

# Development to enhance higher-order thinking on Bloom's taxonomy & item bank analysis

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# Learning Objectives

- 1) Discuss why we have standardized test
- 2) Describe features of a standardized test
- 3) Define Bloom's taxonomy and how it can be applied to item writing
- 4) Describe the components of a multiple-choice question
- 5) Discuss the features of a well-designed versus a poorly-designed multiple choice questions
- 6) Apply what we learned to write a standardized test question

# Why do we have standardized tests?

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- Objective measure of competency
- Allows for the establishment of a benchmark
- Set universal educational standard
- Inform educational policies



# What are features of an ideal standardized test?

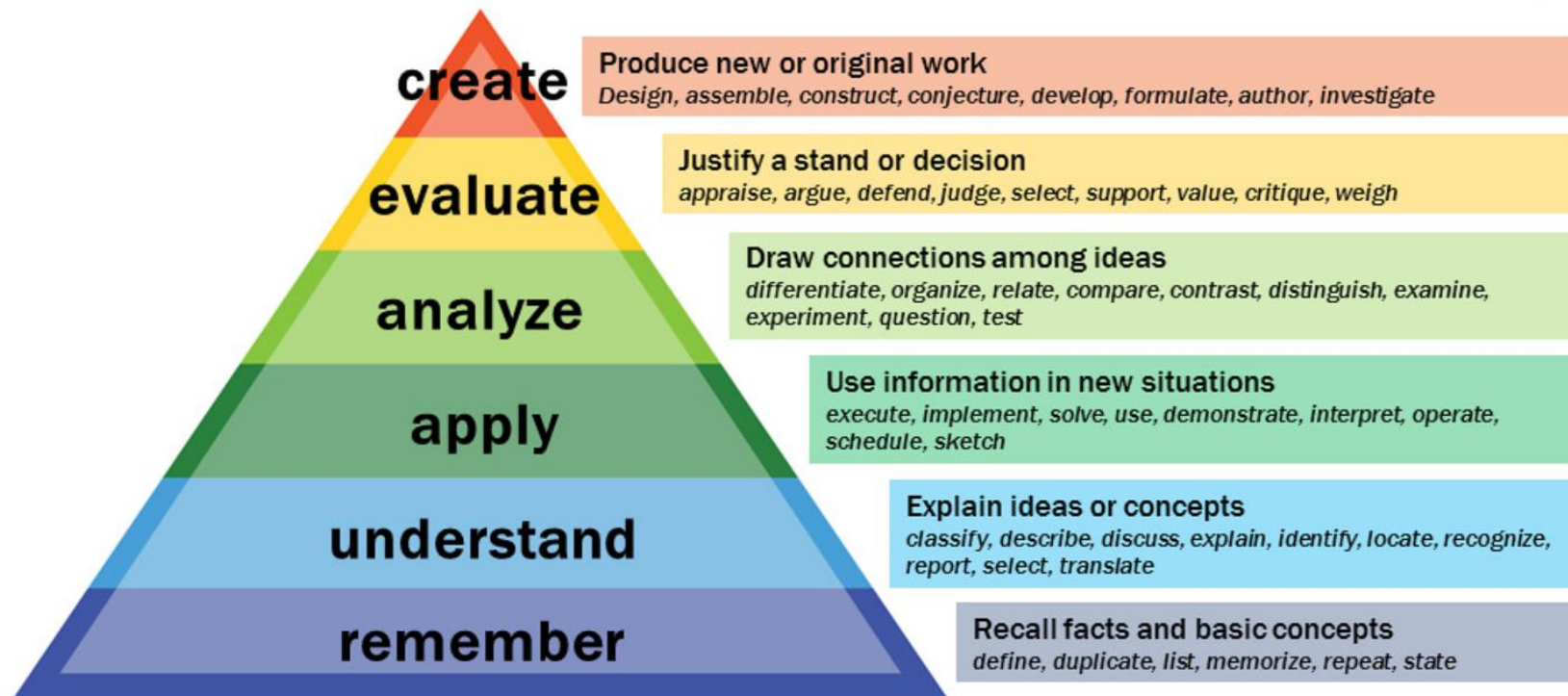
- Uniform – test given under the same conditions
- Standardized scoring – scored in a consistent manner and allow for comparison between the student and the group
- Objective – tests are free from bias
- Valid – test measures what it is intended to measure
- Reliable – test should yield consistent results
- Relevant – relevance to what is being taught in the curriculum.
- Assess competency – test higher level thinking skills



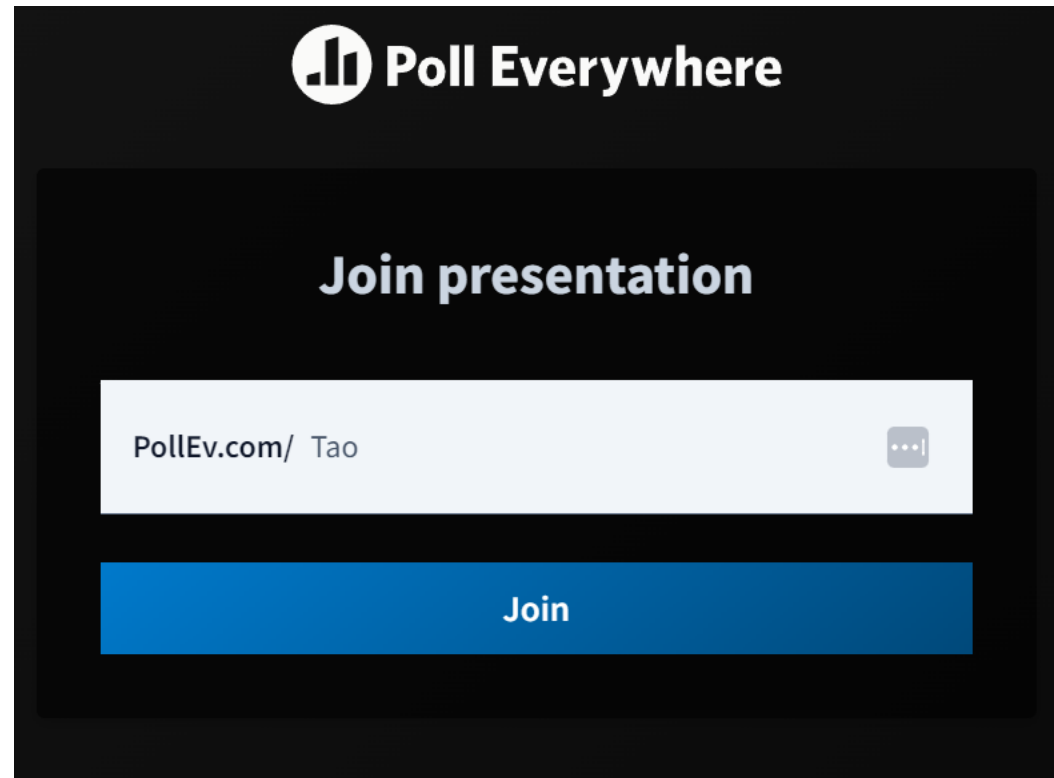
# Bloom's Taxonomy

Definition: a system used to classify the different levels of cognition that occurs during a learning process

