Teaching Biochemistry to Students of Medicine, Dentistry & Pharmacy
April 30– May 4, 2011, Ocean Creek Resort, Myrtle Beach, SC

Sponsored by
The Association of Biochemistry Course Directors (ABCD) and the
Association of Medical & Graduate Departments of Biochemistry (AMGDB)

To: Meeting Participants April 30-May 4, 2011, Ocean Creek Resort Myrtle Beach, SC

Re: ABCD Workshop on Writing Multiple Choice Questions
(Sunday Evening 7:30-9:00)

We are happy you are attending the upcoming meeting on Teaching Biochemistry to Students of Medicine, Dentistry & Pharmacy. One of the workshop sessions at the meeting is on writing multiple choice questions. We are fortunate to have three members of ABCD skilled in writing MCQs to lead the workshop: Dr. Janet Lindsley, Univ. of Utah School of Medicine, past item writer for the USMLE and currently an ad hoc member of the Step 1 Interdisciplinary Review Committee, Dr. Eric Niederhoffer, Southern Illinois Univ. School of Medicine, present item writer for the USMLE, and Dr. Clive Slaughter, Medical College of Georgia, experienced in teaching colleagues to write objective-focused USMLE style questions. We are planning on this being a highly interactive session conducted in a Team-Based Learning format. For those planning on attending this workshop, we are providing a small amount of material (4 pages) to read that will facilitate the workshop. In addition we are asking participants to do a small amount of homework to bring to the workshop. Below we have written two biochemical learning objectives relating to patients presenting with abnormal serum lipids. We are asking that you write one MCQ assessing each of these objectives to bring to the workshop and share with your team.

Looking forward to the meeting,

Ed McKee, Workshop Moderator

Writing Multiple Choice Questions - Homework Assignment:

1. Read the following guide on writing MCQs prepared by the workshop leaders.

2. Please write an MCQ that would assess each of the objectives below.

    a. Identify the class or classes of lipoproteins that are increased or decreased in a patient with hyperlipidemia.

    b. Analyze the observed pattern of hyperlipidemia in a patient to determine the likely causative pathophysiologic processes.

Writing NBME Style One-Best-Answer Multiple Choice Questions

The complete guide from the National Board of Medical Examiners can be found at http://www.nbme.org/publications/item-writing-manual.html. Below is our distillation of relevant parts of their manual, plus a few other tips we've learned along the way.

1. **Choose an important topic.**
   This will happen automatically if your questions link directly to your learning objectives, as they should.
2. **Try to write your stem as if it were a question on a short answer written test.**
   This means that you should be able to cover up the choices, read the stem, and write down a short answer. This usually requires that the stem is long and the choices short. Because several or all of the answers might be possible and the goal is to select the best one, end the stem with "the **most likely**…" such as "the most likely adverse effect of this drug is:" This prevents most student arguments about questions.
3. **Make your choices homogeneous.**
   The choices should be similar in length, grammar and syntax, and theme. You should be able to order your choices from least to most true along a single thematic dimension, with the correct answer being that which you would have written down as a short answer according to rule 2 above. **Put your choices in alphabetical or numeric order.**

   A practical corollary to Rules 2 and 3 is that the question stem and answer choices cannot contain phrases such as:
   "none of the above" "all of the above" "A, B and C above are true"
   "All of the following below are true EXCEPT…" "Which of the following is NOT true"
4. **Avoid cueing to the correct answer.**

   One should not be able to choose the correct answer by: a) matching words in the stem to answer choices, b) eliminating answer choices with grammatical or spelling errors, c) avoiding extremes (never, always, only) in distracters, d) choosing the longest or most technically precise answer, e) counting the number of common elements within the answer choices. This sometimes means that the number of answer choices for a given question should be 4 or 6 or 9, etc.
5. **Assess for higher level thinking rather than recalling a single fact.**
   Having the stem first describe a clinical or experimental situation and then asking for a diagnosis or result or interpretation can often accomplish this. See the materials on Bloom's taxonomy below for more information.
6. **Questions should NEVER be tricky or deceptive; they should be easy for experts in the field.** They should be challenging because of #5 above, not because an obscure fact or a trick is involved.

