3.78	0.03	√
Eukaryotic Cell - Cyto-skeleton	2.88	3.05	0.17	√
Eukaryotic Cell - Mitosis	3.64	3.68	0.04	√
Specialized Cell - Nerve Cell	3.42	3.37	-0.05	√
Specialized Cell - Muscle Cell	3.29	3.21	-0.08	√
Other Specialized Cell Types	3.18	3.34	0.16	√
Biology of Body Systems				
Endocrine System - Hormones and Their Sources	3.30	3.40	0.10	√
Endocrine System - Mechanisms of Hormone Action	3.06	3.08	0.02	√
Nervous System - Structure and Function	3.08	3.07	-0.01	√
Nervous System - Sensory Reception & Processing	2.68	2.63	-0.05	√
Immune System	3.10	3.27	0.17	√
Respiratory System	3.06	2.99	-0.07	√
Circulatory System	3.28	3.24	-0.04	√
Digestive/Excretory System	3.08	3.03	-0.05	√
Reproductive System	3.11	3.10	-0.01	√
Lymphatic System	2.52	2.59	0.07	√
Muscle System	2.90	2.88	-0.02	√

Importance Rating Scale
 5 = Extremely Important
 4 = Very Important
 3 = Important
 2 = Somewhat Important
 1 = Not Important
 9 = Unable to Rate

(continued)

Table 1. Mean Importance Ratings for Biology Topics (2 of 2)

Topic	Mean for the Current Curriculum ^{1,2} , _{3,4}	Mean for the Future Curriculum ^{1,2} , _{3,4}	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Skeletal System	2.82	2.85	0.03	✓
Skin System	2.55	2.55	0.00	✓
Integrative and Systems Biology				
Integrative Analysis of Complex Systems	1.96	2.44	0.48	✓
Ex. - Integration of Systems at Whole Body Level	2.67	2.79	0.12	✓
Developmental, Organismal, and Population Biology				
Dev. Biology - Embryogenesis	2.79	2.94	0.15	✓
Dev. Biology - Mechanisms of Development	2.75	3.05	0.30	✓
Comparative Anatomy	2.01	2.24	0.23	
Energetic Relationships	1.92	2.04	0.12	
Ecosystem Dynamic	1.87	2.28	0.41	
Evolution	2.48	2.73	0.25	✓
Individual Vertebrate Behavior	2.14	2.32	0.18	✓
Behavioral Relationships	1.95	2.14	0.19	✓
Overall Mean Topic Rating	2.97	3.12	0.15	

Notes

1. N ranges from 232-257 for current ratings and 113-130 for future ratings.
2. Standard Deviations range from .85-1.30 for current ratings and .83-1.33 for future ratings.
3. Dark blue = ratings ≥3.50; Medium blue = ratings between 3.00-3.49; Light blue = ratings between 2.50-2.99; Yellow = difference between future and current ratings ≥.25.
4. Ratings were made on a 5-point Likert-type scale. Importance ratings ranged from 1 = Not Important, 2 = Somewhat Important, 3 = Moderately Important, 4 = Very Important, 5 = Extremely Important, and 9 = Unable to Rate.
5. These topics overlap with the entering competencies recommended by the AAMC-HHMI Scientific Foundations for Future Physicians (SSFP) committee.