## Bloom's Taxonomy



# POLLEV.COM



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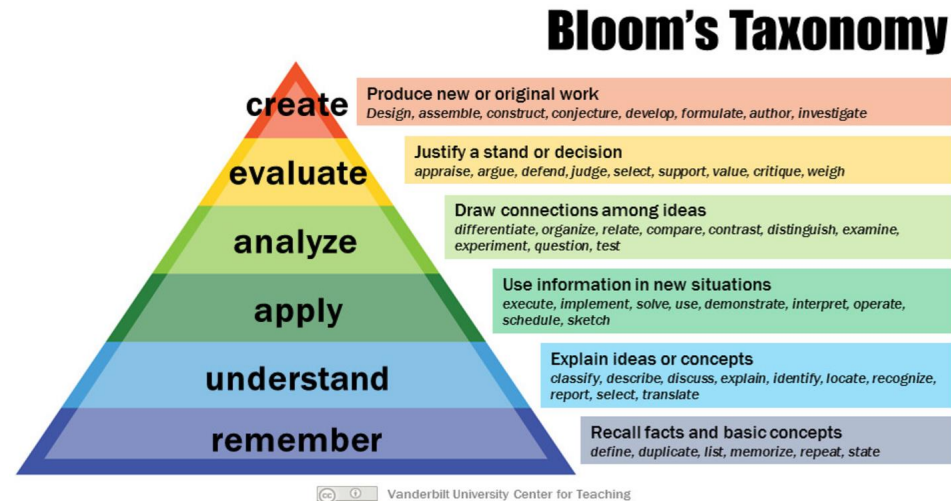
# Classify this question using Bloom's taxonomy

Which of the following is the first line treatment for exercised induced bronchospasm?

- Albuterol
- Salmeterol
- Fluticasone
- Montelukast
- Prednisone

Answer choices:

- A. Analyze
- B. Apply
- C. Remember
- D. Understand

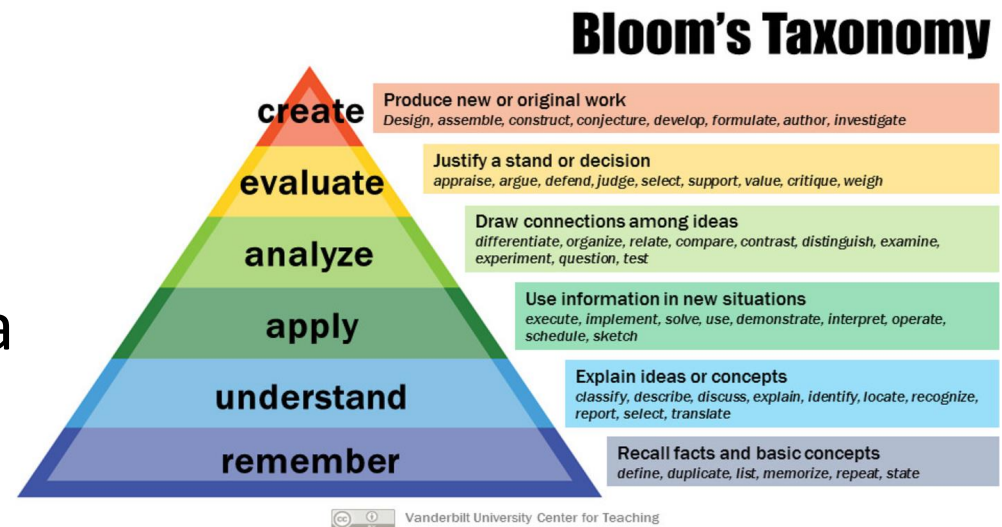


# Answer = Remember

Which of the following is the first line treatment for exercised induced bronchospasm?

- Albuterol
- Salmeterol
- Fluticasone
- Montelukast
- Prednisone

This requires only recall of information that has been memorized.





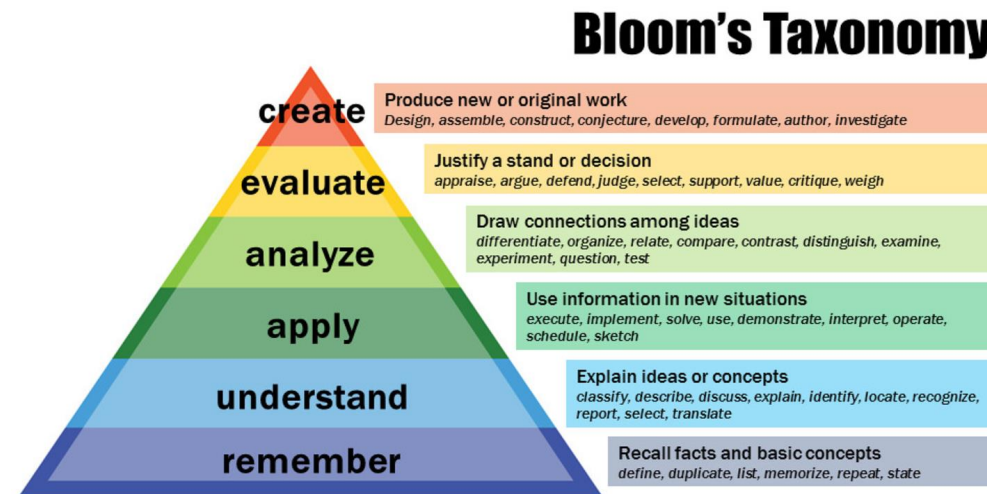
# Classify this question using Bloom's taxonomy

A 25-year-old man presents to the emergency department with chest pain, shortness of breath and coughing for the last 2 days. The shortness of breath is worse with exercise and at night. He also has a runny nose and congestion. The patient was hospitalized multiple times as a child due to "trouble breathing" but has not had symptoms for many years. The patient started smoking 6 months ago. Temperature is 37.6°C; respirations are 18; oxygen saturation is 96% on room air. The physical exam shows decreased air movement with bilateral wheezing and prolonged expiration. Which of the following is the most likely diagnosis?

