

FOREWORD

Purpose

The purpose of this publication is to present examples of test items/questions at the different cognitive levels in various subject areas which are taught in the secondary schools. These examples are designed for individual teacher use and for workshop sessions designed to assist teachers with classifying and developing similar questions in their own subject field.

With the emphasis on basic skills, our students are becoming proficient in the minimum skills in reading, English, and mathematics; however, students need exposure to and practice at higher levels of questioning, reasoning, and problem solving. Such exposure should provide them with a variety of intellectual experiences which go beyond recalling simple facts, soon forgotten, to gaining an ability to formulate generalizations and principles. Such a program of instruction forces the students into active participation in the learning process.

One of our instructional goals includes the development of abilities to use the higher levels of thinking. This goal is best summarized in the following statement from the criteria for the State of California textbook adoptions in English for students achieving above grade level: "Provide instructional strategies that would elicit from students discussion, answers, and written material that use the analysis, synthesis, and evaluation levels of thinking."

For generations, teachers have used the art of questioning as a major component of the instructional process. Norris M. Sanders (1966) presented some practical illustrations for classifying and designing questions in Classroom Questions: What Kinds? An excerpt from this reference appears in Appendix F.

Organization of Content

The contents of this publication are sequentially organized by the six major classes of objectives in the Cognitive Domain Taxonomy as listed in the Table of Contents Matrix. The following information is included for each of the six classes: (1) name and definition of the class, (2) name and definition of the subclass, and (3) at least three examples of questions for each class or each subclass. The first example is in English; the second is in mathematics, and the third is in one of the following: art, foreign language, health, music, physical education, science, or social studies. The correct response is indicated by an asterisk. Appendix A lists the major categories and some possible verbs for use in stating cognitive outcomes. Appendices B through E contain brief descriptions of the affective domain and the psychomotor domain. The latter appendices give some additional information that will assist teachers with balancing the variety of learning opportunities presented to their students.

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REACHING HIGHER LEVELS OF THOUGHT: EXAMPLES OF TEST ITEMS/QUESTIONS BASED ON THE TAXONOMY OF EDUCATIONAL OBJECTIVES IN THE COGNITIVE DOMAIN,¹ GRADES 7-12

Cognitive Levels

Subject Category

English Math. Other

Page Page Page

KNOWLEDGE

Terminology - - - - -	1 - - -	1 - -	Art - - - -	1
Specific Facts- - - - -	2 - - -	2 - -	For. Lang.-	2
Conventions - - - - -	2 - - -	3 - -	Health- - -	3
Trends and Sequences - - - - -	3 - - -	3 - -	Soc. Stud.-	3
Classification and Categories- - - - -	4 - - -	4 - -	Music - - -	4
Criteria - - - - -	4 - - -	5 - -	Phys. Ed. -	5
Methodology - - - - -	5 - - -	5 - -	Music - - -	5
Principles and Generalizations - - - - -	6 - - -	6 - -	Soc. Stud.-	6
Theories and Structures- - - - -	6 - - -	7 - -	Art - - - -	7

COMPREHENSION

Translation - - - - -	8 - - -	8 - -	For. Lang.-	8
Interpretation - - - - -	9 - - -	9 - -	Phys. Ed. -	10
Extrapolation - - - - -	10 - -	11 - -	Health- - -	11

APPLICATION - - - - -	11 - -	-12 - -	Health - -	12
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ANALYSIS

Analysis of Elements - - - - -	13 - -	-13 - -	Music - - -	13
Analysis of Relationships - - - - -	14 - -	-14 - -	Soc. Stud.-	14
Analysis of Organizational Principles - - - - -	15 - -	-15 - -	Science - -	15

SYNTHESIS

Unique Communication - - - - -	16 - -	-16 - -	For. Lang.-	16
Plan or Proposed Set of Operations - - - - -	17 - -	-17 - -	Science - -	17
Set of Abstract Principles - - - - -	18 - -	-18 - -	Art - - - -	18

EVALUATION

Judgments in Terms of Internal Evidence - - - - -	19 - -	-20 - -	Phys. Ed. -	20
Judgments in Terms of External Evidence - - - - -	21 - -	22 - -	Science - -	22

¹Benjamin S. Bloom, Editor, Taxonomy of Educational Objectives, Handbook I: Cognitive Domain (New York: (New York: Longman Inc., 1956), pp. 201-207.

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Cognitive Levels and Examples of Test Items

Cognitive Level and Description

1.00 KNOWLEDGE

Knowledge involves the recalling of previously learned specific items of information which may be in the form of universals, methods and processes, patterns, structures, or settings. Knowledge represents the lowest level of learning outcomes in the cognitive domain.

1.10 Knowledge of Specifics (KNOWLEDGE)

The recall of specifics becomes one of the basic elements the learner must know about the subject. There are many specifics, and a selection must be made for educational purposes. A student is not expected to learn all of the specifics relevant to a particular field.

1.11 Knowledge of Terminology (KNOWLEDGE)

Define technical terms by giving their attributes, properties, or relations.

Use a large number of words in their common range of meaning.

English, Grade 7, Short Story

1. Identify the meaning of the word setting in a short story.

- a. the subject and theme
- b. the cause and effect
- *c. the location and time
- d. the sequence and characters

Mathematics, Grade 7, Properties

2. 0 is the _____ element in addition.

- a. associative
- *b. identity
- c. commutative
- d. distributive

Art, Grade 7, Color

3. Identify monochromatic, analogous, and complementary color harmony in a visual work which contains all three.

1.12 Knowledge of Specific Facts (KNOWLEDGE)

Recall specific bits of information.
Know persons, places, events, and dates.

