


STRATEGIES FOR TEST DESIGN & INSTRUCTION

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Improving Objective Test Item Writing


The "Objective" Test

- What does "Objective Test" really mean?
 - Based on written objectives
 - Universal grader!!



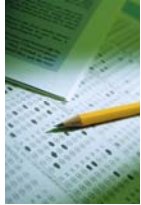
Our Path Today

1. Review guidelines for constructing high quality objective test questions.
2. Improve the quality of objective test items by correcting the flaws.
3. Discuss ways to increase the cognitive level of objective test questions.



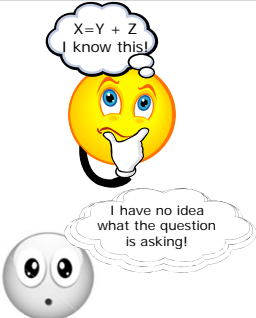
Objective Test Options

- **True and False**
- **Matching**
- **Multiple Choice**
 - One correct answer
- **Multiple Select**
 - Multiple correct answers
- **Context-Dependent Item Sets (Scenario-based)**
 - Can be used for most options



Two Inferences to Write Items By

1. When examinees answer item correctly we need to be able to infer that:
 - They KNOW the answer
2. When examinees answer item incorrectly we need to be able to infer that:
 - They did NOT KNOW the answer




Guidelines for Improving Test Items

Dissecting Objective Test Items


Objective Test Items

- **True and False**
- **Matching**
- **Classic Multiple Choice**
- **Multiple Selection**
- **Context-Dependent Item Sets**
 - Scenario-based items




Anatomy of True/False Statements

- **Examples**
 - "A human arterial blood gas (ABG) pH that is measured as 7.50 is considered acidic." [F]
 - "A speech-language pathologist is a specialist who evaluates and treats communication disorders and swallowing problems." [T]
 - "The rotator cuff muscles arise from the scapula and connect to the head of the humerus." [T]




Anatomy of True/False Statements

- **Anatomy**
 - Single statement – One fact
- **Precisely stated**
 - No ambiguity
- **Universal in application**
 - Does statement stand under all reasonable circumstances?




Objective Test Items

- **True and False**
- **Matching**
- **Classic Multiple Choice**
- **Multiple Selection**
- **Context-Dependent Item Sets**
 - Scenario-based items




Anatomy of True/False Statements

- **Advantages**
- **Disadvantages (Problems)**
 - Dichotomy Issue
 - Qualifying words Issue
 - True statements
 - Usually, sometimes, generally, may
 - False statements
 - Always, never, none, only
 - Low level questions
- **Best use?**




Anatomy of Matching Items

- **Anatomy**
 - **Two columns**
 - Column 1: Names, places, etc.
 - Column 2: Descriptions, facts, associated w/ column 1
- **Best Uses**
 - **Pair up simple facts/concepts**
 - Causes/effects
 - Terms/definitions
 - Drugs/side effects




Anatomy of Matching Items

- Advantages
- Disadvantages
 - Confined to lower levels of testing
 - Potentially confusing
- Suggestions for Improvement
 - Limit size
 - More distractors (column 2) than answers (column 1)
 - Randomize distractors (column 2)
 - Explicit instructions



Objective Test Items

- True and False
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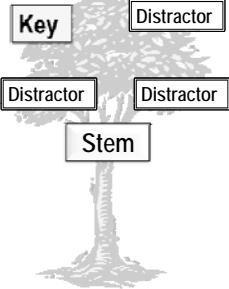
Anatomy of Matching Items: Example (Serum Electrolytes)

If mutually exclusive descriptors --
Instructions: Match the electrolyte description in column 2 with the corresponding electrolyte in column 1. There is only one correct answer for each test.