- Asthma
- Community acquired pneumonia
- Chronic obstructive lung disease
- Cystic fibrosis
- Gastroesophageal reflux disease

Answer choices:

- A. Analyze
- B. Apply
- C. Remember
- D. Understand

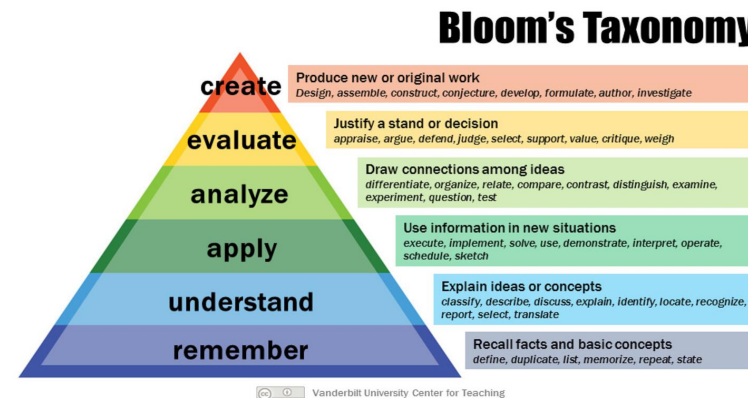


# Answer = apply/understand

A 25-year-old man presents to the emergency department with chest pain, shortness of breath and coughing for the last 2 days. The shortness of breath is worse with exercise and at night. He also has a runny nose and congestion. The patient was hospitalized multiple times as a child due to “trouble breathing” but has not had symptoms for many years. The patient started smoking 6 months ago. Temperature is 37.6°C respirations are 18 oxygen saturation is 96% on room air. The physical exam shows decreased air movement with bilateral wheezing and prolonged expiration. Which of the following is the most likely diagnosis?

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The information provided is used to arrive at a diagnosis. The student must identify key pieces of information in the history and physical exam findings and interpret that these findings are consistent with the diagnosis of asthma.



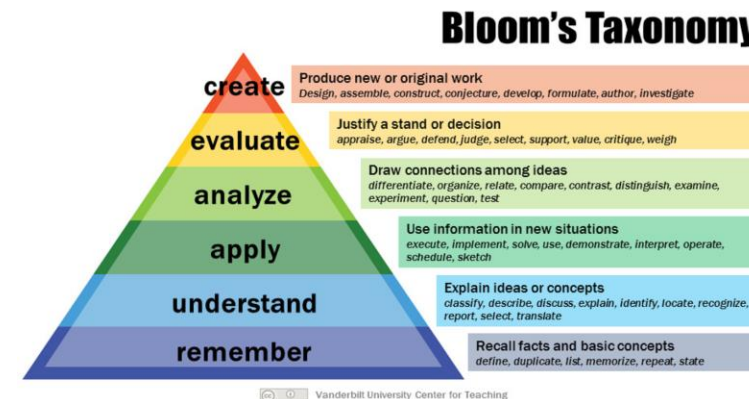
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	FVC	FEV1	FEV1/FVC
A.	Normal	Normal	Normal
B.	Normal	Decreased	Decreased
C.	Decreased	Decreased	Normal
D.	Decreased	Normal	Decreased

Answer choices:

- A. Analyze
- B. Apply
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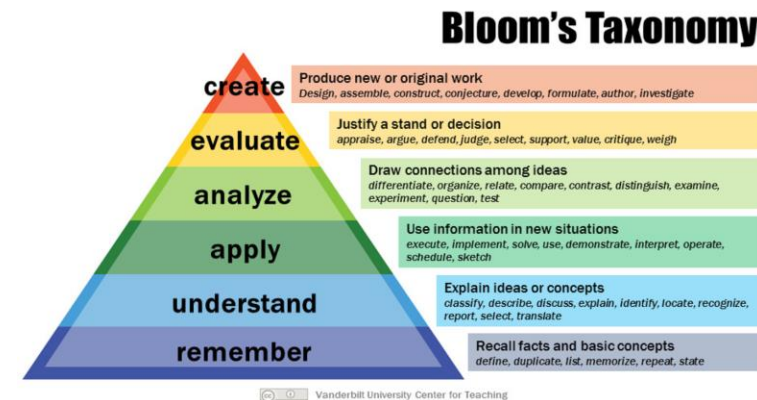


# Answer = apply/analyze

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C.	Decreased	Decreased	Normal
D.	Decreased	Normal	Decreased

This question requires a multi-step logic process where the student must first identify the signs and symptoms of asthma and interpret that this patient has asthma. They then need to interpret the spirometry finding given the presentation.