English, Grade 10, Poetry

1. "The Road Not Taken" was written by _____.
 - a. Edwin Arlington Robinson
 - *b. Robert Frost
 - c. Emily Dickinson
 - d. Margaret Walker

Mathematics, Grade 7, Measurement

2. 1 kg = _____ g.
 - a. 10
 - b. 100
 - *c. 1000
 - d. 1/100

Foreign Language, Grade 9, Sound/Symbol Correspondences

3. The sound/symbol correspondence in Spanish is more _____ than in English.
 - *a. regular
 - b. irregular

1.20 Knowledge of Ways and Means of Dealing with Specifics (KNOWLEDGE)

Knowledge of ways and means of dealing with specifics includes the processes involved in making connecting links between specifics, the operations for dealing with specifics, and the criteria by which specifics are judged and evaluated. Ways and means refer to processes rather than products.

1.21 Knowledge of Conventions (KNOWLEDGE)

Know characteristic ways of treating and presenting data and phenomena.
Know usages, styles, practices, and forms which best suit the purpose.

English, Grade 7, Spelling

1. Identify the correct spelling.
 - a. misspel
 - b. misspell
 - c. misspel
 - *d. misspell

Mathematics, Grade 7, Rounding

2. Round off to the nearest thousandth.

0.38246 =

- a. 0.328
- b. 0.383
- c. 0.3824
- *d. 0.382

Health, Grade 7, First Aid

3. The quickest way to stop nosebleed is to _____.
- a. Tilt the victim's head back.
 - b. Apply a cold compress to the victim's nose.
 - *c. Press bleeding nostril toward the midline.

1.22 Knowledge of Trends and Sequences (KNOWLEDGE)

Know processes, directions, and movements of phenomena with respect to time.

Know basic trends underlying the development of programs.

English, Grade 11, Literary Movements

1. Select the answer that places the literary movements in correct chronological order.
- a. romanticism, realism, Puritanism, existentialism
 - b. romanticism, Puritanism, existentialism, realism
 - *c. Puritanism, romanticism, realism, existentialism
 - d. Puritanism, existentialism, romanticism, realism

Mathematics, Grade 7, Permutations

2. Sandra, Terry, Lucy, and Alice are going to have a race. In how many possible orders can they finish the race?
- *a. 24
 - b. 36
 - c. 16
 - d. 32

Social Studies, Grade 8, History

3. Identify the chronological sequence of the historical documents.
- w. Magna Charta
 - x. United States Constitution
 - y. Mayflower Compact
 - z. Declaration of Independence

- *a. w, y, z, x
- b. z, w, x, y
- c. x, y, z, w
- d. w, x, y, z

1.23 Knowledge of Classifications and Categories (KNOWLEDGE)

Know group classes, sets, divisions, and arrangements which are regarded as fundamental for a given subject field, purpose, argument, or problem. Recognize the area encompassed by various kinds of problems or materials.

English, Grade 7, Grammar


1. Which of the following is not useful in determining whether a word is a noun?
 - a. whether it has a plural form
 - *b. whether it has a past tense
 - c. whether it has possessive forms
 - d. whether it functions as a subject or object
 - e. whether a determiner (article) can precede it

Mathematics, Grade 7, Numbers

2. 11, 13, 15, 17, and 19 are all _____.
 - *a. odd numbers
 - b. even numbers
 - c. prime numbers
 - d. composite numbers

Music, Grade 7, Rhythm

3. Listen to the following patterns of rhythm (teacher plays patterns on a percussion instrument). Which pattern looks and sounds like the pulse or beat?

- a. 
- b. 
- c. 
- *d. 

1.24 Knowledge of Criteria (KNOWLEDGE)

Know the criteria by which facts, principles, opinions, and conduct are tested or judged.

English, Grade 10, Informal Essay

1. Which of the following is the least characteristic of an informal essay?
 - *a. objectivity
 - b. brevity
 - c. style
 - d. personal point of view

Mathematics, Grade 8, Multiples

2. A number that is a multiple of 6 must be a multiple of both _____.
- (Answer: 2 and 3)

Physical Education, Grade 10, Physical Fitness

3. The best test for arm and shoulder strength is _____.
- a. the barbell curl
 - *b. pull-ups
 - c. the softball throw for accuracy
 - d. sit-ups

1.25 Knowledge of Methodology (KNOWLEDGE)

Recall the methods (rather than the ability to use) of inquiry techniques and procedures employed in a particular subject field as well as those employed in investigating particular problems and phenomena.

English, Grade 10, Propaganda Techniques

1. One major use of propaganda techniques has been to _____.
- a. decrease the importance of the buyer
 - *b. advertise products for sale
 - c. confront people with problems
 - d. provide scientific solutions

Mathematics, Grade 7, Mean

2. To find the mean of 11 scores, one must first _____ and then _____.
- (Answer: add the scores and divide by 11)

Music, Grades 7-9, Beginning Strings

3. Which of the following procedures can be used to check and improve the intonation when playing E first finger on the D string?
- *a. Compare with open E string.
 - b. compare with first finger on the A string.
 - c. Put the first finger down firmly.
 - d. Draw the bow slowly.

1.30 Knowledge of the Universals and Abstractions in a Field (KNOWLEDGE)

Knowledge of the universals and abstractions in a field covers the major concepts, ideas, schemes, and patterns by which phenomena are organized. These are at the highest levels of abstraction and complexity. Many students have difficulty with these levels of knowledge; however, if students learn them, they have a means of relating and organizing subject matter and as a result can retain more information.

