Bringing your Exam Questions to Bloom:

Writing Effective Open-ended Questions to Test Higher-level Thinking

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Session Objectives

- List the benefits of open-ended exam questions in testing higher-level cognitive skills

- Categorize open-ended exam questions according to levels of Bloom's taxonomy

- Write open-ended exam questions that test higher level cognitive skills

- Construct rubrics that incorporate cognitive skill level for grading open-ended exam questions
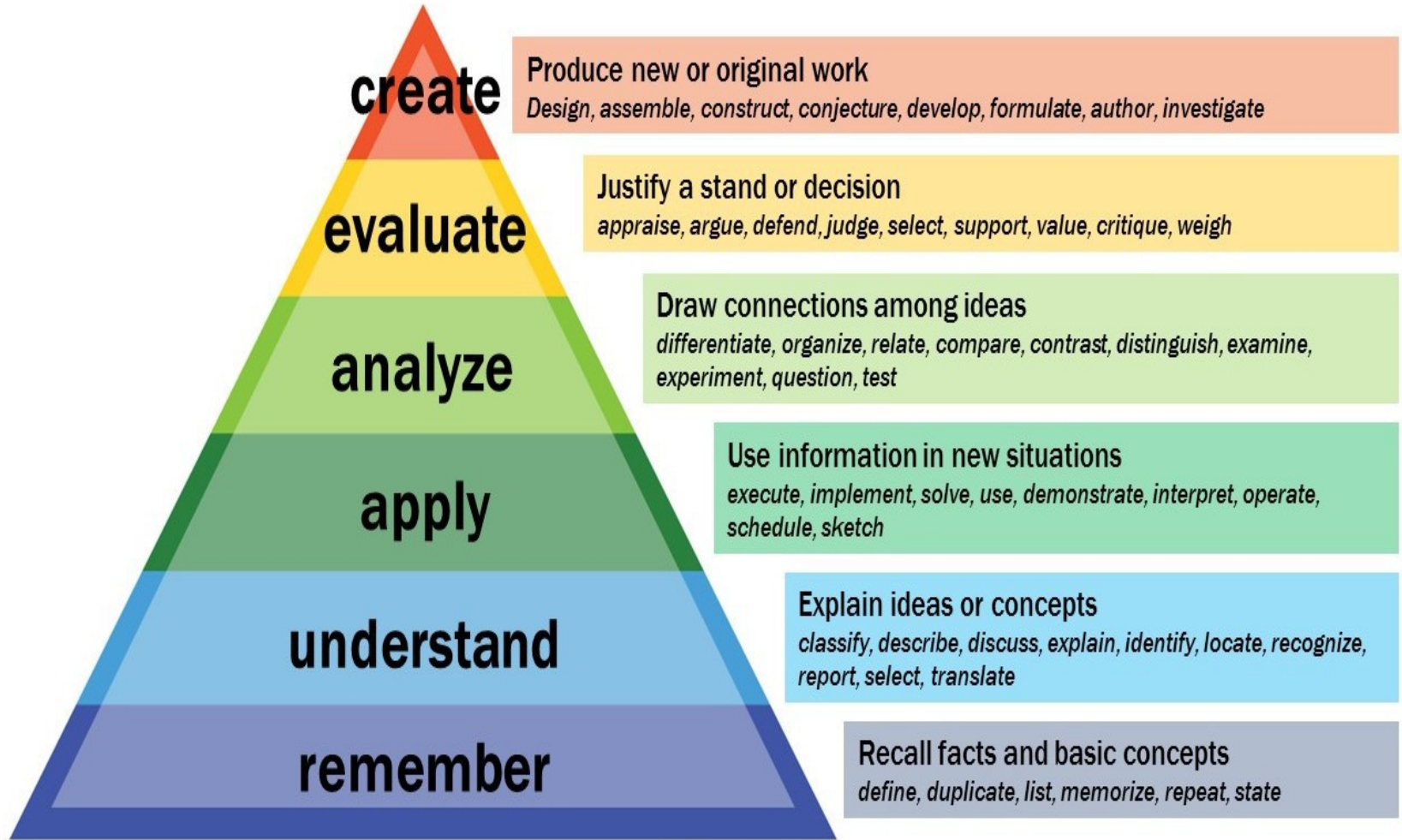
Open Ended Questions: Rationale

Well-designed open-ended questions:

- Allow assessment of analytical and critical thinking skills

- Offer students the opportunity to demonstrate application of knowledge with "real-life" problem solving skills using their own language