# Review learning objectives

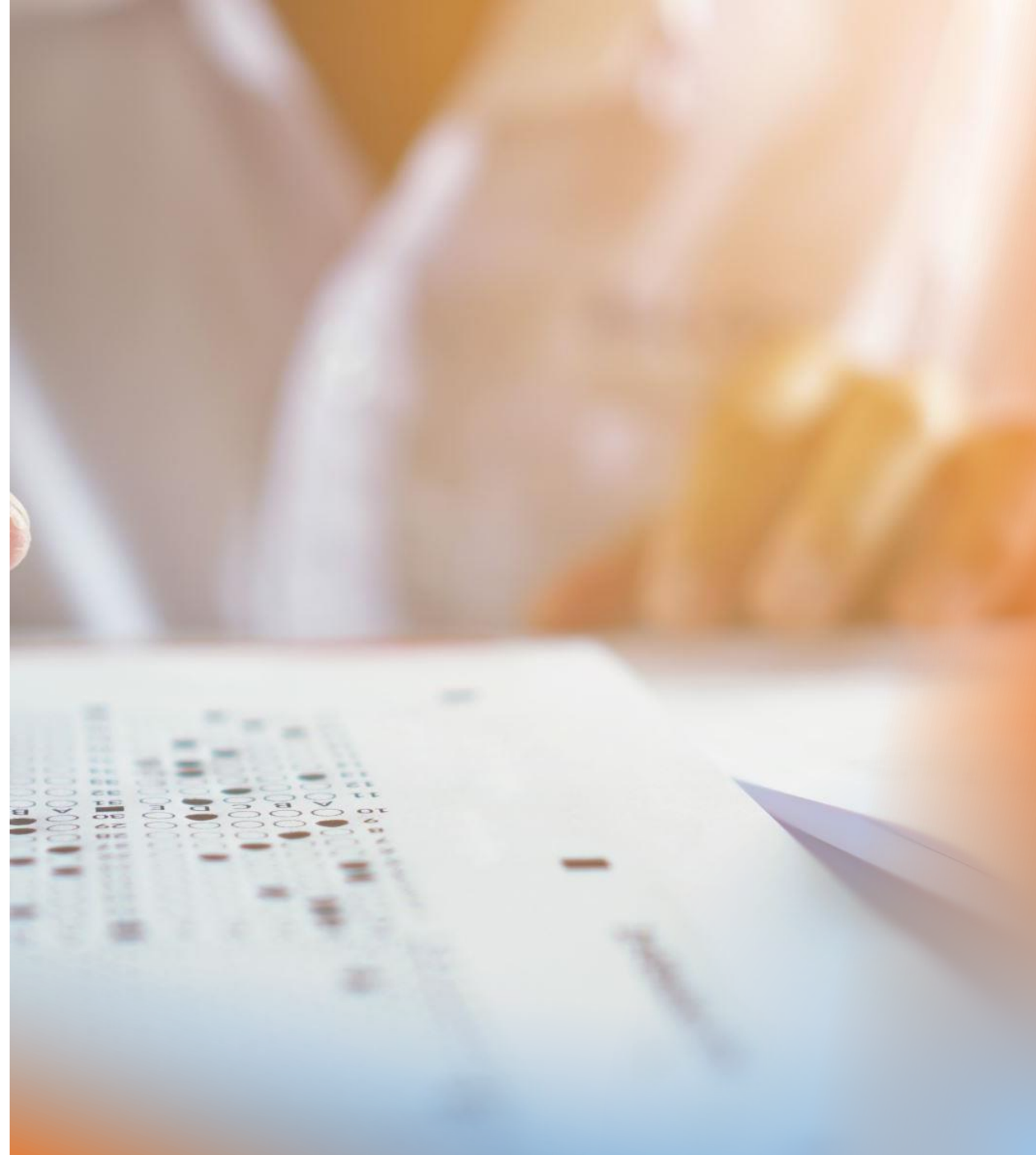
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- Discuss why we have standardized tests
- Recall the features of an ideal standardized tests
- Apply the definition of Bloom's taxonomy



What are the different types of multiple-choice questions on a standardized exam?

- Single correct answer
- Multiple correct answers (A. Choices 1,2 and 3 are correct. B. Choices 1 and 3 are correct. C. Choices 2 and 4 are correct. D. Only choice 4 is correct. E. All choices are correct)
- True-false item





# Anatomy of a question

A 49-year-old man comes to his physician for evaluation of a rash. He first noticed a darkening and roughening of the skin on his neck and underarms about 2 months ago. One week ago, the patient noticed a number of similar patches on the backs of his knees. He reports no other symptoms. He feels well, and his medical history is unremarkable. He is 181 cm (5 ft 9 in) tall and weighs 130 kg (286 lb); body mass index is 42.4 kg/m<sup>2</sup>. Temperature is 36.4°C (97.5°F), pulse is 87/min, respirations are 18/min, and blood pressure is 119/62 mm Hg. Physical examination shows hyperpigmented thin plaques with velvety texture on his neck, underarms (shown), and flexor surfaces of elbows, wrists, and knees. The remainder of the examination is unremarkable.

Stem

Which of the following is the most likely diagnosis?

Lead-in

- A. Acanthosis nigricans ← Correct answer
- B. Erythrasma ← Distractor
- C. Intertrigo ← Distractor
- D. Lichenification ← Distractor
- E. Post inflammatory hyperpigmentation ← Distractor

Answer choices

# Best practices for writing standardized exam question

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- Questions should be based on a blueprint
  - What is the curriculum?
  - What should the test cover?
  - What are the levels of the test takers?
  - What is the purpose of this test?
- Questions should be categorized

Example of how a question can be categorized

  - Discipline – Internal medicine, pediatrics, surgery, etc...
  - Organ system – Gastroenterology, cardiology, nephrology, etc ...
  - Competency – Diagnosis, management, prognosis, etc...
  - Topic – Hypertension, diabetes, COPD, etc...
- Questions should have a clear teaching point
  - Define the purpose of the question
  - Define the desired learning outcome

# Sample template for item writing

## Section 1: Teaching Point and Lead-in

Questions are designed according to their testing concept in the relevant topic, discipline, and organ systems per the table of contents and question mapping process. The first step in writing or revising a question is to create a clear learning objective. What is the purpose of the question? What is the desired learning outcome for the student?

Clearly state the **teaching point** for the question.

The lead in is a single sentence that poses the question to be answered and establishes the relationship between the stem and the answer choices. It is directly linked to the testing concept. The question should require interpreting information from the stem and a clear reasoning process (eg. 1. Disease diagnosis, 2. Disease complications, 3. Diagnostic testing)

Write the **lead in** to reflect the teaching point.

# What are the best practices for writing a lead-in?

- Ask a direct question
  - Which of the following is the most likely diagnosis?
- Asks a single concept
  - ~~Which of the following is the most likely mechanism of action and side effect of this drug?~~
- Avoids negative phrases
  - ~~All of the following factors contributed to the patient's heart failure except:~~
- Clear, focused and unambiguous
- Appropriate for the level of the test taker and competency being tested
- Ask a higher order question
- Stand alone – question passes the “cover-the-options” rule