Electrolyte	Descriptors
___ Sodium	A. Major intracellular cation; abnormally low serum levels can cause cardiac arrest
___ Potassium	B. Protein and albumin bind with this electrolyte; abundant in bones and teeth
___ Chloride	C. Major extracellular anion; important role in maintaining water and osmolality balance
___ Calcium	D. Major cation in extracellular fluid; has a water-retaining effect
	E. Most plentiful intracellularly; important in transporting electrolytes across cell membrane

Multiple Choice: Quick Review of Anatomy

- Anatomy
 - Stem
 - Trigger/stimulus that requires single response
 - Key
 - Clearly correct answer
 - Distractors
 - Plausible incorrect answer choices



Anatomy of Matching Items: Example (Serum Electrolytes)

If more than one possible answers
Instructions: Match the electrolyte descriptions in column 2 with the corresponding electrolyte in column 1. (There may be more than one correct answer for each electrolyte.)

Electrolyte	Descriptors
___ Sodium	A. Abnormally low serum levels can cause cardiac arrest
___ Potassium	B. Protein and albumin bind with this electrolyte; abundant in bones and teeth
___ Chloride	C. Important role in maintaining water and osmolality balance
___ Calcium	D. Primarily located in extracellular fluid; has a water-retaining effect
	E. Most plentiful intracellularly; important in transporting electrolytes across cell membrane
	F. Cation
	G. Anion


Anatomy of a Multiple Choice Item

- The Stem
 - A direct question
 - "The clinician initiates measures to reduce afterload in the client with heart disease. Which finding indicates a need for further afterload reduction?"
 -
 -
 -
 -
 - An incomplete statement
 - A patient has used crutches with a partial weight-bearing toe touch gait for 3 months. When progressed to full weight bearing, the patient is unable to demonstrate a heel-toe gait sequence with the involved extremity. The MOST likely origin of the gait abnormality is:
 - Plantar fasciitis
 - Fibular (peroneal) nerve palsy
 - Heel cord tightness
 - Hammer toe

Multiple Choice: The Stem

Important Principles for Improved Writing

- Poses **ONLY ONE** problem or question
- Examinee should know what is expected without looking at answer choices
- **Include**
 - only relevant information
 - sufficient information to make only one option correct




The stem should not bite!

Multiple Choice: The Stem

Things to avoid!

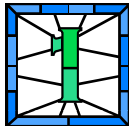
- **Incorrect information**
 - Inappropriate blood levels or dosages, etc.
- **Negatively stated stems**
 - Examples
 - "All of the following are correct **EXCEPT**"
 - "Which is **NOT** a normal value?"
 - **Why do we write them?**
 - **What is wrong with writing them?**
- **Overuse of abbreviations!**



Multiple Choice: The Stem


Important Principles for Improved Writing

- **Stem clearly points to**
 - One correct answer
 - Want more than one correct answer in distractors?
 - Use Qualifiers!
 - Best
 - Most likely
 - What is the **FIRST**...



Multiple Choice: The Key

- **Assure that Key is:**
 - only correct answer, or
 - most appropriate answer (if qualifiers used)
 - clearly the best answer



Example of qualifying word in stem.

- **A family is planning a vacation to Alaska but intensely dislike cold weather. For this reason, the **BEST** season for them to travel to Alaska would be which season?**
 1. Spring
 2. Summer
 3. Fall
 4. Winter

The Key: Problems

- **Should not be the only response to contain a "key word" from the stem.**
 - Example:
 - A patient who is receiving a bronchodilator is experiencing irritability, **tachycardia** and GI upset. Which manifestation is a common side effect of Aminophyllin?
 1. **Tachycardia**
 2. **Dry mouth**
 3. **Fatigue**
 4. **Headache**

The Key: Problems


- **How to quick fix the key word in the stem issue?**
 - Mask it!
 - Similar Example:
 - A patient who is receiving Aminophyllin complains of dry mouth, tachycardia, headache, and fatigue. Which of these manifestations is most likely attributable to his Aminophyllin?
 1. Tachycardia
 2. Dry mouth
 3. Fatigue
 4. Headache

Key Problem: Standing Out

- **How to mask the longest answer/correct answer?**
 - The nurse administers IV tissue plasminogen activator (t-PA). In light of this therapy, which of the following actions would the nurse take?
 - A. Monitor I & O
 - B. Elevate HOB \geq 30 degrees
 - C. Maintain straight lower extremities x 6 hours
 - D. Check neurological signs at least every hour for first 24 hours

The Key: Problems


- **Should not stand out in any manner**
 - length
 - syntax
 - style
 - complexity



Keep the KEY invisible.