- Promote deep learning rather than surface level study habits
  - more likely to focus on broad issues, general concepts, and interrelationships
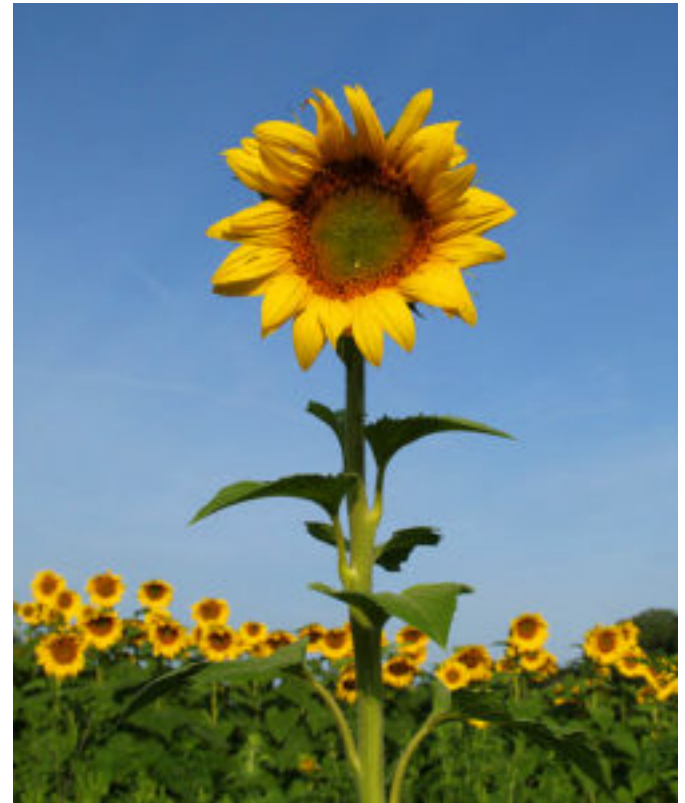
Bloom's Taxonomy

create
Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate

evaluate
Justify a stand or decision
appraise, argue, defend, judge, select, support, value, critique, weigh

analyze
Draw connections among ideas
differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

apply
Use information in new situations
execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

understand
Explain ideas or concepts
classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

remember
Recall facts and basic concepts
define, duplicate, list, memorize, repeat, state

How high do they bloom?

- Exercise: assign Bloom's level to example questions

Choose your verbs wisely…

Level	Explanation	Verbs
Remember*	Recognizing and recalling information, including terms, definitions; facts, principles, theories; methods and procedures	Define, List, State, Label, Name, Describe
Understand*	Understanding the meaning of information, including restating (in own words); translating from one form to another; or interpreting, explaining, and summarizing.	Restate, Paraphrase, Explain, Summarize, Interpret, Illustrate
Apply	Applying general rules, methods, or principles to a new situation, including classifying something as a specific example of a general principle or using a formula to solve a problem.	Apply, Demonstrate, Use, Compute, Solve, Predict
Analyze	Identifying the organization and patterns within a system by identifying its component parts and the relationships among the components.	Compare, Contrast, Categorize, Distinguish
Evaluate	Using evidence and reasoned argument to judge how well a proposal would accomplish a particular purpose; resolving controversies or differences of opinion.	Judge, Appraise, Recommend, Justify, Defend, Criticize, Evaluate
Create	Discovering/creating new connections, generalizations, patterns, or perspectives; combining ideas to form a new whole.	Develop, Create, Propose, Formulate, Design, Invent

The **meaning** of words matters most

A patient with heart failure is started on lasix, and subsequently develops hypokalemia

- Explain the side effects of lasix
    = List *(recall)*
- Explain why this patient develops hypokalemia
    = Apply your knowledge of the side effects of lasix to this patient *(apply)*
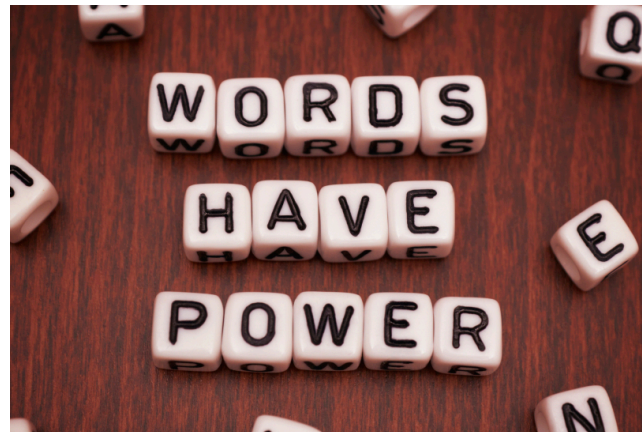
The meaning of words

A patient develops oliguria, with elevated urea and creatinine

- Compare and contrast pre-renal with intrinsic renal disease

  = vague, asks for recall of all you remember about both

- Compare and contrast how you would treat this patient if the oliguria was due to pre-renal vs intrinsic renal disease

  = Analyze the differences between the two causes as applied to this case

The meaning of words

A tennis player presents with progressive pain in the right shoulder, worse in the morning

- Describe the most likely diagnosis
- List the anatomical structures involved

- RECALL?

