# 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*
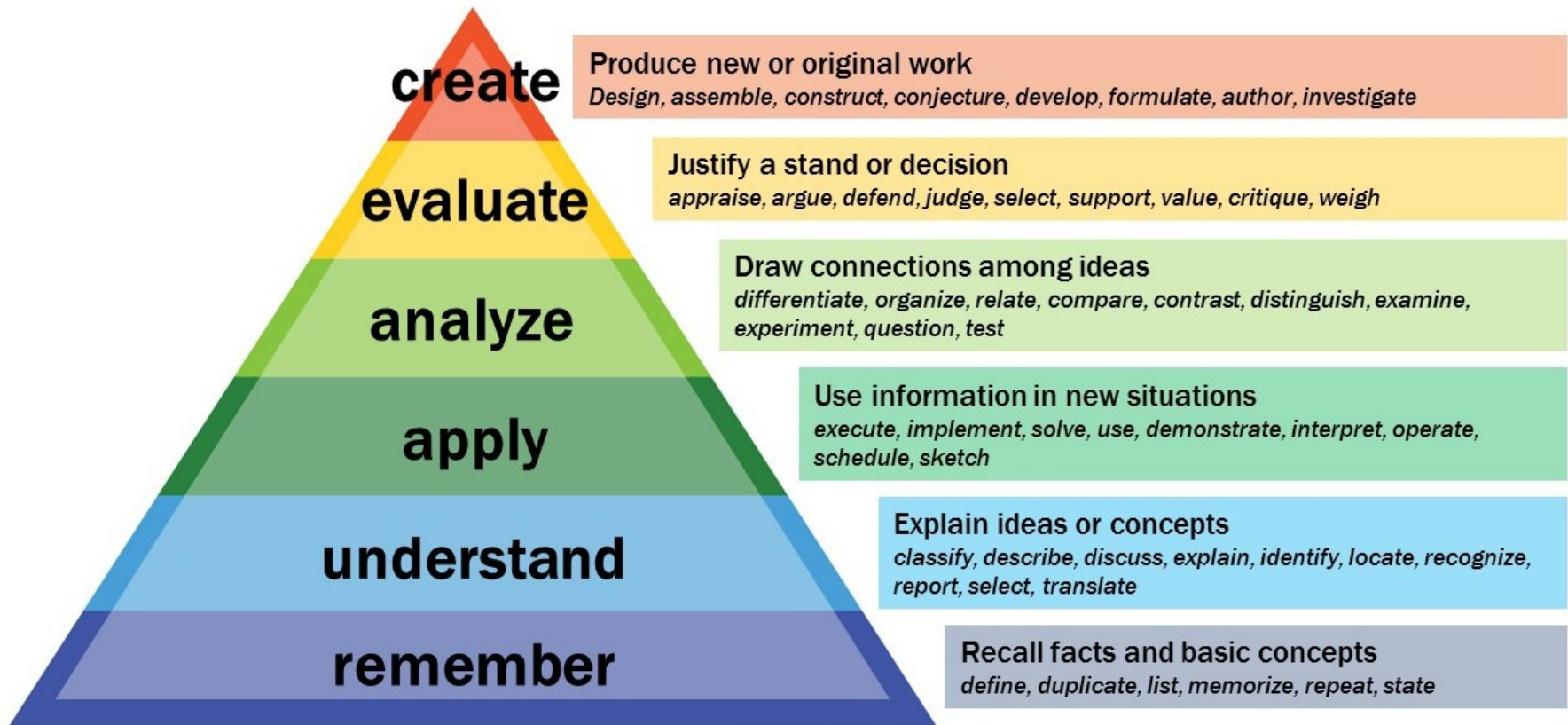
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# Workshop Handout: Bringing your Exam Questions to Bloom
## Writing Effective Open-ended Questions to Test Higher-level Thinking

| Level | Explanation | Verbs | Sample question frames |
|---|---|---|---|
| Remember* | Recognizing and recalling information, including terms, definitions; facts, principles, theories; methods and procedures | Define, List, State, Label, Name, Describe | List three reasons for…? How do we …? Which principle explains….? What is meant by…? |
| 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 | Restate in your own words…? Explain the principle of….? Summarize the main features of…? |
| 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 | How is…an example of… ? How is…related to… ? Why is…significant? |
| Analyze | Identifying the organization and patterns within a system by identifying its component parts and the relationships among the components. | Compare, Contrast, Categorize, Distinguish | Compare .. to… ? Classify …according to… Outline/diagram… |
| 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 | How would you argue for or against…? How would you decide about…? What priority would you give… and why? |
| Create | Discovering/creating new connections, generalizations, patterns, or perspectives; combining ideas to form a new whole. | Develop, Create, Propose, Formulate, Design, Invent | What would you infer from… ? What ideas can you add to… ? How would you create a… ? |