Distractors - General Rules for Improving Quality

- **Distractors**
 - Should look attractive
 - Should not be correct under any plausible circumstances
 - Exceptions:
 - "best", "most likely", "highest priority" stem qualifiers




Key Problem: Standing Out

- **The nurse administers IV tissue plasminogen activator (t-PA). In light of this therapy, which of the following actions would the nurse take?**
 - A. Check neurological signs at least every hour for first 24 hours
 - B. Monitor I & O
 - C. Elevate HOB \geq 30 degrees
 - D. Straight lower extremities x 6 hours

Distractors - General Rules for Improving Quality

- **Distractors should be**
 - Closely associated with stem content and "Key"
 - Correct for a related problem
- **Question the distractors**
 - Can you clearly articulate why each distractor is incorrect or not best choice?



Distractor Flaw: Unrelated Problem

■ The clinician is performing a bedside diagnostic test to evaluate the risk for aspiration on an acute stroke patient with swallowing problems. Which test

- A. Fiberoptic endoscopy*
- B. Abnormal voluntary cough
- C. Dysphonia
- D. Absent gag

Distractors: Mutually Exclusive Flaw

■ Key Should Be Mutually Exclusive

- Want no plausible distractors

■ Example 1 – Plausible Distractors

- A staff development instructor is preparing to teach the staff about a new client management system. The instructor should plan to teach
 - A. in small groups.
 - B. directly at the end of the shift.
 - C. in the evening.
 - D. using demonstration/return demonstration.

Distractors - General Rules for Improving Quality

■ Exaggeration

- Correct action
- Finding
- Measurements
 - Volumes
 - Quantities
 - Time



Distractors: Overlapping Flaw

■ Key should not contain overlapping distractors terms

■ Example 2 - Overlapping

- The clinician is assessing a client for development of right heart failure. The clinician would suspect this problem if the client developed which set of symptoms?
 - A. Jugular vein distention, dependent edema, productive cough
 - B. Dependent edema, cyanosis, dyspnea
 - C. Productive cough, jugular vein distention, etc.
 - D. XXX

Example: Exaggeration

■ A patient with a history of asthma has a routine arterial blood gas (ABG) drawn. The patient is not experiencing acute pulmonary or metabolic problems at this time. The nurse would expect to see which ABG value?

- A. pH = 7.32
- B. PO₂ = 92*
- C. PCO₂ = 55
- D. HCO₃ = 18

Reference values:
 pH: 7.35-7.45
 PO₂: 80-100
 PCO₂: 35-45
 HCO₃: 22-26

Distractors: Plausibility Flaw

■ Each Distractor Should Be Plausible

■ Example

A patient who had major abdominal surgery 24 hours ago has been receiving Demerol 50 mg every 3-4 hours since surgery. Relaxation techniques are not adequately relieving his pain. The clinician should

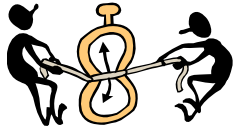
- A. Tell the other staff to ignore him since he *chronically complains*
- B. *Disregard* his complaints since he is already receiving the maximum ordered dose
- C. Report the client's lack of pain relief to the prescribing physician
- D. Administer morphine every 2 hours until relief is achieved

Distractors: Opposites/Almost Identical Flaws

- **Avoid Opposites or Almost Identicals**
- **The Problem?**
- **Examples**
 - Opposites example:
 - place the client on the unaffected side
 - place the client on the affected side
 - raise the head of bed to 45 degrees
 - encourage ambulation
 - Almost identical example:
 - pH = 7.30
 - pH = 7.35
 - PCO₂ = 35
 - PO₂ = 90

Distractors: Can't Find Enough??

- **Problems developing sufficient plausible distractors?**
 - Rewrite stem
 - Include more information

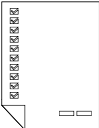


Distractors: Opposites/Almost Identical Flow

- **How to avoid:**
 - Do in pairs in four option items
 - Example
 - A. pH = 7.30
 - B. pH = 7.35
 - C. PCO₂ = 35
 - D. PCO₂ = 55

Answer Options: General Rules

- **Place in logical order**
 - Ascending or descending
- **Similar length for all options**
- **Avoid "All of the above", "None of the above"**
 - It's True!
- **Avoid "never" and "always"**
 - It's False!