1.31 Knowledge of Principles and Generalizations (KNOWLEDGE)

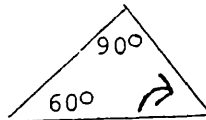
Recall important principles and generalizations which summarize observations, experiments, or relationships.

English, Grade 7, Punctuation (Apostrophe)

1. Which of the following indicates that the shirts belong to more than one boy?
 - a. boys shirt's
 - b. boy's shirts
 - c. boys shirts'
 - *d. boys' shirts

Mathematics, Grade 7, Triangles

2. Without measuring, find the measure of the indicated (\curvearrowright) angle in the figure.



- a. 20°
- b. 45°
- *c. 30°
- d. 40°

Social Studies, Grades 8-11, Coriolis Effect

3. The Coriolis effect deals with the effect of the earth's rotation on moving objects, ocean currents, and air masses. The Coriolis effect makes ocean and air currents move in a _____.
 - *a. clockwise direction in the Northern Hemisphere
 - b. counter-clockwise direction in the Northern Hemisphere
 - c. clockwise direction in the Southern Hemisphere
 - d. to the right in the Southern Hemisphere

1.32 Knowledge of Theories and Structures (KNOWLEDGE)

Recall the body of principles and generalizations together with their interrelations which present a clear, rounded, and systematic view of complex phenomenon, problem, and field.

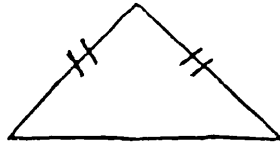
English, Grades 11-12, Literary Movement

1. Which of the following is not a characteristic element of romantic literature?
 - a. an interest in wild nature
 - b. an emphasis on deep emotions
 - c. an interest in the picturesque past
 - *d. an emphasis on satiric plots

Mathematics, Grade 7, Perimeters

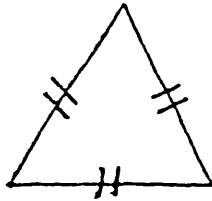
2. Match the formulas for the perimeters with the correct figure.

_____ 1.



a. $p = 3a$

_____ 2.



b. $p = a + b + c$

_____ 3.



c. $p = 2a + b$

Answers: 1. c 2. a 3. b

Art, Grade 7, Color (Theory of Mixing)

3. Explain the theory of color mixing.

(Answer: Complementary colors are mixed to produce grayed colors; white is mixed with complementary colors to change the value--tints; and black is mixed with complementary colors to change the value--shades.)

2.00 COMPREHENSION

Comprehension means understanding at the most basic level, that is, understanding something said or read without necessarily understanding its relationship in or to a larger scheme.

2.10 Translation (COMPREHENSION)

Put a communication into another language.

Paraphrase a communication.

Supply the denoted or literal meaning.

Demonstrate that information can be transformed from one communication to another.

English, Grade 7, Spelling

1. Match the regular spelling in Column II with the phonic spelling in Column I. Write the letter of the correct answer in the appropriate blank space.

Column I. Phonic Spelling Column II. Regular Spelling

_____ 1.	/grāt/	A.	greet
_____ 2.	/āt/	B.	might
_____ 3.	/wun/	C.	mitt
_____ 4.	/hāt/	D.	eight
_____ 5.	/mit/	E.	at
		F.	hate
		G.	one
		H.	great
		I.	hat
		J.	once

Answers: 1. H 2. D 3. G 4. F 5. B

Mathematics, Grade 8, Angles

2. Complete the statements.
- The complement of an angle of 25 degrees is _____ degrees.
 - The supplement of an angle of 25 degrees is _____ degrees.
 - The angle supplement in b is _____ degrees larger than the angle complement.
 - Is the answer to c true or false for all angles?

Answers: a. 65 b. 155 c. 90 d. true

Foreign Language, Grade 7, Translating English into Spanish

3. Select the best Spanish translation of the sentence.

We went to Europe last summer.

- A Europa fuimos el verano pasado.
- *b. Fuimos a Europa el verano pasado.
- c. Fuimos el verano pasado a Europa.
- d. A Europa el verano pasado fuimos.

2.20 Interpretation (COMPREHENSION)

Interpretation involves a reordering, rearrangement, or a new view of the material.

Explain or summarize a communication.

Interpret graphic and symbolic data.

State a rule or make a generalization from a body of data.

English, Grade 9, Metaphor/Simile

1. The garbage cans looked like bums lounging against the brick wall in the alley.

In the sentence above, the garbage cans resemble bums in all but one of the following ways. Select the exception.