# Sample teaching point and lead-in

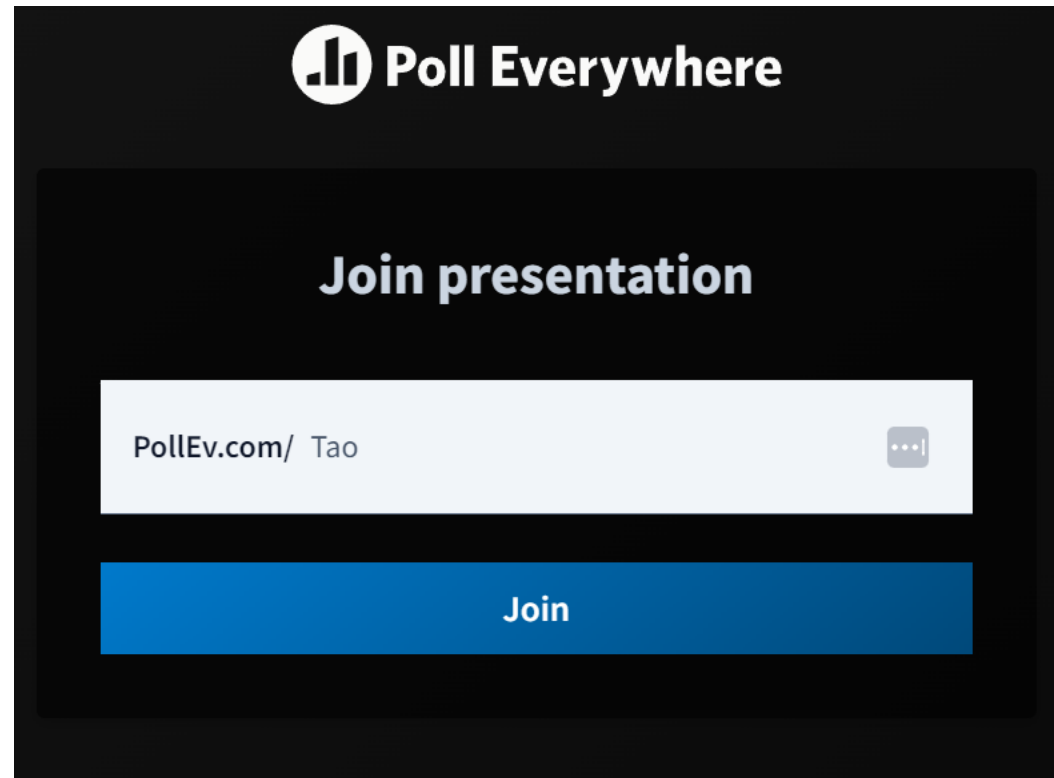
Clearly state the **teaching point** for the question.

Silicosis can present as acute respiratory failure and the diagnosis must be suspected in a patient with occupational exposure

Write the **lead in** to reflect the teaching point.

Which of the following is the most likely diagnosis?

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# Sample test question

A 55-year-old man was admitted to the hospital 2 weeks ago for rapid onset of cough, fatigue, and pleuritic chest pain. At that time, he also endorsed shortness of breath on exertion but reported no hemoptysis. The patient's condition deteriorated over the next 2 weeks. Currently, the patient is intubated and on assist-control ventilation. His medical history is significant for hypertension and allergies treated with hydrochlorothiazide and loratadine. He reports a 20-pack-year smoking history and is a current smoker. He worked in a shipyard for 30 years but recently changed jobs about 2 months ago and now works as a sandblaster. His father had a heart attack at age 78, and his mother died of breast cancer at age 68. He drove out-of-state to visit family members last month. Several people experienced runny nose, congestion, and coughing during his visit. Temperature is 36.7°C (98°F), pulse is 96/min, respirations are 18/min, and blood pressure is 138/85 mm Hg. A recent arterial blood gas study showed a pH of 7.42, arterial carbon dioxide pressure of 36 mm Hg, and arterial oxygen pressure of 110 mm Hg while on 100% oxygen. Physical examination is significant for diffuse crackles throughout both lung fields, a loud pulmonic component of the second heart sound, and jugular venous distention of 9 cm with a prominent A wave, a left parasternal heave, and symmetric 3+ lower extremity pitting edema. X-ray of the chest (CXR) reveals diffuse infiltrates bilaterally. CXR 1 year ago showed clear lungs. Sputum culture reveals no growth. Echocardiogram reveals left ventricular ejection fraction of 55%, normal left atrial size, and a dilated right ventricle with reduced function. There is no aortic or mitral valve pathology. There is 2+ tricuspid regurgitation.

Which of the following is the most likely diagnosis?

- A. Acute silicosis
- B. Asbestosis
- C. Chronic obstructive pulmonary disease
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- F. Bacterial pneumonia
- G. E-cigarette and vaping associated lung injury

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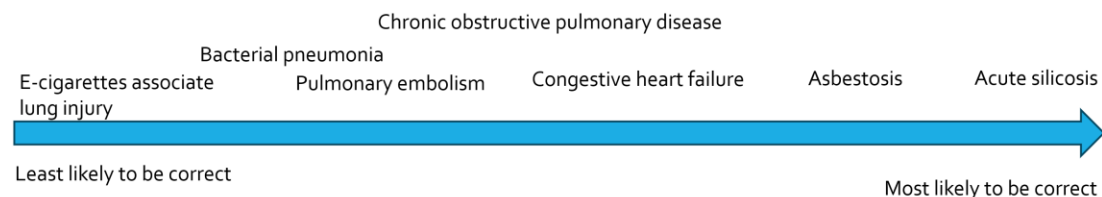
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# Analysis of sample question

A 55-year-old man was admitted to the hospital 2 weeks ago for rapid onset of cough, fatigue, and pleuritic chest pain. At that time, he also endorsed shortness of breath on exertion but reported no hemoptysis. The patient's condition deteriorated over the next 2 weeks. Currently, the patient is intubated and on assist-control ventilation. His medical history is significant for hypertension and allergies treated with hydrochlorothiazide and loratadine. He reports a 20-pack-year smoking history and is a current smoker. He worked in a shipyard for 30 years but recently changed jobs about 2 months ago and now works as a sandblaster. His father had a heart attack at age 78, and his mother died of breast cancer at age 68. He drove out-of-state trip to visit family members last month. Several people experienced runny nose, congestion, and coughing during his visit. Temperature is 36.7°C (98°F), pulse is 96/min, respirations are 18/min, and blood pressure is 138/85 mm Hg. A recent arterial blood gas study showed a pH of 7.42, arterial carbon dioxide pressure of 36 mm Hg, and arterial oxygen pressure of 110 mm Hg while on 100% oxygen. Physical examination is significant for diffuse crackles throughout both lung fields, a loud pulmonic component of the second heart sound, and jugular venous distention of 9 cm with a prominent A wave, a left parasternal heave, and symmetric 3+ lower extremity pitting edema. X-ray of the chest (CXR) reveals diffuse infiltrates bilaterally. CXR 1 year ago showed clear lungs. Sputum culture reveals no growth. Echocardiogram reveals left ventricular ejection fraction of 55%, normal left atrial size, and a dilated right ventricle with reduced function. There is no aortic or mitral valve pathology. There is 2+ tricuspid regurgitation.