Table 2. Mean Importance Ratings for General Chemistry Topics

Topic	Mean for the Current Curriculum ¹ 2,3,4	Mean for the Future Curriculum ¹ 2,3,4	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Classification of the Elements and Their Properties				
Atomic and Nuclear Structure	3.17	3.27	0.10	√
Electronic Structure	2.56	2.64	0.08	√
Periodic Tbl. - Class. of Elmts. by Elec. Structure	2.84	2.87	0.03	√
Periodic Tbl. - Variation of Chem. Prop. Group & Row	2.67	2.67	0.00	√
Molecular Structure				
The Ionic Bond - Electrostatic Forces Between Ions	2.05	2.18	0.13	√
The Covalent Bond	2.89	2.87	-0.02	√
Other Types of Bonding	2.36	2.46	0.10	
Molecular Structure and Spectra	2.71	2.91	0.20	√
States of Matter				
Gas Phase	3.25	3.11	-0.14	
Liquid Phase - Intermolecular Forces	3.42	3.47	0.05	√
Solid Phase - Crystal Struct.; Charge Bal.& the Unit Cell	1.89	1.90	0.01	
Phase Equilibria	3.06	2.97	-0.09	
Chemical Reactions				
Stoichiometry	3.68	3.82	0.14	√
Energy Changes in Chem. Reactions - Thermochem.	3.13	3.19	0.06	√
Rate Processes in Chem. Reactions - Kinetics & Equil.	3.66	3.70	0.04	√
Solution Chemistry				
Ions in Solution	4.04	4.01	-0.03	√
Solubility	3.75	3.86	0.11	√
Acid/Base Equilibria	4.17	4.19	0.02	√
Phase Titration	2.99	3.01	0.02	
Electrochemistry	2.49	2.47	-0.02	√
Separations and Purifications	2.46	2.60	0.14	√
Special Topics in General Chemistry				
Modern Materials	1.88	2.21	0.33	
Chemistry of the Non-metals	1.71	1.65	-0.06	
Overall Mean Topic Rating	2.91	2.96	0.05	

Importance Rating Scale
5 = Extremely Important
4 = Very Important
3 = Important
2 = Somewhat Important
1 = Not Important
9 = Unable to Rate

Notes

1. N ranges from 229-239 for current ratings and 112-118 for future ratings.
2. Standard Deviations range from .91-1.12 for current ratings and .90-1.14 for future ratings.
3. Dark blue = ratings ≥3.50; Medium blue = ratings between 3.00-3.49; Light blue = ratings between 2.50-2.99; Yellow = difference between future and current ratings ≥.25.
4. Ratings were made on a 5-point Likert-type scale. Importance ratings ranged from 1 = Not Important, 2 = Somewhat Important, 3 = Moderately Important, 4 = Very Important, 5 = Extremely Important, and 9 = Unable to Rate.
5. These topics overlap with the entering competencies recommended by the AAMC-HHMI Scientific Foundations for Future Physicians (SSFP) committee.

Table 3. Mean Importance Ratings for Organic Chemistry Topics

Topic	Mean for the Current Curriculum ^{1,2} _{,3,4}	Mean for the Future Curriculum ¹ _{2,3,4}	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Molecular Structure				
The Covalent Bond	2.89	2.87	-0.02	✓
Molecular Structure and Spectra	2.71	2.91	0.20	✓
Separations and Purifications	2.46	2.60	0.14	✓
Aliphatic Hydrocarbons and Related Groups				
Alkanes	2.63	2.74	0.11	✓
Alkenes	2.19	2.27	0.08	✓
Alkynes	2.07	2.17	0.10	✓
Alkyl Halides	2.15	2.15	0.00	✓
Dienes	1.92	2.01	0.09	✓
Units of Unsaturation	2.1	2.2	0.10	
Aromatic Hydrocarbons and Related Groups				
Benzene and Aromatic Hydrocarbons	2.33	2.43	0.10	✓
Arenes	2.03	2.19	0.16	✓
Compounds Containing Oxygen				
Alcohols	2.68	2.7	0.02	✓
Phenols	2.3	2.49	0.19	✓
Ethers	2.15	2.27	0.12	✓
Aldehydes and Ketones	2.5	2.58	0.08	✓
Carboxylic Acids	2.67	2.82	0.15	✓
Acid Derivatives (Acid Chlorides, Anhydrides, Amides, Esters)	2.5	2.66	0.16	✓
Dicarboxylic Acids, Anhydrides, Imides	2.31	2.34	0.03	✓
α, β-Unsaturated Carbonyl Compounds	1.99	2.1	✓	✓
1,3-β-dicarbonyl compounds	1.82	2.01	0.19	✓
Compounds Containing Nitrogen				
Amines	2.51	2.68	0.17	✓
Other Nitrogen-Containing Compds. (Nitriles, Nitro, etc.)	2.16	2.25	0.09	✓
Organic Compounds Containing Other Elements				
Sulfur Compounds	2.37	2.58	0.21	✓
Phosphorus Compounds	3.52	3.59	0.07	✓
Organometallic Compounds	1.62	1.67	0.05	✓
Carbohydrates	3.77	3.89	0.12	✓
Polyfunctional Compounds				
Nucleic Acids	4.47	4.5	0.03	✓
Lipids	4.28	4.25	-0.03	✓
Amino Acids and Proteins	4.17	4.27	0.10	✓
Overall Mean Topic Rating	2.60	2.70	0.10	