- a. condition
- b. location
- c. position
- *d. dimension

Mathematics, Grade 8, Rules

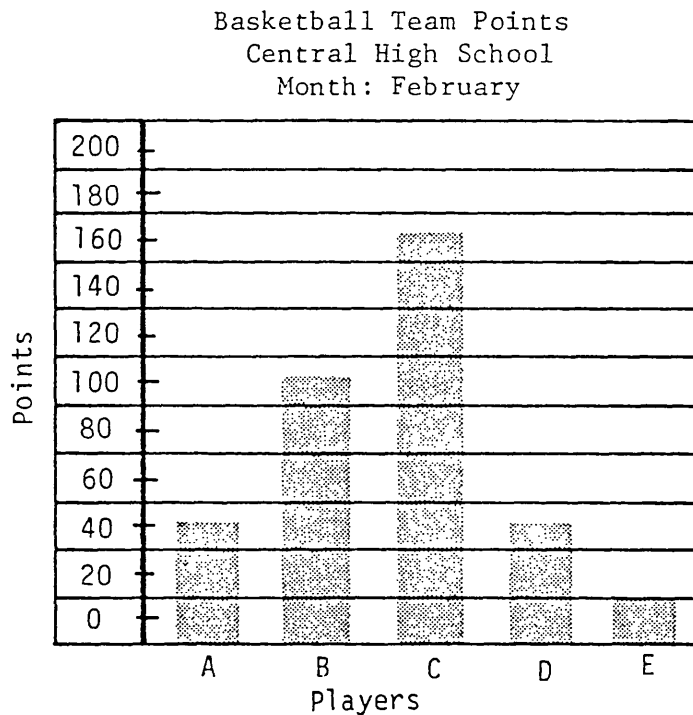
2. Mark the rule for the ordered pair in the chart.

n	??
0	0
1	$\frac{1}{2}$
2	1
3	$1\frac{1}{2}$

- a. $2n$
- b. $n + \frac{1}{2}$
- c. $n + 2$
- *d. $\frac{1}{2}n$

Physical Education, Grade 9, Team Points

3. Read the bar graph. Answer the questions.



Each mark (-) along the vertical axis (bottom to top) represents _____ points.

- *a. 10
- b. 20
- c. 30
- d. 40

The team made a total of _____ points.

- a. 100
- b. 200
- c. 300
- *d. 400

2.30 Extrapolation (COMPREHENSION)

Extend or predict trends or tendencies beyond the given data to determine implications, consequences, corollaries, or effects, which are in accordance with the conditions described in the original communication.

English, Grade 9, Science Fiction Elements

1. A science fiction author who wanted to indicate the dehumanizing influence of technology in our future might employ all but one of the following elements in his or her story:
 - a. a wraparound television room for children
 - *b. a community baseball field
 - c. a city sealed under an antibiotic tent
 - d. a robot serving as nursemaid

2. Folding a sheet of paper in half results in a number of equal parts as shown on the table.

Folding the sheet of paper seven times in half will produce how many equal parts?

	folds	equal parts
a.	0	1
b.	1	2
c.	2	4
d.	3	8
e.	4	—
f.	5	—
g.	6	—
h.	7	—

(Answers: e. 16 f. 32 g. 64 *h. 128)

Health, Grade 10, First Aid

3. Read the incident and describe the first-aid steps to be taken.

A child has been playing in the cupboard near the kitchen sink. You enter the kitchen and find the child lying on the floor. His/her face is flushed. On the floor, you notice a bottle with "aspirin" on the label.

Answer: The objectives in treatment of poisoning by mouth are to dilute or neutralize the poison as quickly as possible, to induce vomiting (except if corrosive poisons are swallowed or if victim is unconscious or having convulsions), to maintain respiration, to preserve vital functions, and to seek medical assistance without delay.

3.00 APPLICATION

Application is the use of abstractions in particular and concrete situations. Abstractions may be technical principles, ideas, or theories which must be remembered and applied and may be in the form of general ideas, rules of procedures, or generalized methods.

Apply a rule to a concrete situation.

Apply learned principles to new situations.

English, Grade 7, Capitalization and Punctuation

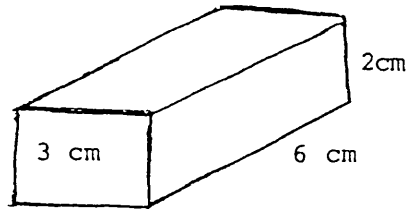
1. Capitalize and punctuate the following paragraph.

"Washington Irving is chiefly remembered for two stories Rip Van Winkle and the legend of Sleepy Hollow. He also wrote the comic Knickerbocker's History of New York and a great many other works during a long career. Irving was the first American author to be widely acclaimed on both sides of the Atlantic."

Answer: "Washington Irving is chiefly remembered for two stories, 'Rip Van Winkle' and 'The Legend of Sleepy Hollow.' He also wrote the comic Knickerbocker's History of New York and a great many other works during a long career. Irving was the first American author to be widely acclaimed on both sides of the Atlantic." (American Literature, Ginn and Company, 1981, page 208)

Mathematics, Grade 8, Area

2. Find the surface area of this figure.



- a. 30 cm^2 c. 96 cm^2
*b. 72 cm^2 d. 108 cm^2

Health, Grade 10, First Aid

3. To stop serious bleeding from a wound just above the knee, the prescribed procedure would be to _____.
- a. Apply direct pressure. If bleeding does not stop, apply pressure to the brachial point.
b. Use femoral pressure.
*c. Apply direct pressure. If bleeding does not stop, apply digital pressure where the leg curves into the groin.
d. Apply a pressure bandage.

4.00 ANALYSIS

Analysis consists of breaking down a problem, a body of facts, a behavior, or a description into component elements.

The purpose of analysis is to find out what these elements are to solve a problem, to achieve a greater understanding, or to accomplish a synthesis of parts or ideas.

In analysis, the student must be conscious of the intellectual processes that he or she is performing and know the rules for reaching a valid and true conclusion. The parts and processes of reasoning are important at the analysis level.

4.10 Analysis of Elements (ANALYSIS)

Break down the material into its constituent parts.
Classify the elements of the communication.

