Supplemental Material

CBE—Life Sciences Education

Zeidan *et al*.

Supplemental Material 1

Volunteers and Their Institutional Affiliations

This table shows the numbers of volunteers per year sorted by their roles in the exam development process or by their institutional affiliations. Some individuals volunteered in multiple years, and some participated in both question development and scoring in a given year. Thus, any given individual may be counted more than once in the table.

	2014	2015	2016	2017	2018	2019
Role of Volunteers						
Question Development	20	25	18	31	14	9
Scoring	11	29	33	36	36	53
Carnegie Classification						
R1	4	14	11	19	7	12
R2	5	6	4	2	2	2
D/PU	4	9	10	7	9	8
M1	7	12	11	11	8	13
M2	2	3	1	4	4	4
M3	1	2	1	1	0	0
BA/BS	4	9	6	9	7	8
Other[a]	2	7	5	7	5	5

[a] Includes: Community Colleges, Baccalaureate Colleges Diverse Fields, Special Focus Four-Year Medical Schools & Centers and Special Focus Institutions.

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Supplemental Material 2

ASBMB Question Writing Guide

1. <u>INTRODUCTION</u>

Each year, the ASBMB administers a short (60-minute), high-stakes examination whose outcomes are used to determine whether or not participating students will have their B.S. degrees in Biochemistry & Molecular Biology certified by the ASBMB. At its heart, the ASBMB assessment exam is a threshold, pass/fail, type exam. Our primary goal is to identify students who display **competence** (not necessarily excellence) across four core concept areas.

Responses are scored on a three-level scale by a set of three (3) or more individuals acting independently of both one another and the author(s) of the question:

- Highly proficient
- Proficient
- Not yet proficient

The key distinction, however, is between Not yet proficient and Proficient, as it is the number of responses that are scored Proficient or above that determine whether or not a student qualifies for an ASBMB certified degree.

Our current exam template calls for each of our core concept categories to be addressed by three (3) questions, two (2) of which assess higher-order cognitive skills [HOCS] and one (1) of which assesses lower-cognitive skills [LOCS].

Experience suggests that 10-14 **focused** questions constitute the maximum that can be addressed within the 60-minute examination period. We have eschewed formats that utilize a smaller set of lengthier questions in order to a) include one or two questions designed to help students get off to a positive start, b) provide reasonable breadth of coverage, and c) help insure that drawing a blank on a particular question does not inordinately impact a student's chances to achieve degree certification.

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2. NOT ALL EXAMS ARE CREATED EQUAL

The objectives and structure of the ASBMB Certification Examination differ is several important ways from many typical "in class" examinations:

Typical classroom examination	**ASBMB certification exam**
Designed to distinguish among multiple degrees of mastery, oftentimes by including multipart or subtly nuanced questions.	Threshold exam. Does the student exhibit competency across multiple topic areas?
Each individual exam score constitutes only one of multiple assessments utilized to determine a final grade.	One-time, all-or-none assessment.
Typical points-based scoring system provides a degree of fine resolution.	De facto binary pass/fail (P/F) scale for scoring questions -- (HIGHLY) PROFICIENT / NOT YET PROFICIENT – does not allow for distinguishing between multiple degrees of completeness / correctness.
Points-based scoring is adaptable to a wide range of question structures. The number of possible points associated with a given question can be scaled to match its length or number of component parts.	No ability to weight credit for questions based on length or number of parts.
Scored using total points. A student can "bomb" multiple questions, ace others, and come up with a net passing score.	Certification is based on the number of questions on which a student was scored (HIGHLY) PROFICIENT. Student cannot offset Not yet proficient answers with Highly proficient ones.
Students and teacher are able to develop shared language and expectations over time.	Cold turkey. Exam preparer/scorer not even available as a proctor.
Author of question generally scores student responses.	Questions are scored independently by three (3) individuals. Scorers have no knowledge of context or backstory and are reliant on the ANSWER KEY provided.

Experience has shown that one cannot construct an effective ASBMB assessment examination by simply plugging in questions taken directly from typical classroom examinations.

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3. <u>THE CHALLENGE</u>

To develop questions that assess a student's grasp of core concepts and critical-thinking skills, especially at middle to upper Bloom's levels, using questions that are:

- Tightly focused on a single learning objective.
- Worded in a clear and straightforward manner.
- Concise.