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Asbestosis

Bacterial pneumonia

Chronic obstructive pulmonary disease

E-cigarettes associate lung injury

Congestive heart failure

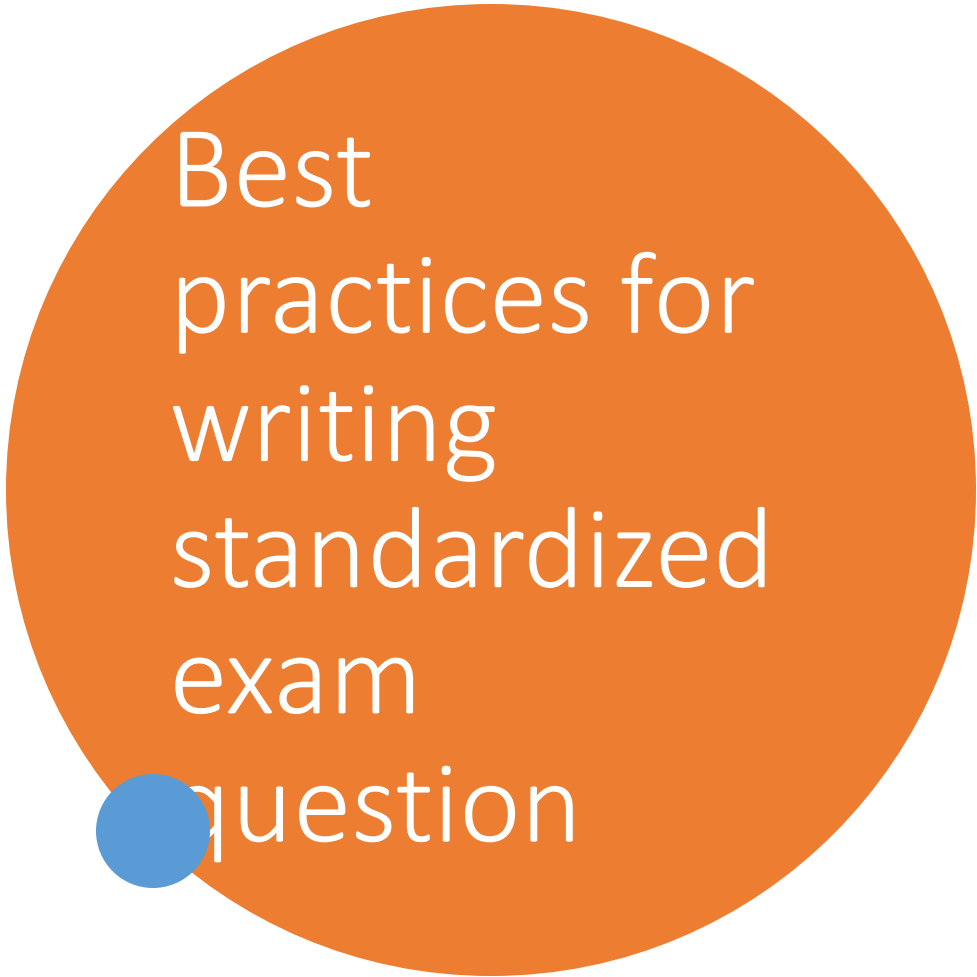
Acute silicosis

Pulmonary embolism


Least likely to be correct

Most likely to be correct





Best  
practices for  
writing  
standardized  
exam  
question



Questions should start with a clear plan of how to proceed

- Don't start with the correct answer and construct a question around the correct answer
- Start with what are the possible correct answers

# What are the best practices for writing a stem?

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- All the information needed to answer the question are in the stem
- Information to make distractors plausible are in the stem
- The stem is required to be able to answer the question
- Buzzwords and clues to the correct answer are absent from the stem
- Language should be clear and without colloquialisms or slangs
- Bias (age, gender, etc...) should not be included
- Realistic clinical scenario is presented if it is a clinical vignette
- Word length requirement is set