Constructed by: Janet Lindsley, Eric Niederhoffer, Clive Slaughter & Ed McKee

For illustration, here is an example from the NBME manual that violates several of the rules above:

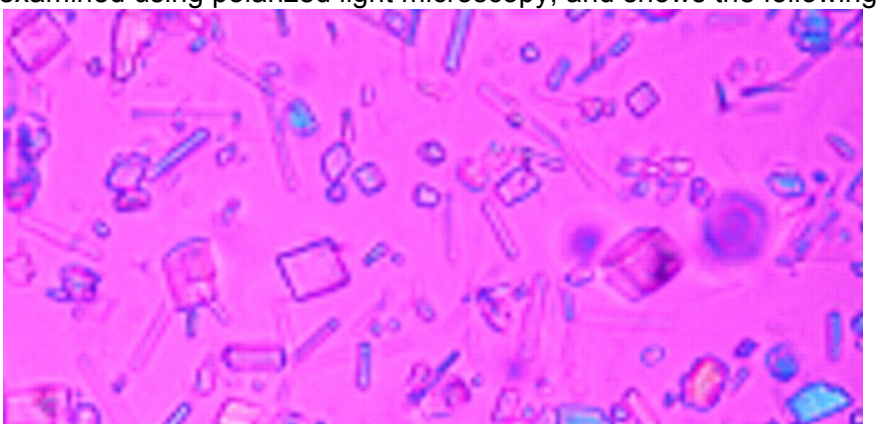
1. Which of the following is true about pseudogout?
   a. it occurs frequently in women.
   b. it is seldom associated with acute pain in a joint.
   *c. it may be associated with a finding of chondrocalcinosis.
   d. it is clearly hereditary in most cases.
   e. it responds well to treatment with allopurinol.

What's wrong with it?

- First, it violates rule 2; there isn't a clear question in the stem, you must read the stem along with each choice, making this a multiple True/False question. While 'C' is true, a case could be made for 'A' since it occurs as frequently in women as in men.
- Second, the choices don't fall along a single dimension: you're asked to compare apples and oranges, or in this case, gender, location, pathology, genetics, and pharmacology.

To repair this question we've rewritten the stem, focusing it and the choices on one theme.

1. A 72-year-old man presents complaining of the sudden onset of knee pain that began a week ago. He describes the pain as sharp and severe and located in the joint. The knee is swollen, warm to the touch, and the skin over it is red. Joint fluid is aspirated, examined using polarized light microscopy, and shows the following:



What is the most likely diagnosis for the patient's knee pain?
   a. gout
   b. osteoarthritis
   *c. pseudogout
   d. rheumatoid arthritis
   e. traumatic effusion

Bloom's Taxonomy Levels

Levels of difficulty that discriminate among test takers.

Knowledge Remembering	Comprehension Understanding	Application Applying	Analysis Analyzing	Synthesis Evaluating	Evaluation Creating
lowest	→				highest

I. Knowledge (Remembering) Questions

1. Can the student recall or remember the information?
2. Can the student exhibit memory of previously learned materials by recalling facts, terms, basic concepts and answers?
3. Can the student identify or list variables found in patient history, vital signs, and/or clinical test results.
4. Does the student know which physiological problem each named disease represents (e.g., Graves' disease, hyperthyroidism)?
5. Can the student identify what is being measured by a molecular technique?

Examples:

1. What is the definition of an intrinsic membrane protein?
2. What is another name for vitamin B_{12}?
3. Which of the following is being measured by Northern analysis?

II. Comprehension (Understanding) Questions

1. Can the student explain ideas or concepts?
2. Can the student demonstrate understanding of facts and ideas by organizing, comparing, interpreting, giving descriptions, and stating main ideas?
3. Can the student define each variable?
4. Can the student define the presenting signs and symptoms of each disease?
5. Does the student understand what the results of a molecular technique indicate?