4. <u>RULES OF THE ROAD</u>

Solid not flashy. Our goal is to amass a collection of questions that cover the breadth of Biochemistry and Molecular Biology and do so over a range of cognitive levels. The best questions are straightforward and structurally simple rather than *tour de force.* Complicated / subtle questions do not work in this format.

One topic / learning objective per question, please. Appropriate assessment questions should be tightly focused. The author must decide what **single** aspect of pH, metabolism, enzyme kinetics, etc. to target for assessment. The successful author should be able to identify the concept or skill being assessed in the form of a simple declarative statement with concrete outcomes.

Compound questions can undermine the fidelity of the scoring process. Scoring a compound question is like trying to analyze the results of an experiment in which a student altered two variables simultaneously. Assume that Exam A consists of eight two-part questions, while Exam B consists of sixteen single questions that cover the same core concepts, and that a score of 75% is required for accreditation.

> Student 1 answers only one part of each compound question correctly on exam A, but because of how the key weights them, the student is scored Proficient on all eight and is certified.
> Student 2 performs similarly, but because each concept is addressed by a discrete question, this student is scored Proficient on only eight of sixteen questions (50%) and hence is not certified.

Try to keep questions concise and direct. The longer the text of a question, the more likely that the student will forget, confuse, or overlook some key element contained therein. To maximize the likelihood that a given question assesses a student's understanding of biochemistry rather than reading comprehension skills, efforts should be made to design questions that are as concise and direct as possible.

Subtlety generally backfires. *Our experience as scorers has been that well-intended efforts to avoid including elements that "give the answer away", or to disguise these elements, oftentimes lead to tortured and ambiguous question structures that backfire more often than not.*

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Consider employing backward design. One strategy for developing questions that are lean and direct is to start by drafting a preliminary answer key. You can then use the expected student responses to identify any disconnects between the question and the key. *Does the question explicitly ask for the expected response?* Did some extraneous requirements that do not appear in the key find their way, perhaps implicitly, into the question? An overly complex key is a strong indicator that the question *as written* is too long and compound / complex.

Make liberal use of diagrams and figures. One of the most effective means of keeping questions lean and direct is to use figures and diagrams rather than words to set up your premise or as a format for generating a response. Since one of our goals is to promote teaching and learning of concepts and critical thinking over rote memorization, it is incumbent upon us to provide sufficient information to enable students to answer without resorting to memorized factoids.

Define the boundaries of an acceptable answer. As instructors, we have ample opportunity to acclimate our students to our expectations of what constitutes an acceptable list, statement, explanation, justification, etc. Students taking the ASBMB exam do not have the benefit of such acclimatization and thus can be left guessing as to the expectations associated with terms such as list, state, justify, explain, draw, etc. It is therefore incumbent on the question-writer to be specific concerning their expectations:

1. Instead of “List some properties”, try “List **two (2)** properties”.
2. Instead of “Justify your answer”, try “Explain in three sentences or less”.
3. Instead of “draw a graph illustrating the kinetic behavior of the enzyme”, try “Using the axes below, draw a graph showing the dependence of reaction rate (velocity) upon the concentration of substrate B”.

Answer keys must be concrete and clear. For each question, we need an answer key that lays out either some samples of highly proficient, proficient, and not yet proficient answers or lists the components that must be present in each type of answer. The language of the rubric “the answer must demonstrate a clear understanding of…” is of little value for the purpose of scoring the exam. What is needed is a concrete description of the attributes or elements that characterize a satisfactory answer.

Supplemental Material 3

Example of Iterative Question Development Informed by Students' Responses

Introduction

One of the most basic concepts in the molecular life sciences is that the bioenergetics of virtually all living organisms is founded on electron transfer processes involving the reduction and oxidation of carbon atoms. This foundational concept is key to achieving a genuine understanding of the architecture of photosynthetic pathways, the tricarboxylic acid (TCA) cycle, the electron transport chain, etc.

2014 — The First Attempt

Background

The 2014 ASBMB certification exam contained a question that asked students to explain the chemical basis of the underlying differences in the relative energy yield of lipids versus carbohydrates. Specifically, the question was intended to probe whether a student could connect relative energy yields of these biomolecules to the number of electrons that could be extracted, i.e. the redox state, from the carbon atoms of these molecules.