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

### Example: UCSF School of Medicine Bridges Curriculum Rubric Template

| | Meets expectations | Borderline achievement of expectations | Does not meet expectations |
|---|---|---|---|
| Score criterion | Demonstrate ability to apply/evaluate/analyze/create with appropriate and complete content knowledge (6-5 pts.) | Demonstrate ability to apply/evaluate/analyze/create but limited content knowledge or answer has errors/is incomplete (4-3 pts.) | Demonstrate content knowledge only but does not apply/evaluate/analyze/create (2-1 pts.) |
| Analytic skills and content knowledge | Explanation of elements of model answer that contribute to the score (knowledge and application), and approximate delineation of 6 vs 5 pt score | Explanation of elements of answer that contribute to the score (has to have some application), and approximate delineation of 4 vs 3 pt score | Explanation of elements of answer that contribute to the score (can be content knowledge only), and approximate delineation of 2 vs 1 pt score |
| Writing style component | Organization and clarity of content and explanations are clear with natural flow | Reasonable organization and clarity of content and explanations, with small deficiencies in organization and/or clarity | Writing characterized by lack of clarity and difficulty following organization and flow of argument. |

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

**GENERAL PRINCIPLES**

**Open-ended, essay or short answer questions?**
- Open-ended questions differ from multiple-choice questions, because the student is not provided with options to choose from but must generate concepts and information.
- The literature makes further distinctions between essay questions (answer is several paragraphs) and short answer questions (a sentence or two)

**Why Open-ended Questions?**
- Well-designed open-ended questions promote deep learning, and allow assessment of analytical and critical thinking.
- Written questions offer students the opportunity to demonstrate their own judgment and vocabularies, and thereby reflect their "real-life" problem solving skills and application of knowledge more accurately than multiple-choice questions.
- Open-ended questions may promote different study habits: students are more likely to focus on broad issues, general concepts, and interrelationships.

*Potential limitations:*
- Open-ended questions permit only a limited sampling of content learning due to the time required for students to respond – *so pick the content carefully*
- They can favor students who possess good writing skills – *but they also promote good writing skills and allow students to practice clear writing*
- Students can go off on tangents or misunderstand the main point of the question – *so ensure question is clear*


**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
- Write a model answer
- ***Proofread exam questions carefully*** and have another person proofread as well, to check the following:
  - The question tests at the desired Bloom's level – apply or above?
    *If you don't need the vignette to answer the question, likely not application level*
  - Does the vignette contain important and relevant information for the question?
    *No extraneous information*
  - Does the model answer match the question?
    *Can you expect the student to provide this answer based on the question?*
  - Do the question and model answer match the objectives?

# Workshop Exercises: Bringing your Exam Questions to Bloom
## Writing Effective Open-ended Questions to Test Higher-level Thinking

**Exercise 1: How high do they bloom?**

| Question | Bloom's Level |
|---|---|
| 1. A 70-year-old man presents to the emergency room with chest pain. What is the differential diagnosis? | |
| 2. A newborn baby presents with jaundice. The total bilirubin is 15 and the indirect bilirubin is 2. What is the most likely cause of the baby's jaundice? | |
| 3. A 20-year-old woman presents after a syncopal event. What work-up would you propose to distinguish between a cardiac and a neurological cause of the syncope? | |
| 4. Summarize the therapeutic options for a patient with Parkinson's disease. | |
| 5. A newborn baby presents with jaundice. What other clinical features help you distinguish between indirect and direct hyperbilirubinemia? | |
| 6. A 50-year-old man presents with hypercholesteremia and hypertension, and you decide to prescribe a statin. Justify your choice. | |

**Exercise 2: How well do they bloom?**

**Read the vignette, questions and model answer, and then answer the questions on the other side of this page**

*Vignette 1:*

A 26-year-old female presents to the ED with sore throat and fever. On exam, she has enlarged erythematous tonsils, and a rapid Strep test is positive.

*Question:*
    a.   What drug would you choose to treat this patient?
    b.   What is the mechanism of action for the drug you chose?

*Model answer:*

Penicillin (10 days of oral therapy or one injection of intramuscular benzathine penicillin) is the treatment of choice because of cost, narrow spectrum of activity, and effectiveness. Amoxicillin is equally effective and more palatable. Erythromycin and first-generation cephalosporins are options in patients with penicillin allergy.

# Workshop Exercises: Bringing your Exam Questions to Bloom
## Writing Effective Open-ended Questions to Test Higher-level Thinking

**Answer the following questions for each of the 2 questions for vignette 1 and justify your answers:**

1) *Identify Bloom's level:*

| Question | Bloom's level |
|---|---|
| A: What drug would you choose to treat this patient? | |
| B: What is the mechanism of action for the drug you chose? | |

2) *Does the model answer match the question(s)*? (Can you expect the student to provide this answer based on the question?)