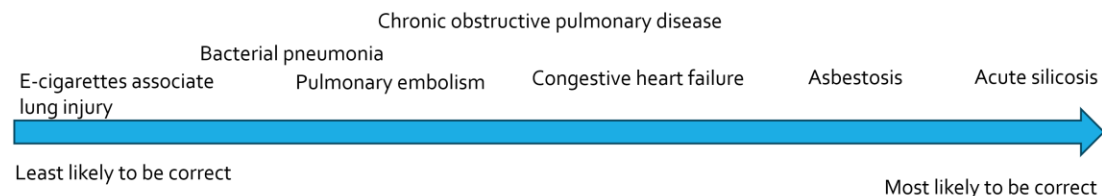


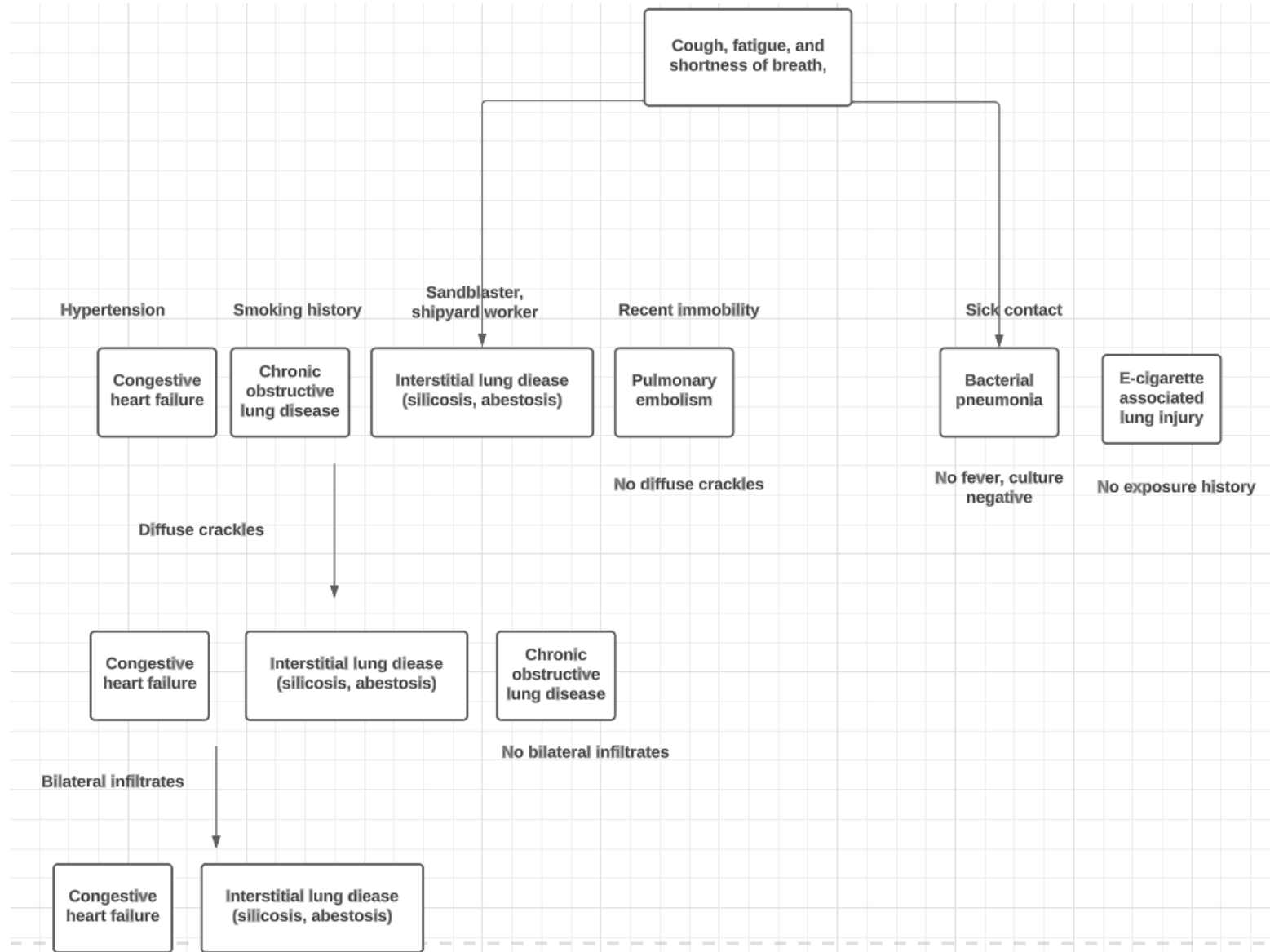
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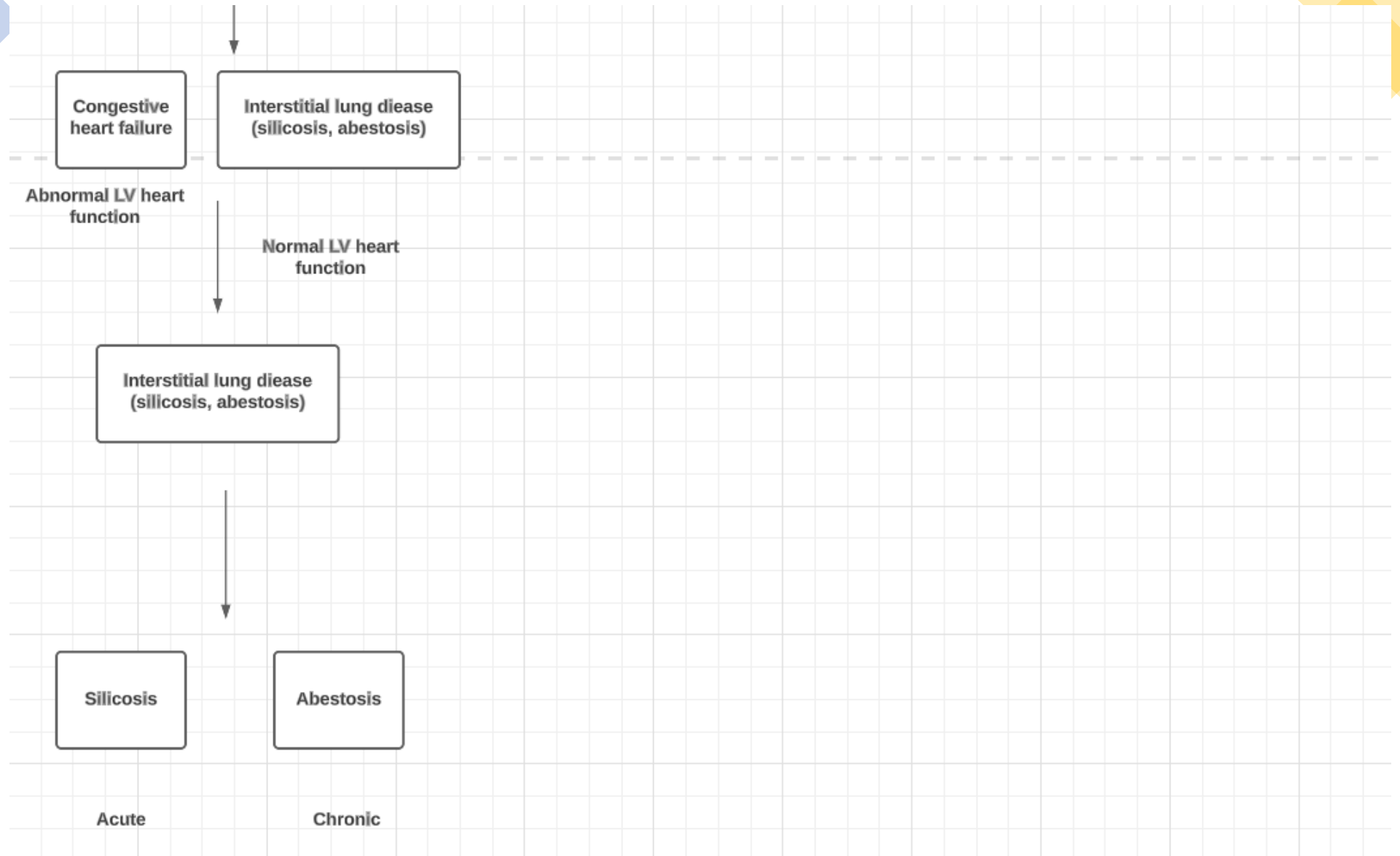
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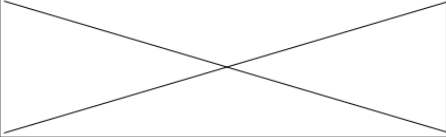
	What makes the answer plausible?	What makes the answer incorrect?
<b>Correct Answer</b> Acute silicosis	Pt's new job as a <b>sandblaster</b> involved high dose exposure to silica, which induced <b>acute silicosis</b> as evidenced by <b>acute respiratory decompensation with bilateral infiltrate and right ventricular failure</b> .	Not applicable
<b>Distractor 1</b> Asbestosis	<b>Bilateral interstitial infiltrate</b> in a patient with <b>asbestos exposure</b>	Acute development of symptoms is not consistent with asbestosis
<b>Distractor 2</b> Chronic obstructive pulmonary disease	Pt is a <b>smoker</b>	COPD alone does not cause bilateral parenchymal infiltrates. This suggests an additional cause.
<b>Distractor 3</b> Congestive heart failure	Patient has <b>hypertension</b> , a risk factor for CHF. CHF with acute pulmonary edema may cause acute respiratory decompensation with <b>bilateral infiltrates</b>	With normal LV systolic function and normal LA size and no aortic or mitral valve pathology, this is less likely.
<b>Distractor 4</b> Pulmonary embolism	Patient recently had a <b>long trip</b> (out-of-state). PE could cause respiratory decompensation and <b>right ventricular failure</b> .	PE does not show parenchymal abnormality on chest radiograph.
<b>Distractor 5 (optional)</b> Bacterial pneumonia	Patient had <b>ill-contact</b> . Pneumonia is a common cause of <b>acute respiratory decompensation with pulmonary infiltrates</b>	No features to suggest infection (afebrile, sputum cultures no growth)
<b>Distractor 6 (optional)</b> E-cigarette and vaping associated lung injury	Could present similarly	No history of vaping or e-cigarette use.