The two-part question shown below was constructed. Part 1a was intended both to cue students and to provide insight into whether students who experienced difficulty answering Part 1b lacked a basic knowledge of the redox states of carbon. Part 1b directly posed the central question: Why do fats yield more ATP per carbon atom than carbohydrates? Question writers intended word choice in 1b to guide students towards relevant responses. The term "ATP" was chosen to place the concept of energy yield into concrete and quantifiable terms and was intended to remind students of the key role of the electron transport chain, and hence oxidation-reduction, in generating the proton gradient that drives ATP synthase activity. The phrase "per carbon" was intended to steer students away from physical explanations, for example the perception that fats and oils are denser than starches, and towards the use of a molecular lens.

2014 Question and Associated Answer Key

Q1a. List the following compounds in order of increasing oxidation starting with the most reduced:

CH_4 CH_2O CO_2 CH_3OH HCOOH

Q1b. Use your answer from Part **a** above to explain why fats yield more ATP per carbon atom than carbohydrates.

Q1a. Answer Key

[For all keys and categories, raters are given the option to appropriately credit students for unanticipated responses that still meet the criteria for "highly proficient" or "proficient" by the implicit additional option "OR words to that effect".]

Highly Proficient Answers Include:

CH_4 - CH_3OH - CH_2O – HCOOH - CO_2(must be in the correct order)

Proficient Answers Include:

CO_2 - HCOOH - CH_2O - CH_3OH – CH_4 (confuses reduction and oxidation state)

OR

CH_4 - CH_3OH - CH_2O - CO_2 – HCOOH
(misidentifies carboxylic acid as more highly oxidized than CO_2)

OR

Any variation of CH_4-X-X-X-X- CO_2(in which the student correctly identifies most and least reduced)

Not Yet Proficient Answers Include:

Any other combination

Q1b. Answer Key

Highly Proficient Answers Include:

- ATP is made by sending electrons through the electron transport chain. Fats (generally speaking: -$(CH_2)_n$-) are more reduced than carbohydrates (general formula $(CH_2O)_n$. Fats therefore can contribute more electrons to the electron transport chain, leading to the translocation of more protons and the subsequent synthesis of greater quantities of ATP.

OR

- Metabolic energy is produced by the oxidation of organic compounds. As the carbon atoms in carbohydrates are already partially oxidized, they yield less energy than the reduced carbons present in fats, which are predominantly hydrocarbon in nature.

Proficient Answers Include:

- Fats yield more acetyl-CoA, per carbon atom, than do carbohydrates. The greater the amount of acetyl-CoA that enters the TCA cycle, the more NADH is produced, leading to a greater yield of ATP.

Not Yet Proficient Answers Include:

- Fats / triglycerides are physically denser than carbohydrates.

OR

- There are more C atoms present in a fatty acid chain than in a monosaccharide.

Student Response Analysis 2014

The first thing that stood out was the striking disparity between student success rates on Question 1a (Q1a) versus on Question 1b (Q1b). On Q1a, 81% of students earned a score of proficient or better, with 62% giving responses judged as highly proficient. These scores indicate that the vast majority of students recognized that the carbon atoms in organic biomolecules exist in a variety of oxidation states and were able to rank order them, in relative if not always absolute terms, according to their degree of oxidation. However, only 40% of the students were able to subsequently compose an answer meeting a score of proficient on Q1b. Even more striking, whereas every single student attempted to answer Q1a, 35% left Q1b blank.

Score	**Question 1a (N = 193)**	**Question 1b (N = 193)**
Highly proficient	120 (62%)	8 (4%)
Proficient	36 (19%)	70 (36%)
Not yet proficient	37 (19%)	47 (24%)
No response	0 (0%)	68 (35%)

It is unlikely that this outcome was a positional effect, as Q1a and Q1b were located on the first page of the exam. Moreover, the number of students who left any of the last four questions blank were Q8: 0, Q9a.: 3, Q9b.: 6, and Q10: 0. Overall, the average number of students who provided no response to a given question averaged 20, or 10.5%, for over the entire thirteen-item exam.

Although in theory the 73 students who received scores of proficient and not yet proficient on Q1a were sufficient to conceivably account for the 68 non-responses on Q1b, a breakdown of the data indicated that this was not the case. As expected, students who earned scores of highly proficient on Q1a performed better, in aggregate, on Q1b relative to those who earned scores of proficient or not yet proficient. However, roughly half of the students who earned a score of highly proficient on Q1a were unable or did not take the opportunity to formulate a proficient or highly proficient response to Q1b; in fact a striking three in ten left no response at all.