English, Grade 7, Parts of Speech

1. Which sentence has the words labeled with the appropriate part of speech?

*a. Maria and Tony are excellent swimmers.
n conj n v adj n

b. Maria and Tony are excellent swimmers.
n prep n v v n

c. Maria and Tony are excellent swimmers.
n conj n v adv n

d. Maria and Tony are excellent swimmers.
n conj n v adj pron

Mathematics, Grades 4-12, Division

2. List the single computation facts that one must know to perform this computation.

$$\begin{array}{r} 9 \overline{)38} \\ \underline{9 \times 4 = 36} \\ 38 - 36 = 2 \end{array} \quad \text{Answer: } \begin{array}{l} 9 \times 4 = 36 \\ 8 - 6 = 2 \\ 38 - 36 = 2 \end{array}$$

Music, Grades 10-12, Sonata Allegro Form

3. Outline the structure of Sonata-Allegro form
Answer:

Introduction

Exposition

Theme 1 Transition Theme 2 (dominant key)

Bridge

Development

An unfolding of previously stated thematic material through the use of devices such as fragmentation, augmentation, inversion, modulation, etc.

Recapitulation

Theme 1 Transition Theme 2 (tonic key)

Coda

4.20 Analysis of Relationships (ANALYSIS)

Recognize the arrangement and structure which hold together communication.

English, Grade 8, Paragraph Organization

1. Read the following sentences:

A quart of milk costs more money today than five years ago.
A pair of shoes costs much more than even three years ago.
Candy bars are smaller and more expensive than ever before.
Many consumers cannot afford a ticket to the movies.
Some consumers cannot afford a daily newspaper nor pay for the light to read it by.

Which of the following serves best as a topic sentence for the sentences listed above?

- a. Inflation is gradual and insidious.
- b. Inflation affects only a few items.
- *c. Inflation makes all consumers poorer.
- d. Inflation makes prices go up.

Mathematics, Grades 4-12, Problem Solving

2. Identify the information that is unnecessary and the information that is missing.

Frank has three marbles. Mary has red marbles. Frank's marbles are small. Who has more marbles?

Unnecessary: _____
Missing : _____

Answers:

Unnecessary: Mary has red marbles. Frank's marbles are small.
Missing : Need to know how many marbles Mary has.

Social Studies, Grade 11, Propaganda Techniques

3. Analyze the statements and identify the propaganda technique used.

Computers can perform miracles. Everybody is thinking and talking computers. Join the crowd! Attend our school and prepare for the computer career of your choice. Fill out and mail the application today.

- a. transfer
- b. glad names
- *c. band wagon
- d. testimonial

4.30 Analysis of Organizational Principles (ANALYSIS)

Make explicit the relationships among elements to determine their connections and interactions.

English, Grade 9, Short Story Structure

1. Read the following opening paragraph of a well-known short story:

"True--nervous--very, very dreadfully nervous I had been and am! but why will you say that I am mad? The disease had sharpened my senses--not destroyed--not dulled them. Above all was the sense of hearing acute. I heard all things in heaven and in the earth. I heard many things in _____. How, then, am I mad? Hearken! and observe how healthily--how calmly I can tell you the whole story."

The author's purpose in using this paragraph to open his story is likely to be which of the following:

- a. to tell you that the main character is a nervous person
- b. to tell you that the main character has an acute sense of hearing
- c. to tell you that the main character is a reasonable person
- *d. to tell you that the main character may well be mentally ill

Mathematics, Algebra 2AB, Binomial Expansion

2. Combine these two statements into one statement.

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

Answer: $(a \pm b)^2 = a^2 \pm 2ab + b^2$

Science, Grades 8-10, Life Science (General Science)

3. Plan a list of environmental conditions and health habits which should enable an individual to live for one hundred and twenty-five years.

5.00 SYNTHESIS

Synthesis is defined as the putting together of elements and parts so as to form a whole. This combination or whole can be such a pattern or structure that was not there before.

5.10 Production of a Unique Communication (SYNTHESIS)

Communicate ideas, feelings, and experiences to others.

English, Grade 11, Poetic Structure

1. Rearrange the following lines to recreate the setting of an old poem about two young lovers. ("Ballad of the Oysterman" by Oliver Wendell Holmes)
 - a. The daughter of a fisherman, that was so straight and slim,
His shop was just upon the bank, his boat was on the tide;
It was a tall young oysterman lived by the river-side,
Lived over on the other bank, right opposite to him.
(Answer: 3, 2, 1, and 4)
 - b. Write an original second stanza, using the same stanza format and developing the romantic relationship between the two characters.

Mathematics, Grades 3-12, Permutations

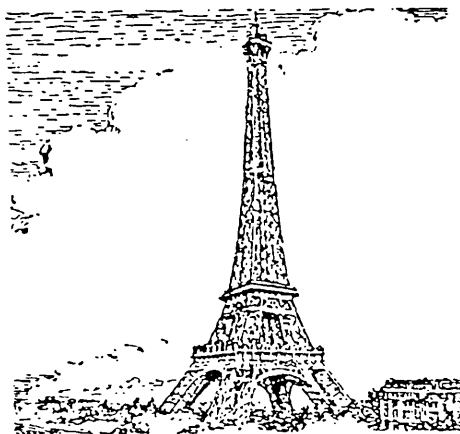
2. Use the digits and letters on the license plate below to make as many different plates as you can. Describe the method that you use to make certain that you have not left any plates out of the group.

643 CYM

Answer: 3 digits taken 3 at a time = $3.2.1 = 6$
3 letters taken 3 at a time = $3.2.1 = 6$
 $6 \times 6 = 36$ permutations

Foreign Language, Grade 10, Description

3. Use French to give an oral description of the Eiffel Tower.



5.20 Production of a Plan or Proposed Set of Operations

Propose ways of testing hypotheses.