Importance Rating Scale
5 = Extremely Important
4 = Very Important
3 = Important
2 = Somewhat Important
1 = Not Important
9 = Unable to Rate

Notes

1. N ranges from 227-239 for current ratings and 112-118 for future ratings.
2. Standard Deviations range from .69-1.14 for current ratings and .69-1.13 for future ratings.
3. Dark blue = ratings ≥ 3.50 ; Medium blue = ratings between 3.00-3.49; Light blue = ratings between 2.50-2.99; Yellow = difference between future and current ratings $\geq .25$.
4. Ratings were made on a 5-point Likert-type scale. Importance ratings ranged from 1 = Not Important, 2 = Somewhat Important, 3 = Moderately Important, 4 = Very Important, 5 = Extremely Important, and 9 = Unable to Rate.
5. These topics overlap with the entering competencies recommended by the AAMC-HHMI Scientific Foundations for Future Physicians (SSFP) committee.

Table 4. Mean Importance Ratings for Physics Topics

Topic	Mean for the Current Curriculum ^{1,2} ,3,4	Mean for the Future Curriculum ^{1,2} ,3,4	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Basic Concepts and General Techniques				
Units and Dimensions	4.00	4.02	0.02	✓
Basic Concepts	4.05	4.13	0.08	✓
Graphing Techniques	3.17	3.38	0.21	✓
Error Analysis	3.77	4.09	0.32	✓
Mechanics				
Translational Motion	2.84	3.00	0.16	✓
Force and Motion, Gravitation	2.67	2.88	0.21	✓
Equilibrium	2.60	2.78	0.18	✓
Momentum	2.22	2.37	0.15	✓
Work	2.46	2.60	0.14	✓
Energy	2.74	2.82	0.08	✓
Rotational Motion	1.60	1.78	0.18	✓
Waves				
Periodic Motion	2.45	2.61	0.16	✓
Wave Characteristics	2.65	2.73	0.08	✓
Sound	3.06	3.19	0.13	✓
Molecular Motion, Heat and Work and Statistical Physics				
Thermodynamics	2.93	2.97	0.04	✓
Kinetic Theory and Ideal Gas Law	3.20	3.32	0.12	✓
Statistical Physics	2.96	3.19	0.23	✓
Transport Processes	4.40	4.33	-0.07	
Bulk Properties of Matter				
Solids	2.87	2.98	0.11	✓
Fluids	3.46	3.47	0.01	✓
Electricity and Magnetism				
Electrostatics	2.62	2.79	0.17	✓
Circuit Elements	3.01	3.07	0.06	✓
Circuits	1.85	1.87	0.02	✓
Electronic Devices	2.15	2.49	0.34	✓
Magnetism	2.05	2.21	0.16	✓
Electromagnetic Induction	1.86	2.00	0.14	✓
Alternating Currents and Reactive Circuits	1.70	1.82	0.12	✓
Electromagnetic Radiation and Geometrical Optics				
Light, Electro-magnetic Radiation	2.62	2.68	0.06	✓
Geometrical Optics	2.61	2.52	-0.09	✓
Topics in Modern Physics				
Quantum Mechanics	2.72	2.96	0.24	✓
Atomic Structure and Spectra	2.38	2.60	0.22	✓
Atomic Nucleus	2.93	3.16	0.23	✓
Feedback and Control				
Feedback and Control	3.14	3.33	0.19	✓
Overall Mean Topic Rating	2.78	2.91	0.13	

Importance Rating Scale
5 = Extremely Important
4 = Very Important
3 = Important
2 = Somewhat Important
1 = Not Important
9 = Unable to Rate

Notes

1. N ranges from 212-217 for current ratings and 89-91 for future ratings.
2. Standard Deviations range from .78-1.15 for current ratings and .81-1.20 for future ratings.
3. Dark blue = ratings ≥ 3.50 ; Medium blue = ratings between 3.00-3.49; Light blue = ratings between 2.50-2.99; Yellow = difference between future and current ratings $\geq .25$.
4. Ratings were made on a 5-point Likert-type scale. Importance ratings ranged from 1 = Not Important, 2 = Somewhat Important, 3 = Moderately Important, 4 = Very Important, 5 = Extremely Important, and 9 = Unable to Rate.
5. These topics overlap with the entering competencies recommended by the AAMC-HHMI Scientific Foundations for Future Physicians (SFFP) committee.