- Categorize the symptoms and identify the components - *analyze*

Application of knowledge

- To apply knowledge, need something to apply it to…. A situation, scenario, context

- In medical education, most commonly a vignette

- If you can answer the question without a vignette, it is most likely recall

OEQ's: Potential Limitations

- Time intensive: permit only a limited sampling of content
  - *Pick content carefully (and BTW, all tests sample)*
- Can favor students with good writing skills
  - *But also promote writing skills*
- Students can go off on tangents or misunderstand the main point of the question
  - *Ensure question and expectations for answer are clear*
- Students can "guess" the application answer
  - *Ask students to explicitly state rationale*

Best Practices

- Link questions to course objectives
- Questions should be stated in simple, clear language and reflect the language that is used in course materials
- Keep questions free of nonfunctional material and extraneous clues
- Explicitly state expectations regarding length, detail of answer, etc
- Avoid separate questions that depend upon answers or skills required in previous questions

Getting started

- Select course objectives you want to test

- Write a vignette relevant to the objective(s) covered

- Create a question, and verify Blooms' level for each item, should be "apply" or above

- Write a model answer

Check yourself

1. Bloom's level – apply or above?

   If you don't need the vignette to answer the question, likely not application level

2. Does the vignette contain important and relevant information for the question?

   No extraneous information

3. Does the model answer match the question?

   Can you expect the student to provide this answer based on the question?

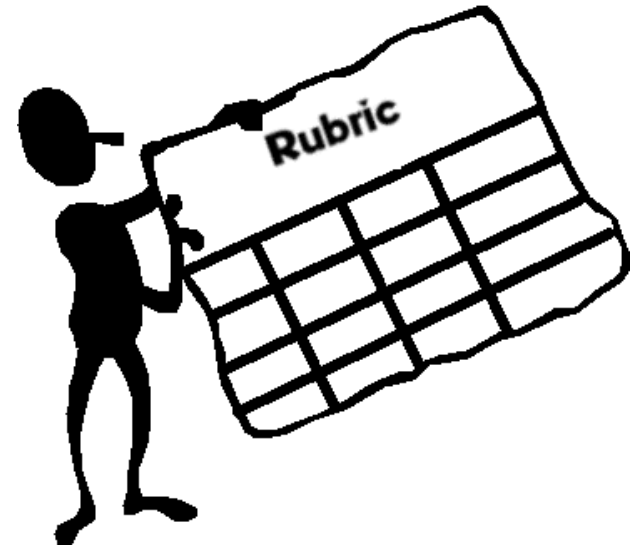4. Do the question and model answer match the objectives?

How well do they bloom?

- Review examples

Rating OEQ's

- Rating Rubrics:
  - Holistic: to give an overall sense of student performance
  - Analytic: to detail where students perform well
- No rubric is perfect, and some subjectivity is inherent to grading OEQ's

Holistic rubric

- Scores the answer as a whole:
  - Responses graded in terms of the accuracy, completeness, and relevance of the ideas expressed.
- Example: The answers demonstrates that student understanding is:

Well developed	Adequate	Limited	Low to none
4 points	3 points	2 points	1 points

Analytic Rubric

- Scores the elements of an answer and gives discrete points for each element

Answer contains xyz all correct	Answer contains xyz with minor error	Answer contains xyz with major error	Answer is missing several elements
4 points	3 points	2 points	1 points

- Risk: may lead to giving equal (or more) credit for recall vs application rather than favoring application

UCSF School of Medicine Rubric

Elements of both a holistic and analytic rubric, which allows for specific feedback to students, but also provides faculty flexibility to decide what constitutes a good answer

Demonstrate ability to apply/evaluate/analyze/create with appropriate and complete content knowledge	Demonstrate ability to apply/evaluate/analyze/create but limited content knowledge or answer has errors/is incomplete	Demonstrate content knowledge only but does not apply/evaluate/analyze/create
6-5 points	**4-3 points**	**2-1 points**
Meets expectations	**Borderline achievement of expectations**	**Does not meet expectations**

Creating a rubric

- Create rubric when you write exam items, based on session objectives
- Rubric does not need to contain every possible answer, but provide an approximate guide
- Check that rubric matches question (and model answer)
- Use rubric to clarify and refine your initial question