Integrate the results of an investigation into an effective plan or solution to solve a problem.

English, Grades 7-12

1. Prepare a five-minute speech on "How Students Can Improve Their Reading."

Mathematics, Grade 8, Factoring

2. Develop a plan for teaching someone to use the Factor Tree Method to find the Greatest Common Factor of two numbers.

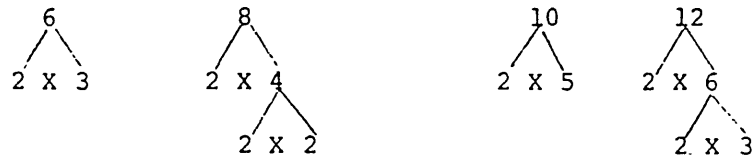
Answer: First, teach factoring.

$$6 = 2 \times 3 \quad 8 = 2 \times 4 \quad 10 = 2 \times 5 \quad 12 = 2 \times 6$$

Second, teach factoring into primes.

$$6 = 2 \times 3 \quad 8 = 2 \times 2 \times 2 \quad 10 = 2 \times 5 \quad 12 = 2 \times 2 \times 3$$

Third, teach the Factor Tree Method.



Fourth, teach writing as powers.

$$6 = 2 \cdot 3 \quad 8 = 2^3 \quad 10 = 2 \cdot 5 \quad 12 = 2^2 \cdot 3$$

Fifth, teach Greatest Common Factor.

$$8 = 2^3 \quad 12 = 2^2 \cdot 3$$

$$\text{GCF}(8, 12) = 2^2 = 4$$

Science, Grades 8-10, Pollution

3. Develop a set of actions that will help reduce the pollution in our environment. Identify the scientific principles upon which the actions are based.

5.30 Derivation of a Set of Abstract Relations (SYNTHESIS)

Produce a set of abstract relations. Tasks include (1) beginning with concrete data or phenomena and classifying or explaining, and (2) beginning with some basic propositions or other symbolic representations and deducing other propositions or relations.

English, Grades 10-11, Short Story Structure

1. Read the two paragraphs.

"As Mr. John Oakhurst, gambler, stepped into the main street of Poker Flat on the morning of the twenty-third of November, 1850, he was conscious of a change in its moral atmosphere since the preceding night. Two or three men, conversing earnestly together, ceased as he approached and exchanged significant glances. There was a Sabbath lull in the air, which, in a settlement unused to Sabbath influences, looked ominous."

"Mr. Oakhurst's calm, handsome face betrayed small concern in these indications. Whether he was conscious of any predisposing cause was another question. 'I reckon they're after somebody,' he reflected; 'likely it's me.' He returned to his pocket the handkerchief with which he had been whipping away the red dust of Poker Flat from his boots, and quietly discharged his mind of any further conjecture."

Based on the reading of the preceding two paragraphs, which of the following is not a reasonable deduction?

- a. John Oakhurst will be the protagonist in the story.
- b. The story will deal with some threat to Oakhurst's pattern of life.
- *c. The handkerchief will play an important part in the story.
- d. Oakhurst's action with the handkerchief illustrates an important character trait.

Mathematics, Grades 10-12, Geometry

2. Using "horse" for point and "race" for line segment, complete the definitions listed below.
 - a. _____ horses determine a race.
 - b. A line segment consists of _____.
 - c. A ray is _____.
 - d. A triangle is _____.
 - e. An opened line segment is _____.
 - f. A half-opened line segment is _____.

- Answers: a. Two
b. One race
c. A race that's non-stop in one direction.
d. Three races with no horse in more than two races.
e. A race with two outside horses missing.
f. A race with one outside horse missing.

Art, Grade 7, Creative Visual Forms

3. Use new visual forms and materials to create an assemblage using only synthetic materials, such as styrofoam, resin, plastics, plexiglass, and synthetic fibers.

6.00 EVALUATION

Evaluation involves judgments about the value of material and methods for given purposes, the quantitative and qualitative extent to which material and methods satisfy criteria, or the use of a standard of appraisal. The criteria may be those determined by the student or those which are given to him or her.

6.10 Judgments in Terms of Internal Evidence (EVALUATION)

Making judgments from internal evidence involves the evaluation of the accuracy of a communication from such evidence as logical accuracy, consistency, and other internal criteria. Judging by internal standards requires the ability to assess general probability of the accuracy in reporting facts from the care given to exactness of statement, documentation, proof, etc.

English, Grade 11, Nonfiction

Read the following account from Walt Whitman's Specimen Days, which is about a Civil War hospital. Then answer the questions below.

"Let me specialize a visit I made to the collection of barrack-like one-story edifices, Campbell Hospital, out on the flats, at the end of the then horse railway route, on Seventh Street. There is a long building appropriated to each ward. Let us go into Ward 6. It contains today, I should judge, eighty or a hundred patients, half sick, half wounded. The edifice is nothing but boards, well white-wash'd inside, and the usual slender-framed iron bedsteads, narrow and plain. You walk down the central passage, with a row on either side, their feet towards you, and their heads to the wall. There are fires in large stoves, and the prevailing white of the walls is relieved by some ornaments, stars, circles, etc., made of evergreens. The view of the whole edifice and occupants can be taken at once, for there is no partition. You may hear groans or other sounds of unendurable suffering from two or three of the cots, but in the main there is quiet--almost a painful absence of demonstration; but the pallid face, the dull'd eye, and the moisture on the lip, are demonstration enough."