Table 5. Mean Importance Ratings for Biochemistry Topics

Topic	Mean for the Current Curriculum ^{1, 2,3,4}	Mean for the Future Curriculum ^{1, 2,3,4}	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Structure and Catalysis				
Water	3.70	3.81	0.11	✓
Amino Acids, Peptides, Proteins	3.57	3.71	0.14	✓
The Three-Dimensional Protein Structure	3.05	3.27	0.22	✓
Protein Function	3.18	3.29	0.11	✓
Enzymes	3.38	3.48	0.10	✓
Carbohydrates and Glycobiology	2.91	3.24	0.33	✓
Nucleotides and Nucleic Acids	3.53	3.78	0.25	✓
DNA-Based Information Technology	3.44	4.12	0.68	✓
Lipids	2.91	3.18	0.27	✓
Biological Membranes and Transport	3.32	3.28	-0.04	✓
Biosignalling	3.45	3.41	-0.04	✓
Bioenergetics and Metabolism				
Principles of Bioenergetics	3.00	3.23	0.23	✓
Glycolysis, Gluconeogenesis & the Pentose-Phosphate Pathway.	3.27	3.37	0.10	✓
Principles of Metabolic Regulation	2.80	3.15	0.35	✓
Glucose and Glycogen	3.12	3.30	0.18	✓
Citric Acid Cycle	2.85	3.09	0.24	✓
Fatty Acid Catabolism	2.92	3.18	0.26	✓
Amino Acid Oxidation and Urea Production	2.55	2.88	0.33	✓
Oxidative Phosphorylation	3.00	3.15	0.15	✓
Lipid Biosynthesis	2.75	2.99	0.24	✓
Biosynthesis of Amino Acids, Nucleotides	2.44	2.62	0.18	✓
Hormonal Regulation & Integration of Mammalian Metabolism	2.95	3.28	0.33	✓
Genes and Chromosomes				
Genes and Chromosomes	3.31	3.56	0.25	✓
DNA Metabolism	3.51	3.63	0.12	✓
RNA Metabolism	3.28	3.36	0.08	✓
Protein Metabolism	3.31	3.48	0.17	✓
Regulation of Gene Expression	3.09	3.45	0.36	✓
Overall Mean Topic Rating	3.13	3.34	0.21	✓

Importance Rating Scale
 5 = Extremely Important
 4 = Very Important
 3 = Important
 2 = Somewhat Important
 1 = Not Important
 9 = Unable to Rate

Notes

1. N ranges from 222-224 for current ratings and 108-109 for future ratings.
2. Standard Deviations range from .93-1.16 for current ratings and .91-1.23 for future ratings.
3. Dark blue = ratings ≥3.50; Medium blue = ratings between 3.00-3.49; Light blue = ratings between 2.50-2.99; Yellow = difference between future and current ratings ≥.25.
4. Ratings were made on a 5-point Likert-type scale. Importance ratings ranged from 1 = Not Important, 2 = Somewhat Important, 3 = Moderately Important, 4 = Very Important, 5 = Extremely Important, and 9 = Unable to Rate.
5. These topics overlap with the entering competencies recommended by the AAMC-HHMI Scientific Foundations for Future Physicians (SSFP) committee.

Table 6. Mean Importance Ratings for Cell and Molecular Biology Topics (1 of 3)