Distractors: Discontinuous Flow Flow

- **Statement flow from stem**
 - logical
 - grammatically correct
- **Example**

The clinician is caring for a client.... Based on these assessments, the priority intervention is to

 1. call the physician.
 2. encourage ambulation.
 3. deep breathing exercises are initiated.
 4. nasotracheal suctioning.




Example: Logical Order

- **Ascending (length)**
 - A. encourage fluid intake
 - C. increase oxygen concentration
 - B. initiate deep breathing exercises
 - D. administer Theophylline, as ordered
- **Ascending (values)**
 - A. pH = < 7.30
 - B. pH = 7.31-7.35
 - C. pH = 7.36-7.40
 - D. pH = 7.41-7.45

Objective Test Items

- True and False
- Matching
- Classic Multiple Choice
- Multiple Selection
- Context-Dependent Item Sets
 - Scenario-based items



Multiple Select Examples

- **Classic Design**


Diseases that are known to be associated with autoimmune HLA problems include which of the following? (Choose correct combination)

 1. Rheumatoid arthritis
 2. Hodgkin's disease
 3. Diabetes mellitus
 4. Primary lung cancer
 5. Thyroid disease

A. 1, 2, and 3
B. 2 and 4
C. 3, 4, and 5
D. 1, 3, and 5*

Multiple Select Items

- What are they?
- Advantages
 - Replace exception questions
 - Easy to write
 - Great if insufficient distractors!
- Disadvantages
 - Potentially confusing
 - Increased answering time
 - Classic multiple select method
 - Savvy students win!



Multiple Select Examples

- **Modern Design**
 - Diseases that are known to be associated with autoimmune HLA problems include: (choose all that apply)
 - A. Rheumatoid arthritis
 - B. Hodgkin's disease
 - C. Diabetes mellitus
 - D. Thyroid disease

Multiple Select Examples

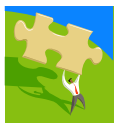
- **First, an exception question**

Diseases that are known to be associated with autoimmune HLA problems include all of the following EXCEPT:

 - A. Rheumatoid arthritis
 - B. Hodgkin's disease*
 - C. Diabetes mellitus
 - D. Thyroid disease


Multiple Select

- **Suggestions for use**
 - Avoid classic design or provide instructions
 - Limit number included on exam
 - If exam uses bubble sheets that require computer analysis
 - Place all multiple select items at end
 - Hand grade
 - Hand enter 1 for "correct" vs 2 for "incorrect" on bubble sheet before send out for computer analysis



Objective Test Items

- True and False
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Guidelines: Context-Dependent

- In Part I - Data/Introduction (Establishing context)
 - Realistic and appropriate
 - Include only relevant data
 - Consistent with what examinee has supposedly learned
 - Novel experience
 - At learner's reading level
 - Minimize reading demands as much as possible

Context Dependent Item Sets

- What are these?
- Anatomy of an Context Dependent Item Set
 1. Data/Introduction
 - Sets up a clinical situation (data, etc.), or
 - Composed of:
 - Graph, photo of a piece of equipment
 - Actual piece of equipment
 - Paragraph from textbook
 - ECG tracing
 2. Item Cluster
 - Series of questions based on the data/introduction

Guidelines: Context-Dependent

- Part II – Item Cluster (Setting up items)
 - Can apply to:
 - all testing formats
 - Most cognitive levels of learning (apply, analyze, interpret, etc.)
 - Comply with usual item writing rules
 - Each item must be independent of other items in the set!
 - Exception – when testing a multiple step process
 - Page layout:
 - Relationship between Context (Part I) and its dependent items (Part II) should be obvious to the examinee
 - Provide adequate directions.
 - Practice helps!