Score on Q1a	**n**	**Number of scores* on Q1b in Each Category**			
		HP	**P**	**NYP**	**No response**
Highly Proficient	120	6 (5%)	54 (45%)	23 (19%)	37 (31%)
Proficient	36	1 (3%)	8 (22%)	9 (25%)	18 (50%)
Not Yet Proficient	37	1 (3%)	6 (16%)	14 (38%)	16 (43%)

*HP = Highly Proficient, P = Proficient, NYP = Not Yet Proficient

It seemed inconceivable that nearly six in ten senior biochemistry majors were unable to satisfactorily explain why the carbon atoms in lipid molecules yield more ATP, i.e. energy, than the carbon atoms in carbohydrates. Typical biochemistry textbooks contain detailed calculations of the ATP molecules generated from the oxidation of glucose and palmitic acid. Moreover, the bulk of the students exhibited a grasp of the key underlying concept of the multiple oxidation steps of carbon. In the absence of other evidence (e.g. exit interviews), our inference was that students were underperforming relative to expectations because of some inherent flaw in the question as constructed, causing students to misinterpret it or become confused. Therefore, the question was revised and administered again on the 2015 exam.

2015 — The Second Attempt

Background

A new, one part "replacement" for Q1b was drafted for the 2015 exam. Prior Q1a was dropped in order to make space available for questions addressing other topics, to better meet the criterion of 11-13 questions total on this assessment instrument, and because the prior exam suggested that Q1a did not assist students in answering Q1b.

In an attempt to clarify the thrust of the question for students, figures depicting a carbohydrate (maltose) and a lipid (lauric acid) were included. In addition, the text pointed out that the repeating units for carbohydrates and fatty acids were CHOH and CH_2, respectfully, and the phrase "per carbon atom" was highlighted in bold type.

2015 Question and Answer Key

Q1. The repeating unit in carbohydrates is CHOH (Figure A) while in lipid tails the repeating unit is CH_2 (Figure B). **Explain** why, when these fuel molecules are metabolized, the quantity of ATP generated **per carbon atom** is greater for lipid tails than for carbohydrates.

Figure A

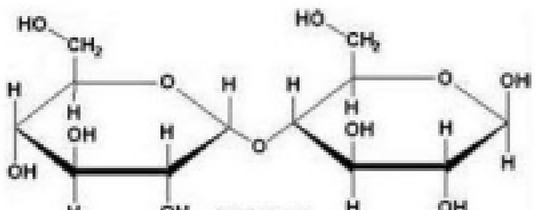
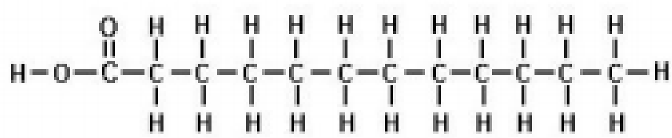


Figure B



Answer Key

Highly Proficient Answers Include:

- ATP is produced by sending electrons through the electron transport chain. Fats [generally speaking: $-(CH_2)_n-$] are more reduced than carbohydrates [general formula $(CH_2O)_n$]. Fats therefore can feed more electrons into the electron transport chain, leading to the translocation of more protons and the subsequent synthesis of greater quantities of ATP.

OR

- Metabolic energy is produced by the oxidation of organic compounds. As the carbon atoms in carbohydrates are already partially oxidized, they yield less energy than the reduced carbons present in fats, which are predominantly hydrocarbon in nature.

Proficient Answers Include:

- Fats yield more acetyl-CoA, per carbon atom, than do carbohydrates. The greater the amount of acetyl-CoA that enters the TCA cycle, the more NADH is produced leading to a greater yield of ATP.

OR

- Carbohydrates yield less acetyl-CoA, per carbon atom, than do fats. The lesser the amount of acetyl-CoA that enters the TCA cycle, the less NADH that is produced resulting in a lower yield of ATP.

OR

- Losses occur during transport of electrons / reducing equivalents from the cytoplasm, where glycolysis takes place, to the mitochondria, where the electron transport chain is located, whereas all of fatty acid oxidation occur in the mitochondria, so no transport losses occur.

Not Yet Proficient Answers Include:

- Fats yield more acetyl-CoA than do carbohydrates.

OR

Carbohydrates yield less acetyl-CoA than do fats.

OR

- Fats / triglycerides are physically denser than carbohydrates.

OR

- There are more C atoms present in fatty acid chains than in monosaccharides.

OR

- Water content / hydration of carbohydrates renders them less energy-dense than fatty acids.