Iterative process
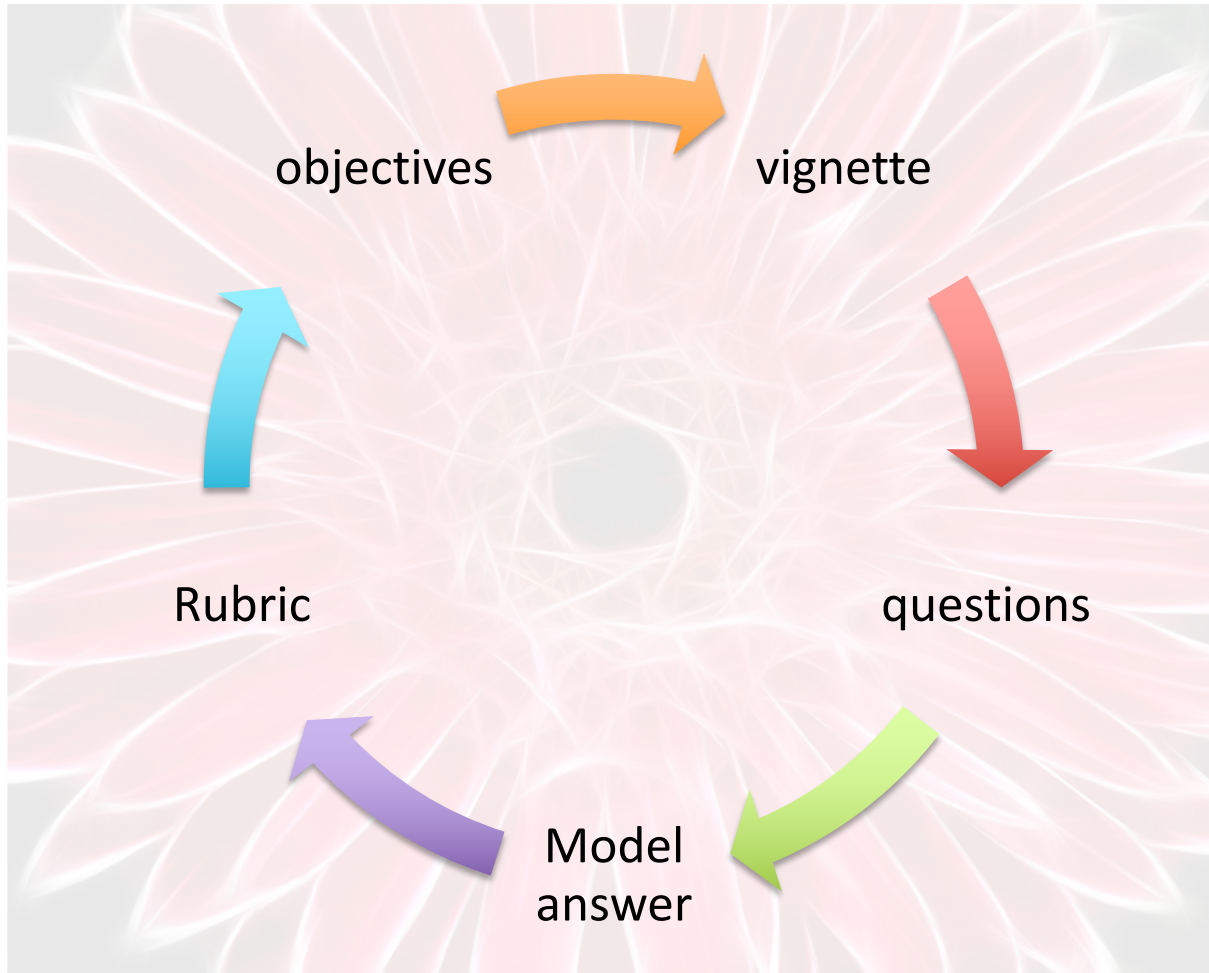
Rate your bloomers

Does the rubric:

- Match the question?

- Match the model answer?

- Reward application over recall?

Improved rubric

Demonstrate ability to apply/ evaluate/analyze/create with appropriate and complete content knowledge	Demonstrate ability to apply/ evaluate/analyze/create but limited content knowledge or answer has errors/is incomplete	Demonstrate content knowledge only but does not apply/evaluate/analyze/create
6-5 points	**4-3 points**	**2-1 points**
Meets expectations	**Borderline achievement of expectations**	**Does not meet expectations**
Lists 3 appropriate different classes of antibiotics and justifies their top choice based on clinical scenario	*List 2 out of 3 classes with correct mechanism of action, or all 3 with some errors or no errors but minimal application to **this** patient*	*List 1 out of 3 classes with correct mechanism of action, or 2 out of 3 with incorrect mechanism/ and or no application*

Wrap up

Please share one take home
point from todays workshop