Topic	Mean for the Current Curriculum ^{1,2,3,4}	Mean for the Future Curriculum ^{1,2,3,4}	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Introduction to the Study of Cell Biology				
Basic Properties of Cells and the Cell Theory	4.10	4.32	0.22	
Two Fundamentally Different Classes of Cells	3.43	3.65	0.22	√
Viruses	3.37	3.65	0.28	
The Origin of Eukaryotic Cells	2.05	2.11	0.06	
The Chemical Basis of Life				
Attractions Between Atoms and Molecules	3.44	3.71	0.27	√
The Life Supporting Properties of Water	2.80	2.89	0.09	√
Acids, Bases, and Buffers	4.23	4.33	0.10	√
Biological Molecules	4.05	4.34	0.29	√
Bioenergetics, Enzymes, and Metabolism				
Bioenergetics	2.55	2.84	0.29	√
Enzymes as Biological Catalysts	3.59	3.80	0.21	√
Metabolism	3.57	3.79	0.22	√
The Structure and Function of the Plasma Membrane				
An Overview of Membrane Functions	3.54	3.79	0.25	
History of Studies on Plasma Membrane Structure	3.48	3.69	0.21	
The Chemical Composition of Membranes	2.92	3.07	0.15	
The Structure and Functions of Membrane Proteins	3.00	3.32	0.32	
Membrane Lipids and Membrane Fluidity	2.68	3.01	0.33	
The Dynamic Nature of the Plasma Membrane	2.73	2.85	0.12	
The Movement of Substances Across Cell Membranes	3.53	3.50	-0.03	
Membrane Potentials and Nerve Impulses	3.60	3.40	-0.20	√
Aerobic Respiration and the Mitochondrion				
Mitochondrial Structure and Function	2.82	3.03	0.21	
Oxidative Metabolism and the Formation of ATP	3.36	3.43	0.07	
Peroxisomes	2.33	2.48	0.15	
Interactions Between Cells and Their Environment				
The Extracellular Space	2.45	2.81	0.36	√
Interactions of Cells with Extracellular Materials	2.36	2.66	0.30	√
Interactions of Cells with Other Cells	2.56	2.80	0.24	√
Tight Junctions - Sealing the Extracellular Space	2.47	2.68	0.21	√
Gap Junctions - Mediating Intercellular Communication	2.48	2.59	0.11	√
Cytoplasmic Membrane Systems: Structure, Function, and Membrane Trafficking				
An Overview of the Endomembrane System	2.75	3.00	0.25	
Approaches to the Study of Endomembranes	1.98	2.41	0.43	
The Endoplasmic Reticulum	3.11	3.26	0.15	
The Golgi Complex	2.76	3.01	0.25	
Types of Vesicle Transport and Their Functions	2.10	2.35	0.25	
Lysosomes	2.69	2.88	0.19	
Endocytic Pathway: Moving Membrane & Materials into the Cell Inter	3.03	3.14	0.11	
Posttranslational Uptake of Proteins by Peroxisomes, and Mitochondria	2.00	2.13	0.13	√
The Cytoskeleton and Cell Motility				
Overview of the Major Functions of the Cytoskeleton	2.94	3.28	0.34	
The Study of the Cytoskeleton	2.10	2.46	0.36	
Microtubules	2.93	3.04	0.11	√
Intermediate Filaments	2.14	2.33	0.19	
Microfilaments	2.67	2.75	0.08	√
The Sliding Filament Model of Muscle Contraction	3.10	2.94	-0.16	
Nonmuscle Motility	2.36	2.36	0.00	
The Nature of the Gene, Genome, and Genetic Expression				
The Concept of a Gene as a Unit of Inheritance	4.32	4.37	0.05	
Chromosomes - The Physical Carriers of the Genes	3.97	4.11	0.14	√

Importance Rating Scale
5 = Extremely Important
4 = Very Important
3 = Important
2 = Somewhat Important
1 = Not Important
9 = Unable to Rate

(continued)

Table 6. Mean Importance Ratings for Cell and Molecular Biology Topics (2 of 3)