OR

- Fats have more calories per gram than carbohydrates. Therefore, fats yield more ATP.

Student Response Analysis 2015

The number of students participating in the certification exam increased to 465 in 2015. However, although the revised question was successful in driving down the number of students who elected not to attempt a response to this new version of Q1b, from 35% to 5%, the proportion of students who successfully provided either a proficient or a highly proficient response **decreased** from 40% to 20%. Therefore, we concluded that the question was still not eliciting desired responses.

2018 — The Third Attempt

Background

Following a two-year hiatus, a new version of the question was constructed and piloted. A common feature of the previous versions was the requirement that the student explain why energy yields differed *per carbon atom.* We hypothesized that students working under the time pressure of the exam were struggling to identify the meaning of this phrase. We therefore eliminated this phrase and instead asked them to compare energy yield from the same, explicitly stated number (18) of carbon atoms from two sources: the 18 carbon atoms of a molecule of palmitic acid versus the 18 carbon atoms from three molecules of glucose. We also framed the difference in energy yield in terms of explicitly defined quantities of ATP molecules, discarding less precise terms such as “more” or a “greater number of ATP”. It was hoped that this change to numerically defined values would improve question clarity and hence student performance.

2018 Question and Answer Key

Q1. When a fatty acid containing 18 carbon atoms is completely catabolized to the end products CO_2 and H_2O, the energy yield is 122 molecules of ATP. When three molecules of glucose are completely catabolized to the end products CO_2 and H_2O, the maximum energy yield is 96 molecules of ATP. Three molecules of glucose also contain a total of 18 carbon atoms. Please explain why glucose yields less ATP per carbon atom than fatty acids.

Highly Proficient Answers Include:

- Student mentions that the **carbons** in fatty acids are more highly reduced / less oxidized than those in glucose.

AND

- Therefore, more electrons are generated to power the electron transport chain.

Proficient Answers Include:

- Student mentions that the carbons in fatty acids are more highly reduced / less oxidized than those in glucose

OR

- that fatty acids provide more electrons to power the electron transport chain.

Not Yet Proficient Answers Include:

- All other responses

Student Response Analysis 2018

Pilot questions were tested by placing one of the 8-10 being tested as the last question at the end of the exam given to a set of randomly selected students. In the case of this question, a total of 26 student responses were received.

Score	Number of responses	% of responses (n = 26)
Highly proficient	10	38%
Proficient	2	8%
Not yet proficient	14	54%
No response	0	0%

The performance on this version of the question was much higher than any of its predecessors.

2019 — The Fourth Attempt

Background

Given that a reasonable level of student success was evident on the pilot of the revised question, it was decided that the intent of the question was sufficiently clear to incorporate it

into the body of the 2019 ASBMB Certification Exam. The wording was further refined as part of the normal exam preparation process, for example by specifying a maximum length for student responses (100 words or fewer).

2019 Question and Answer Key

Q1. When a fatty acid containing 18 carbon atoms is completely catabolized to the end products CO_2 and H_2O, the energy yield is 122 molecules of ATP. When three molecules of glucose are completely catabolized to the end products CO_2 and H_2O, the maximum energy yield is 96 molecules of ATP. Three molecules of glucose also contain a total of 18 carbon atoms. Using 100 words or fewer, explain why glucose yields less ATP per carbon atom than fatty acids.

Highly Proficient Answers Include:

- Student mentions that the **carbons** in fatty acids are more highly reduced / less oxidized than those in glucose.

AND

- Therefore, more electrons are generated to power the electron transport chain.

Proficient Answers Include:

- Student mentions that the carbons in fatty acids are more highly reduced / less oxidized than those in glucose

OR

- that fatty acids provide more electrons to power the electron transport chain.

Not Yet Proficient Answers Include:

- All other responses

Student Response Analysis 2019

A total of 992 students participated in the 2019 ASBMB certification exam. Their performance on Q1 was as follows:

Score	Number of responses	% of responses (n = 992)
Highly proficient	194	20%
Proficient	280	28%
Not yet proficient	515	52%
No response	3	<1%

As was the case with the pilot version, the number of "no responses" was virtually nil, while nearly one-half of all respondents earned a score of proficient or above. These results suggest that this revised question was not only clear enough to elicit responses from almost all BMB students taking the exam but also allowed them to demonstrate their conceptual understanding.