1. Select the one technique that the writer does not use to make the description of a Civil War hospital real.
 - a. an exact account of its location
 - b. an account of how the buildings are heated
 - *c. the careful description of one soldier
 - d. an overall impression of the patients' condition

2. Select the one experience that the writer does not use to make his description vivid to his readers.
- *a. the writer's long walk through several corridors
 - b. the open geometric design and plainness of the hospital
 - c. the attempt to relieve the plainness through some ornaments on the walls
 - d. the fires in the large stoves
3. On the basis of the evidence presented in this passage, write a paragraph in which you cite how Whitman documents accurately his visit to a hospital ward.

Mathematics, Grades 8-12, Logical Reasoning

4. For three consecutive Mondays it rained in Chicago. Does this mean that it always rains on Monday in Chicago?
- a. Yes No
 - b. Why not? _____.

- Answers: a. No
- b. Because it rained for three consecutive Mondays will not suffice to reason inductively that it will always rain on Monday. Perhaps it is the rainy season in Chicago.

Physical Education, Grades 8-12, Basketball

The ninth grade Red-Blue all-star basketball game was won by the Red team. The final score was 47 to 45. During the game the Red team took eight free throws and made five of them. The Blue team also took eight free throws and made five of them.

5. Which of the following is the most accurate statement based on the given data?
- a. The Red team was a much better team.
 - b. The Blue team would have won if they had tried harder.
 - *c. The Blue team would have won if they had made all of their free throws.

6.20 Judgments in Terms of External Criteria (EVALUATION)

Evaluate material with reference to selected or remembered criteria.

English, Grades 11-12, Poetic Structure

Read the following poem on "The Eagle" by Tennyson:

He clasps the crag with crooked hands,
Close to the sun in lonely lands,
Ringed with the azure world he stands.

The wrinkled sea beneath him crawls;
He watches from his mountain walls,

1. Select the appropriate line to complete the above poem.
 - a. And sometimes he experiences the ocean squalls.
 - b. And to the mermaids sweet sounds he calls.
 - c. And his happy childhood he fondly recalls.
 - *d. And like a thunderbolt he falls.

2. Defend your choice of the line in a paragraph, applying selected literary criteria that involve careful reference to the rest of the poem.

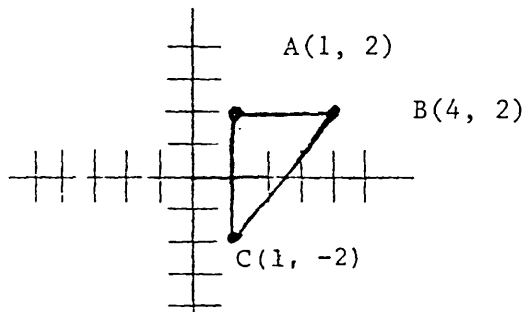
(Answer might refer to rhythm and meter, consistent and relevant imagery, or tone and voice, and assonance.)

Mathematics, Grade 10, Coordinate Geometry

3. The vertices of a triangle are located at the points, (1, 2); (4, 2); and (1, -2).

Prove that the triangle is a right triangle.

Answer:



First: Prove the slope of \overline{AB} = the negative reciprocal of the slope AC. Thus, $\overline{AB} \perp \overline{AC}$ and $\angle A$ is a right angle.

$$\text{Slope } \overline{AB} = \frac{2 - 2}{4 - 1} = \frac{0}{3} = 0$$

$$\text{Slope } \overline{AC} = \frac{2 - (-2)}{1 - 1} = \frac{2 + 2}{0} \text{ (undefined)}$$

It is impossible to prove these slopes are negative reciprocals.

Second: Prove $\overline{AB}^2 + \overline{AC}^2 = \overline{BC}^2$

Use distance formula.

$$\overline{AB} = \sqrt{(4 - 1)^2 + (2 - 2)^2} = \sqrt{3^2 + 0} = 3$$

$$\overline{AC} = \sqrt{(1 - 1)^2 + (2 - (-2))^2} = \sqrt{0 + 4^2} = 4$$

$$\overline{BC} = \sqrt{(4 - 1)^2 + (2 - (-2))^2} = \sqrt{(3)^2 + (4)^2} = \sqrt{9 + 16} = \sqrt{25} = 5$$

$$3^2 + 4^2 = 5^2$$

$$\overline{AB}^2 + \overline{AC}^2 = \overline{BC}^2$$

Science, Grade 8, Scientific Discoveries

4. Develop a set of criteria for evaluating five of the most important scientific discoveries in the last ten years. Judge the importance of each discovery in relation to the criteria and rank the discoveries by degrees of importance.

APPENDICES

*Purpose

Instructional excellence is a major educational goal. In working toward this goal, teachers need to challenge all of their students to think at the higher levels.

The purpose of these appendices is to assist teachers with (1) planning lessons to broaden the students' range of learning, (2) assessing whether they are offering all types of learning opportunities in all of their classes, and (3) classifying types of learning into three domains:

COGNITIVE DOMAIN: emphasizes intellectual outcomes such as the recall of knowledge

AFFECTIVE DOMAIN: concerns attitudes, interests, and appreciation

PSYCHOMOTOR DOMAIN: focuses on the concept of physical coordination

This information can be used in curriculum meetings to generate an exchange of ideas on how best to bring about high levels of thinking in each subject area.