3) *Does the vignette contain important and relevant information for the question(s)*? (no extraneous information)?

4) *If you had to guess, what do you think the objectives for this question were?*

3

*Developed by: Christy Boscardin PhD, Tracy Fulton PhD, Karen Hauer MD PhD, Marieke Kruidering PhD, Sandrijn van Schaik MD PhD*

**Exercise 2: How well do they bloom?**

**Read the vignette, questions and model answer, and then answer the questions on the other side of this page**

*Vignette 2*

Mr. Juan Rodriquez is a 73-year-old man who is a life-long smoker and has a history of COPD who was recently hospitalized for chest pain. His work-up included serial troponins and EKGs to rule out a myocardial infarction, for which there was no evidence. He also had a d-dimer level checked which was elevated, he subsequently had a CT scan of the chest to rule out a pulmonary embolism, which was negative. The CT scan did show signs of chronic emphysema as well as a 4mm round lesion in the middle lobe of the right lung, concerning for possible malignancy. He followed up with a pulmonologist, who suggested they watch and wait to do another CT scan of the chest in 6 months.

After this hospitalization, Mr. Rodriquez and his family are worried about his risk for myocardial infarction. His father died from an MI at 76 and his mother died from a stroke at 77. He weighs 210 lbs. and is 5'10" (BMI 30.1). He has hypertension, and was prescribed an anti-hypertensive medication, but his BP remains elevated at 155/95. He has been told he has high cholesterol and was prescribed a medicine for that, which he has never taken.

Mr. Rodriquez has had a lot of social and family stressors in the past few months. His granddaughter, who is 16, has had a lot of trouble in school and he suspects she is doing drugs. His grandson, who is 14, recently came out as gay and was beaten up by some kids in the neighborhood. His wife is increasingly forgetful and since there is a family history of Alzheimer's in her family he worries that she may be showing the first signs of this disease herself. He is unsure how he would manage all of the family issues and his health problems if his wife can no longer help him.

*Questions:*
   a. Based on all the information you have about Mr. Rodriguez, what would you recommend to help him reduce his risk for coronary heart disease (CHD)?
   b. What are the main behavioral risk factors that concern you about Mr. Rodriquez' increased risk of CHD?

*Model Answer:*
Mr. Rodriquez has both a family history of cardiovascular disease (his mother and father) and a number of current risk factors that are cause for concern. His absolute risk of CHD can be dramatically altered by treating his tobacco dependence, diet modification to reduce weight (and salt intake), efforts to increase physical activity, and achieving better control of his hypertension and hypercholesterolemia (via diet, exercise, and stress management). In addition to modification of behavioral risk factors of CHD, pharmacotherapy interventions to better control his blood pressure, decrease fasting glucose levels and statin therapy for hypercholesterolemia could be recommended.

4

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**Workshop Exercises: Bringing your Exam Questions to Bloom**
**Writing Effective Open-ended Questions to Test Higher-level Thinking**

**Answer the following questions for each of the 2 questions for vignette 2 and justify your answers:**

1) *Identify Bloom's level:*

| Question | Bloom's level |
|---|---|
| A. Based on all the information you have about Mr. Rodriquez, what would you recommend to help him reduce his risk for coronary heart disease (CHD)? | |
| B. What are the main behavioral risk factors that concern you about Mr. Rodriquez' increased risk of CHD? | |

2) *Does the model answer match the question(s)*? (Can you expect the student to provide this answer based on the question?)

3) *Does the vignette contain important and relevant information for the question(s)*? (no extraneous information)?

4) *If you had to guess, what do you think the objectives for this question were?*

5

6

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**Exercise 3: Rate your bloomers**

*The following rubric is provided for the questions associated with vignette 1*

| (6-5 pts.) | (4-3 pts.) | (2-1 pts.) |
|---|---|---|
| **Meets expectations** | **Borderline achievement of expectations** | **Does not meet expectations** |
| *Lists 3 different classes of antibiotics* | *List 2 out of 3 classes with correct mechanism of action, or all 3 with incorrect mechanism of action* | *List 1 out of 3 classes with correct mechanism of action, or 2 out of 3 with incorrect mechanism* |

**Does the rubric:**

   **1)** Match the question?

   **2)** Match the model answer?

   **3)** Reward application over recall?

**How would you improve the rubric?**

| (6-5 pts.) | (4-3 pts.) | (2-1 pts.) |
|---|---|---|
| **Meets expectations** | **Borderline achievement of expectations** | **Does not meet expectations** |
| | | |

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