Context-Dependent Items


- Major Advantages
 - Can assess higher levels of learning
 - Practice professions are context specific
 - Can test more reality based situations
- Major Disadvantages
 - Difficult development
 - Increased student response time

Example: Basic Case Scenario

■ Scenario: James S. is a 55-year-old construction worker. He is active and considers himself fairly healthy. He has a history of smoking one pack of cigarettes per day for 35 years. Mr Smith becomes ill. He develops a cough and fever and is producing greenish sputum. He is diagnosed with a right middle lobe pneumonia. He also has an underlying chronic obstructive pulmonary disorder.

[Questions 1-5 pertain to this scenario]

1. His pneumonia can affect pulmonary diffusion by increasing membrane thickness due to
 - A. inflammation
 - B. atelectasis
 - C. bronchial secretions
 - D. surfactant deficiency
2. James' underlying emphysema can complicate his



The nurse is about to turn Mr. S. Look at diagram A.

When turning him to the side with the consolidated lung in the dependent position, it would affect his V/Q ratio in which way?

1. Low V/Q
2. Normal V/Q
3. High V/Q
4. Both V & Q become equally impaired

In Summary

- **Review exams for**
 - Accuracy
 - Items completely correct? No misspellings? No grammatical errors?
 - Answer choices
 - Are flaws resolved for Key and Distractors?
 - Congruence with objectives
 - Do objective verbs match with level of test item?
 - Relevance
 - Essential information?
 - Item difficulty
 - Consider level of test items, number of items, and allotted time!

Data Rich Scenario Example

Scenario: A patient presents with the following: ABG: pH, 7.30; PCO₂, 60; PO₂, 80; HCO₃, 33; SaO₂, 93%. His latest vital signs are: BP, 164/98; HR, 102; RR, 26/min, which are elevated from previous ones. A strong productive cough is noted. He is drowsy but arouses with light shaking at this time. [Items 1-XX pertain to this scenario]

1. The highest priority nursing management goal at this time will be to
 - improve his V/Q ratio.
 - improve his ventilatory status.
 - improve his oxygenation status.
 - promote better airway clearance
2. Which data most likely explains the cause of the patient's drowsiness?
 - pH: 7.30
 - PCO₂: 60
 - PO₂: 80
 - HCO₃: 33

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MEASURING MORE THAN RECALL

Adapted from
SAMPLE QUESTIONS
National Council of State Boards of Nursing

Context-Dependent Item Sets Flaw

- **Scenario:** James S. is a 55-year-old construction worker. He is active and considers himself fairly healthy. He has a history of smoking one pack of cigarettes per day for 35 years. Mr Smith becomes ill. He develops a cough and fever and is producing greenish sputum. He is diagnosed with a right middle lobe pneumonia. He also has an underlying chronic obstructive pulmonary disorder.


[Questions 1-5 pertain to this scenario]

1. His pneumonia can affect pulmonary diffusion by increasing alveolar-capillary membrane thickness due to
 - A. inflammation
 - B. atelectasis
 - C. bronchial secretions*
 - D. surfactant deficiency
2. The nurse can reduce James' alveolar-capillary membrane thickness by initiating:
 - A. Hydrate and deep breathe every 1-2 hours while awake
 - B. Administer anti-inflammatory agents, as prescribed
 - C. XXX

Leveling the Test: Hints for Success

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- **Going back to Bloom's Taxonomy!**
 - Include some but not too many knowledge level questions
 - Include a moderate amount of comprehension level items
 - Include many application items
 - Include a few-to-moderate number of analysis items



Ways to “Up the Ante”
(Measure More Than Recall)

61

- **In place of asking for:**
 - the action of a medication
 - Recognition of a particular laboratory value
 - Purpose of some therapy
- **Ask:**
 - how the medication affects a particular patient (age, pre-existing health condition, etc.)
 - Which associated manifestations a particular abnormal value can cause in the client
 - How, based on certain client factors, the therapy may require some adjustments
- **Requires extra steps in reasoning**

Remembering (Knowledge) Level Questions

64

- **Choose**
 - True and False (if used at all)
 - Multiple Choice
 - particularly one best answer
 - matching
 - Short Answer
- **Involves memorization and simple recognition among answer choices**

Ways to “Up the Ante”
(Measure More Than Recall)

62

- **Pose problems in which the learner must prioritize among goals, diagnoses, or interventions in order to answer the item**
 - Requires analysis of client situation to determine the priority
 - A priority involves other factors that come into play

Leveling an Item: Aspirin

65

- **Knowledge Level**
 - Acetylsalicylic acid (aspirin) is classified as which type of drug?
 - A. diuretic
 - B. anti-inflammatory*
 - C. Bronchodilator
 - D. Antiarrhythmic

Ways to “Up the Ante”
(Measure More Than Recall)

63

- **Rather than asking for a particular intervention when a client experiences a particular health problem ...**
 - describe a client who is having the health problem and ask learner for appropriate actions to take, given the clinical description.