Conclusion

Over the past several years ASBMB question writers collected response process validity evidence in the form of student written responses and engaged in an iterative process to develop a question that would probe student knowledge of the relationship between the oxidation state of carbon atoms and the quantity of energy, in the form of ATP, yielded by various biomolecules when used as fuel. Analysis of students' responses revealed the degree to which perceptions of the intent of a question can differ between its author and the students asked to respond to it. An iterative process of drafting, revising, and piloting questions, together with the analysis of student responses resulted in a refined version of the question that produced a range of student responses that aligned with expectations.

Supplemental Material 4

American Society for Biochemistry and Molecular Biology Certification Exam 2019 – Notes for Proctors

Thank you for participating in the 2019 ASBMB degree certification exam.

A. Paper exams
B. Proctoring instructions
C. Returning paper exams to the ASBMB
D. Results
E. Study Informed Consent Form
F. Questions?

A. Paper Exams

You will receive paper copies of the exam via USPS. This shipment will also contain a roster of all students taking the exam and for which a copy of the exam has been printed and sent. A paper copy of these proctoring instructions will also be included in the shipment.

B. Proctoring Instructions

1. The exam should be proctored during the week of March 4 or March 11, 2019.
2. **Only registered students may take the exam.**
3. Students should be given 60 minutes to complete the exam unless they have a recognized disability that requires they receive additional time.
4. The exam should be administered under normal proctoring conditions; i.e. no access to electronic devices other than a calculator, no access to books or notes, and a proctor available to assist students with questions seeking to clarify content.
5. Please refrain from familiarizing yourself with the contents of the exam prior to its distribution to students.
6. Before starting the exam, instruct students to read the instructions printed on the cover page.
7. Instruct students to correct any mistakes in the spelling of their names or email addresses on the cover page of the exam. **If students are graduating this summer, ask them to provide an email address that will work after graduation.**

8. The ASBMB would like to use anonymized student answers from the certification exam as a source of data for research studies on student learning, question construction, etc. The front page of the certification exam contains a consent form for the study. The full text of the consent form is included at the end of these guidelines. Participation in the study is completely optional and will have no effect on the scores students receive for the exam.
9. Students should answer all questions. All answers should be written clearly in **dark blue or black pen (no pencil)** on the **front** of each page. The back of the page will not be scored.
10. Different students may receive different versions of the exam. This is intentional.
11. At the end of the exam, ask students to remove the staple holding their exam together.

C. Returning Paper Exams to the ASBMB

<u>Unused exams should be sent back to ASBMB along with all used exams**</u>**

1. Ensure that all the students have removed the staples from their exams.
2. If you have been approved for **multiple test periods**: Please group the finished exams by period and clearly mark with the testing time and date.
3. It is **not** necessary to sort the exams into alphabetical or numerical order. It is **not** necessary to sort separated exam pages into numerical order. However, to speed the scoring of the exam, please ensure that all exams are stacked **face-up.**
4. Exams should be returned to the address below on or before **Friday, March 22, 2019.** **<u>Exams returned after this deadline will not be scored.</u>**

All copies of the exam, used and unused, should be returned to:

ASBMB
11200 Rockville Pike, Suite 302
Rockville MD, 20852

D. Results

1. The ASBMB will send all students their results by June 30th, 2019. Results will be distributed via email.
2. Students who achieve proficient or highly proficient scores in the exam will receive a certificate of recognition via postal mail.
3. You will receive an anonymized summary of the aggregate performance of your students, both overall and for each question.

E. Study Informed Consent Form

The ASBMB would like to analyze student responses to the exam questions to determine whether particular concepts are commonly misunderstood by students. The goals of this research are to improve the education of all students in biochemistry and molecular biology, identify critical concepts that are widely misunderstood and provide instructors with a tool to address the teaching of one of these concepts. The responses you provide to the exam questions would be used to identify the misconceptions and link these to foundational concepts. The analyst would have no access to your name or institution. During the analysis your exam would be identified only by a number assigned through the ASBMB staff which the researcher would not be able to trace to your name.

There is minimal risk to consenting to this study. The study will be done after the exam results are completed and your status on the exam has been determined. Since the results of the study are completely anonymous, the study cannot impact your future or whether you pass the exam. You must be aged 18 years or over to participate.

F. Questions?

If you have any questions about the 2019 certification exam that are not answered above, please contact the ASBMB education and professional development department: certexam@asbmb.org

Thank you for taking the time to offer the certification exam to your students.