Examples:

1. Which of the following best represents the health benefits of eating apples versus oranges?
2. Which of the following best explains the intensity of the band observed in the Northern analysis?

III. Application (Applying) Questions

1. Can the student solve problems for a novel situation by applying acquired knowledge, facts, techniques and rules in a different way?
2. Given a set of clinical variables, can the student identify the relevant variables and make a diagnosis?
3. Can the student identify the expected results you would obtain from a given molecular technique or state which technique could be used to solve a novel problem?

Examples:

1. Which of the following medications would be best to treat the patient?

2. Which of the following best explains the intensity of the band observed in the Northern analysis?
3. Which of the following banding patterns would you expect if you analyzed a protein complex containing a 55-kDa and 35-kDa protein by SDS-PAGE?

IV. Analysis (Analyzing) Questions

1. Can the student distinguish between the different parts?
2. Can the student make inferences and find evidence to support generalizations?
3. Given a set of clinical variables and a diagnosis, can the student determine which other possible diseases (differential diagnoses) need to be ruled out?
4. Can the student interpret the raw data obtained from a molecular technique, including the interpretation of controls and how to normalize data?

Examples:

1. Which of the following diets would be most beneficial for a patient with diabetes?
2. Which of the following best explains the results of a RT-PCR gel analysis by comparing relative expression of experimental genes to a standardize control gene?

V. Synthesis (Evaluating) Questions

1. Can the student justify a stand or decision?
2. Can the student compile information together in a different way by combining elements in a new pattern or proposing alternative solutions?
3. Given a set of clinical variables and a diagnosis, can the student determine the next clinical test that needs to be performed to confirm the diagnosis?
4. Can the student design or identify an experiment using a given molecular technique to test a hypothesis?

Examples:

1. What is your leading diagnostic hypothesis?
2. What are your active alternate hypotheses?
3. Which is the treatment of choice for this particular patient?
4. Which of the following Northern analysis experiments would best test the hypothesis that transcription factor A regulates expression of gene B?

VI. Evaluation (Creating) Questions

1. Can the student present and defend opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria?
2. Given a set of clinical variables and a diagnosis, can the student evaluate the evidence supporting the diagnosis and provide the patient with a second opinion?
3. Can the student assess relative merit of using two different molecular approaches to address a particular hypothesis?

Examples:

1. Which of the following is the best design of an experiment to test X hypothesis? Which treatment would you choose if the standard-of-care option is poorly tolerated?

Examples of learning objectives appropriately matched to NBME-style multiple-choice questions:

1. Identify the short-term and long-effects effects that consumption of high fat and high carbohydrate foods have on blood lipids.

A healthy, 70-year-old man is instructed to fast for at least 12 hours prior to having blood drawn for measurement of his plasma lipids. Which of the following lipids would show the greatest change in level depending on whether he adheres to his instructions on fasting, or succumbs to the temptation of eating breakfast at McDonald's 3 hours prior to his 11:00 am visit to the doctor's office?

a. High-density lipoprotein (HDL)
b. Low-density lipoprotein (LDL)
c. Phospholipid
d. Total cholesterol
e. Total triacylglycerol*

2. Calculate the approximate serum LDL cholesterol concentration from appropriate lipid measurements.

A 68-year-old woman presents for an annual physical examination. She has fasted for 12 hours and a blood sample is drawn for measurement of plasma lipid levels. The clinical chemistry laboratory reports the following:

Total cholesterol: 275 mg/dL
Triglycerides: 300 mg/dL
HDL cholesterol: 40 mg/dL

In accord with standard procedure, the laboratory calculates a value for LDL-cholesterol level from these measurements. Into which of the following National Cholesterol Education Program categories does this patient's LDL-cholesterol level fit?

a. Optimal (<100 mg/dL)
b. Near optimal (100-129 mg/dL)
c. Borderline high (130-159 mg/dL)
d. High (160-189 mg/dL)*
e. Very high (≥190 mg/dL)