Understanding (Comprehension) Level Questions

66

- **Choose**
 - Multiple Choice
 - particularly one best answer
 - matching
 - Short Answer
- **Choose when you want**
 - Simple interpretation of data (e.g., lab values, vital signs, symptoms) to answer the item
- **Does not require relating concepts to other data**


Leveling an Item: Aspirin

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- **Comprehension Level**
 - The clinician is evaluating a client who is taking acetylsalicylic acid (aspirin). Which statement by the client would suggest that the client may be experiencing toxicity?
 - A. "I hear a ringing in my ears." *
 - B. "Everything that I look at looks double."
 - C. "I have not had a bowel movement in three days."
 - D. "I have had a moderate headache for several days."

Analysis Level Test Questions

70



- Choose**
 - Context-Dependent Items
 - Multiple Choice or Select Items
 - Essay
 - Case Analysis
 - Simulation
- Choose when you want student to**
 - Distinguish between critical and non-critical information
 - Breakdown behaviors or communication
 - Interpret relationships between things
 - Examine information components to answer the question

Application Level Test Questions

68

- Choose**
 - Multiple Choice Items
 - One Best Answer
 - Context-Dependent Items
- Choose when you want student to use knowledge of**
 - procedures, rules
 - principles or theories
- to apply to novel reality based situation**

Applying to Test Item: Analysis

1. A high acuity patient has the following trends available:

Time	VS	O2	ABG
0900	BP, 120/82; HR, 92/min; RR, 20/min	28%	pH 7.38, PaCO ₂ 43, HCO ₃ 24, PaO ₂ 92, SaO ₂ 98%
1100	BP, 142/88; HR, 102/min; RR, 26/min	40%	pH 7.44, PaCO ₂ 37, HCO ₃ 24, PaO ₂ 86, SaO ₂ 92%
1200	BP, 156/90; HR, 112/min; RR, 30/min	50%	pH 7.47, PaCO ₂ 33, HCO ₃ 24, PaO ₂ 76, SaO ₂ 86%

Based only on the above trends, which statement can be made?

- A. The patient's compensatory mechanisms are maintaining a steady state of respiratory insufficiency
- B. The patient's compensatory mechanisms are not adequately maintaining his oxygenation status
- C. The trends are consistent with acute ventilatory failure
- D. The trends are consistent with improving right-to-left pulmonary shunt

Leveling an Item: Aspirin

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- **Application Level**


A 60-year-old client is admitted to the medical unit with acute onset chest pain and a history of longstanding atrial fibrillation. When preparing to administer prescribed acetylsalicylic acid (aspirin) orally, the clinician auscultates an irregular heart rhythm with a rate of 92. Which action would be most appropriate for the nurse to take?

 - A. Withhold the aspirin and notify the prescribing physician that the client has an irregular heart rhythm
 - B. Withhold the aspirin and recheck the heart rate and rhythm in one hour
 - C. Administer the aspirin and notify the prescribing physician that the client has an irregular heart rhythm
 - D. Administer the aspirin and document the heart rate and rhythm. *

Evaluation & Creativity (Synthesis)

72

- Not commonly tested on**
 - Essay type test questions are best
- Learner is "asked to make judgments about the value of material and methods for given purposes,**
- or the extent to which materials and methods satisfy criteria."** NCSBN, 1995, p. 19



EXCELLENCE BEGINS WITH THE
PROPER STATE OF MIND.

EXCELLENT EXAMS BEGINS WITH A
COMMITMENT TO IMPROVE THEM!

Contact me for any additional information:
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