Topic	Mean for the Current Curriculum ^{1,2,3,4}	Mean for the Future Curriculum ^{1,2,3,4}	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
The Chemical Nature of the Gene	4.09	4.25	0.16	
The Structure and Complexity of the Genome	3.22	3.34	0.12	
The Stability of the Genome	2.94	3.24	0.30	✓
Sequencing Genomes - The Genetic Basis of Being Human	3.25	3.51	0.26	
The Relationship Between Genes and Proteins	4.27	4.47	0.20	✓
An Overview of Transcription in Both Prokaryotic and Eukaryotic Cells	3.54	3.76	0.22	✓
Synthesis and Processing of Ribosomal and Transfer RNAs	2.75	2.85	0.10	✓
Synthesis and Processing of Messenger RNAs	3.30	3.58	0.28	✓
Small Noncoding RNAs and RNA Interference	2.25	3.07	0.82	✓
Encoding Genetic Information	3.96	4.09	0.13	✓
Decoding the Codons - The Role of Transfer RNAs	3.38	3.50	0.12	✓
Translating Genetic Information	3.24	3.44	0.20	✓
The Nucleus of a Eukaryotic Cell	3.39	3.71	0.32	✓
Control of Gene Expression in Prokaryotes	2.41	2.47	0.06	✓
Transcriptional-Level Control of Gene Express. in Eukaryotes	3.10	3.49	0.39	✓
Processing-Level Control of Gene Expression in Eukaryotes	2.92	3.15	0.23	✓
Translational-Level Control of Gene Expression in Eukaryotes	2.71	2.93	0.22	✓
Posttranslational Control: Determining Protein Stability	2.57	3.01	0.44	✓
DNA Replication	3.18	3.21	0.03	
DNA Repair	2.92	2.95	0.03	
Cellular Reproduction				
The Cell Cycle	3.40	3.57	0.17	✓
M Phase - Mitosis	3.39	3.53	0.14	✓
Cytokinesis	2.80	3.04	0.24	
Meiosis	3.59	3.64	0.05	✓
Cell Signaling and Signal Transduction: Communication Between Cells				
The Basic Elements of Cell Signaling Systems	3.27	3.63	0.36	✓
G Protein-Coupled Receptors and Their Second Messengers	3.16	3.30	0.14	✓
Protein-Tyrosine Phosphorylation as a Mechanism for Signal Transduction	2.57	2.67	0.10	✓
The Role of Calcium as an Intracellular Messenger	2.82	2.86	0.04	✓
The Role of NO as an Intercellular Messenger	2.63	2.51	-0.12	✓
Apoptosis (Programmed Cell Death)	2.77	2.92	0.15	✓
Cancer				
Basic Properties of a Cancer Cell	3.15	3.21	0.06	
The Causes of Cancer	3.10	3.23	0.13	
The Genetics of Cancer	3.02	3.11	0.09	
Strategies for Combating Cancer	2.55	2.73	0.18	
The Immune Response				
An Overview of the Immune Response	3.29	3.33	0.04	✓
The Clonal Selection Theory	3.00	3.03	0.03	✓
Antigen Processing and Presentation	2.81	2.77	-0.04	✓
T Lymphocytes - Activation and Mechanism of Action	2.79	2.81	0.02	✓
Cellular and Molecular Basis of Immunity	2.93	3.02	0.09	✓
Techniques in Cell and Molecular Biology				
The Light Microscopes	2.13	2.35	0.22	
Electron Microscopy	1.91	2.12	0.21	
The Use of Radioisotopes	2.25	2.53	0.28	
Cell Culture	2.27	2.48	0.21	
The Fractionation of a Cell's Contents by Diff. Centrifugation	1.89	1.92	0.03	
Isolation, Purification, and Fractionation of Proteins	2.08	2.22	0.14	
Flow Cytometry	2.11	2.15	0.04	
Determination of Protein Structure	1.63	1.77	0.14	

Importance Rating Scale
 5 = Extremely Important
 4 = Very Important
 3 = Important
 2 = Somewhat Important
 1 = Not Important
 9 = Unable to Rate

(continued)

Table 6. Mean Importance Ratings for Cell and Molecular Biology Topics (3 of 3)

Topic	Mean for the Current Curriculum ¹ 2,3,4	Mean for the Future Curriculum ¹ 2,3,4	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Purification and Fractionation of Nucleic Acids	2.19	2.24	0.05	
Measurement of Protein and Nucleic Acid Concentration	1.91	2.08	0.17	
Ultracentrifugation	1.46	1.54	0.08	
Nucleic Acid Hybridization	2.56	2.56	0.00	
Recombinant DNA Technology	2.81	3.21	0.40	
Overall Mean Topic Rating	2.90	3.07	0.17	

Notes

1. N ranges from 208-218 for current ratings and 110-114 for future ratings.
2. Standard Deviations range from .75-1.42 for current ratings and .63-1.41 for future ratings.
3. Dark blue = ratings ≥ 3.50 ; Medium blue = ratings between 3.00-3.49; Light blue = ratings between 2.50-2.99; Yellow = difference between future and current ratings $\geq .25$.
4. Ratings were made on a 5-point Likert-type scale. Importance ratings ranged from 1 = Not Important, 2 = Somewhat Important, 3 = Moderately Important, 4 = Very Important, 5 = Extremely Important, and 9 = Unable to Rate.
5. These topics overlap with the entering competencies recommended by the AAMC-HHMI Scientific Foundations for Future Physicians (SSFP) committee.