# Sample template for item writing

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## Section 2: Answer Options

There is only one best correct answer and at least four incorrect answers referred to as *distractors*. All answer choices should be plausible and attractive, similar in length and complexity, and parallel in construction (eg, all diagnoses). Be sure to select distractors that share multiple elements with the correct answer and are plausible for different reasons.

	What info in the stem supports that this answer is plausible?	What makes the answer incorrect?
Correct Answer:		
Distractor 1:		
Distractor 2:		
Distractor 3:		
Distractor 4:		
Distractor 5 (optional):		
Distractor 6 (optional):		

# What are the best practices for writing answer choices?

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- Contains only one most correct answer choice
- Contains distractors that are plausible
- Grammatically align with the stem and lead-in
- Answer choices are homogenous
  - eg all medications, diagnostic testings, etc..
- Answer choices are similar in length, format, and complexity
- Answer choices do not converge
  - eg amoxicillin, amoxicillin and ciprofloxacin, amoxicillin and gentamicin, metronidazole, fluconazole
- Answer choices are arranged in alphabetical order

# Best practices for writing the stem

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1) The initial sentence (typically the patient's presentation) should allow all the distractors to be correct. A choice should not be eliminated by reading the first sentence.

Example: Cough, fatigue, and shortness of breath are all symptoms of congestive heart failure, COPD, interstitial lung disease, pulmonary embolism, bacterial pneumonia, and E-cigarette associated lung injury

2) The next few sentences must include pertinent positives or negatives to support the correct answer in addition to two or more of the distractors

Example: He has hypertension, works in a shipyard, works as a sandblaster, sat for a prolonged period (drove out-of-state) and has sick-contact exposure

# Best practices for writing the stem

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3) The next few sentences should provide additional information to further support the correct answer and to rule out the incorrect choices

Example: The physical exam shows diffuse crackles, the chest radiograph shows bilateral infiltrates, and the LV ejection fraction is normal.

4) The stem should contain at least one piece of information that allows for the correct answer to be the most likely correct choice

Example: The symptoms presented acutely which separated silicosis from asbestosis



# Sample template for item writing

## Section 3: Stem

The stem describes a realistic situation, often a patient or research scenario. It starts with the chief concern described in patients' words, and then goes into relevant history, physical exam and, if relevant, labs and management. More specifically, the chief concern should encompass the presentation of the correct answer and distractor choices.

Section	Details
Chief concern (include duration, site of care)	<p><b>WRITE THE STEM IN THIS BOX.</b></p> <p>A 55-year-old man was admitted to the hospital 2 weeks ago for rapid onset of cough, fatigue, and pleuritic chest pain. At that time, he also endorsed shortness of breath on exertion but reported no hemoptysis. The patient's condition deteriorated over the next 2 weeks. Currently, the patient is intubated and on assist-control ventilation. His medical history is significant for hypertension and allergies treated with hydrochlorothiazide and loratadine. He reports a 20-pack-year smoking history and is a current smoker. He worked in a shipyard for 30 years but recently changed jobs about 2 months ago and now works as a sandblaster. His father had a heart attack at age 78, and his mother died of breast cancer at age 68. He drove out-of-state trip to visit family members last month. Several people experienced runny nose, congestion, and coughing during his visit. Temperature is 36.7°C (98°F), pulse is 96/min, respirations are 18/min, and blood pressure is 138/85 mm Hg. A recent arterial blood gas study showed a pH of 7.42, arterial carbon dioxide pressure of 36 mm Hg, and arterial oxygen pressure of 110 mm Hg while on 100% oxygen. Physical examination is significant for diffuse crackles throughout both lung fields, a loud pulmonic component of the second heart sound, and jugular venous distention of 9 cm with a prominent A wave, a left parasternal heave, and symmetric 3+ lower extremity pitting edema. X-ray of the chest (CXR) reveals diffuse infiltrates bilaterally. CXR 1 year ago showed clear lungs. Sputum culture reveals no growth. Echocardiogram reveals left ventricular ejection fraction of 55%, normal left atrial size, and a dilated right ventricle with reduced function. There is no aortic or mitral valve pathology. There is 2+ tricuspid regurgitation.</p>
HPI (include pertinent ROS here)	
PMHx, PSHx	
Social Hx	
Meds	
ROS	
Vital Signs	
Physical Exam	
Labs (optional)	
Imaging (optional)	

# Sample template for item writing

## Section 4: Correct Answer Explanation

Questions should require a multi-step reasoning process, where the learner will have to make an inference (eg, diagnosis or interpret test results) to get to the correct answer.

**Logic step 1:**

**Logic step 2 (optional):**

**Logic step 3 (optional):**

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## Section 5: Distractors and Explanations

All answer choices should be similar length and complexity and parallel in construction (same category, eg, all diagnosis). Most importantly, all distractors should be plausible. Use the information from the distractor table to explain why distractor is plausible, but incorrect. Make sure to highlight specific findings from the stem.

<b>Distractor 1:</b> <i>Insert distractor choices in this column.</i>	<i>Insert distractor explanations in this column.</i>
<b>Distractor 2:</b>	
<b>Distractor 3:</b>	
<b>Distractor 4:</b>	
<b>Distractor 5 (optional):</b>	
<b>Distractor 6 (optional):</b>	



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Thank you for your time !