Table 7: Mean Importance Ratings for Research Methods and Statistics Topics

Topic	Mean for the Current Curriculum ¹ , 2,3,4	Mean for the Future Curriculum ¹ , 2,3,4	Difference between Future & Current ³	Overlap with At Least One SFFP Entry-level Competency ⁵
Understanding the Scientific Method				
The Scientific Approach	3.67	3.92	0.25	√
Role of Natural and Social Science Research	3.34	3.57	0.23	
Basic and Applied Research	3.10	3.44	0.34	√
Generating Research Ideas, Conducting Lit. Searches, & Reading Research Articles				
Developing Research Questions	3.33	3.60	0.27	√
Choosing a Research Method	2.82	3.15	0.33	√
Ethical Research Practices				
Normative Ethics	3.34	3.37	0.03	
Scientific Integrity	4.10	4.30	0.20	√
Studying Biological, Behavioral, and Social Relationships				
Variables	2.31	2.68	0.37	
Independent and Dependent Variables	1.97	2.29	0.32	
Nonexperimental vs. Experimental Methods	2.89	2.94	0.05	√
Criteria for Establishing Causality	2.54	2.73	0.19	√
Measurement Concepts and Sampling				
Reliability/Precision and Accuracy of Measures	2.44	2.57	0.13	√
Validity	2.43	2.64	0.21	√
Measurement Scales	1.99	2.34	0.35	
Population and Samples	2.93	3.09	0.16	
Sampling Techniques	2.00	2.19	0.19	
Evaluating Samples	1.83	2.08	0.25	
Study Design				
Qualitative vs. Quantitative Approaches	2.42	2.74	0.32	
Survey Design	2.19	2.36	0.17	
Observational Studies/Case-Control and Cohort	2.07	2.31	0.24	
Quasi-Experimental Design	1.71	1.97	0.26	
Population Comparisons or Ecological Studies	1.98	2.28	0.30	
Randomized Trials	2.63	2.69	0.06	
Factors that Introduce Bias (Major Confounding Variables)	2.43	2.50	0.07	√
Strategies to Reduce Bias	2.39	2.39	0.00	√
Understanding Research Results: Descriptive Statistics and Displaying Data				
Roles of Analysis	2.42	2.77	0.35	
Analyzing the Results of Research Investigations	2.77	2.98	0.21	√
Frequency and Probability Distributions	2.78	2.93	0.15	√
Using and Interpreting Frequency Distributions	3.21	3.37	0.16	√
Measures of Central Tendency	4.03	4.01	-0.02	√
Measures of Dispersion	3.38	3.44	0.06	√
Using and Interpreting Graphical Data	2.83	3.00	0.17	√
Understanding Research Results: Effect Size, Inference, and Power				
Tests/Indices of Statistical Relationships - Continuous Variables	2.40	2.71	0.31	
Tests/Indices of Statistical Relationships - Categorical Variables	2.60	2.98	0.38	
Selection of Appropriate Statistical Significance Test	2.26	2.57	0.31	√
Inferring Statistical Significance	3.14	3.35	0.21	√
Uncertainty in Statistical Significance Testing	3.09	3.22	0.13	
Power	2.48	2.60	0.12	
Bayes' Theorem	3.00	2.97	-0.03	
Generalizing Results				
External Validity (Generalizability)	2.17	2.33	0.16	
Importance of Replications	1.58	1.80	0.22	
Other Techniques	2.94	3.15	0.21	
Overall Mean Topic Rating	2.67	2.86		

Importance Rating Scale
5 = Extremely Important
4 = Very Important
3 = Important
2 = Somewhat Important
1 = Not Important
9 = Unable to Rate

Notes

1. N ranges from 242-258 for current ratings and 116-123 for future ratings.
2. Standard Deviations range from .86-1.49 for current ratings and .84-1.41 for future ratings.
3. Dark blue = ratings ≥3.50; Medium blue = ratings between 3.00-3.49; Light blue = ratings between 2.50-2.99; Yellow = difference between future and current ratings ≥.25
4. Ratings were made on a 5-point Likert-type scale. Importance ratings ranged from 1 = Not Important, 2 = Somewhat Important, 3 = Moderately Important, 4 = Very Important, 5 = Extremely Important, and 9 = Unable to Rate.