*Berendo Junior High School, Dr. R. S. Heyman, Principal, Los Angeles Unified School District, January 7, 1981

APPENDIX A

MAJOR CATEGORIES AND SOME POSSIBLE VERBS FOR USE IN STATING COGNITIVE OUTCOMES

					<u>EVALUATION</u>
					appraise
					assess
					choose
					estimate
					evaluate
					judge
					measure
					rate
					revise
					select
					score
				<u>ANALYSIS</u>	<u>SYNTHESIS</u>
				analyze	arrange
				calculate	assemble
				categorize	collect
				compare	compose
				contrast	construct
				criticize	create
				debate	design
				diagram	formulate
				distinguish	manage
				examine	organize
				experiment	plan
				inspect	prepare
				inventory	propose
				question	set up
				relate	
				solve	
				test	
	<u>COMPREHENSION</u>	<u>APPLICATION</u>			
	describe	apply			
	discuss	demonstrate			
	explain	dramatize			
	express	employ			
	identify	illustrate			
	locate	interpret			
	recognize	operate			
	report	practice			
	restate	schedule			
	review	show			
	tell	sketch			
	translate	use			
<u>KNOWLEDGE</u>					
define					
list					
name					
recall					
record					
relate					
repeat					
underline					

APPENDIX B: SUMMARY OF THE MAJOR CATEGORIES IN THE AFFECTIVE DOMAIN²

- 1.0 Receiving (attending): The willingness to attend to or receive certain stimuli
 - 1.1 Awareness--to be conscious of stimulus events
 - 1.2 Willingness to receive--to attend willingly, without avoidance
 - 1.2 Controlled or selected attention--to differentiate aspects of a stimulus from adjacent stimuli

- 2.0 Responding: The active involvement and participation
 - 2.1 Acquiescence in responding
 - 2.2 Willingness to respond
 - 2.3 Satisfaction in response

- 3.0 Valuing: The worth of a thing, phenomenon, or behavior
 - 3.1 Acceptance of a value
 - 3.2 Preference for a value
 - 3.3 Commitment

- 4.0 Organization: The organization, interrelationship, and ordering of values
 - 4.1 Conceptualization of a value
 - 4.2 Organization of a value system

- 5.0 Characterization by a value or value complex: The generalization and integration of a total world view or philosophy
 - 5.1 Generalized set--one's basic orientation or point of view
 - 5.2 Characterization--the peak of the internalization process

²David R. Krathwohl, Benjamin S. Bloom, and Bertrand B. Masia, Taxonomy of Educational Objectives: Handbook II: Affective Domain (New York: Longman Inc., 1964), pp. 176-185.

APPENDIX C

MAJOR CATEGORIES AND SOME POSSIBLE TERMS FOR USE IN STATING AFFECTIVE OUTCOMES

				<u>CHARACTERIZATION BY A VALUE OR VALUE SYSTEM COMPLEX</u>
			<u>ORGANIZATION</u>	(value system reflected by life style)
		<u>VALUING</u>	(initiation of students' value system)	discriminates influences qualifies questions revises solves uses verifies
	<u>RESPONDING</u>	(worth or value to student)	alters arranges combines defends generalizes integrates modifies organizes relates synthesizes	
<u>RECEIVING</u>	(reacts)	completes differentiates explains initiates joins justifies proposes selects shares		
(pays attention to)	answers assists complies conforms discusses greet helps labels performs practices presents reports tells writes			
asks chooses describes follows gives holds identifies locates names points to replies selects				

APPENDIX D. MAJOR CATEGORIES OF THE PSYCHOMOTOR DOMAIN

IMITATION

(model)

The learner begins covert imitation when he or she is exposed to an observable action. Such covert behavior appears to be the starting point in the growth of psychomotor skill. This is then followed by overt performance of an act and capacity to repeat it. The performance, however, lacks neuromuscular coordination or control, and hence is generally in a crude and imperfect form (i.e., impulsive, overtly repetitive).

MANIPULATION

The learner demonstrates the development of skill in following directions, the performing of selected activities, and the fixation of performance through necessary practice. At this level the learner is capable of performing an act according to instruction (rather than just on the basis of observation as in the case of the level of imitation).

PRECISION

(one single
act)

The learner reaches a higher level of proficiency of performance in reproducing a given act. Here, accuracy, proportion, and exactness in performance become significant (i.e., reproduction, control, errors reduced to a minimum).

ARTICULATION

The learner coordinates a series of acts by establishing appropriate sequence and accomplishing harmony or internal consistency among the different acts (i.e., performance involves accuracy, control, and the elements of speed and timing).

NATURALIZATION

The learner reaches a high level of proficiency in the skill of performance of a single act. The act is performed with the least expenditure of psychic energy. The act is routinized to such an extent that it results in automatic and spontaneous response (i.e., performance becomes natural and smooth).

APPENDIX E

EXAMPLES OF SOME POSSIBLE TERMS AND OBJECTIVES FOR USE IN STATING PSYCHOMOTOR OUTCOMES

Illustrative Behavioral Terms for
Stating Specific Learning Outcomes

Illustrative General Instructional
Objectives

assembles
builds
calibrates
changes
cleans
composes
connects
constructs
corrects
creates
dismantles
drills
fastens
fixes
follows
grinds
grips
hammers
heats
hooks
identifies
locates
makes
manipulates
mends
mixes
nails
paints
sands
saws
sharpens
sets
sews
sketches
starts
stirs
uses
weighs
wraps

Writes smoothly and legibly

Draws accurate reproductions of a picture (or map, biology specimen, etc.)

Sets up laboratory equipment quickly and correctly

Types with speed and accuracy

Operates a power saw safely and skillfully

Performs skillfully on the violin

Performs a dance step correctly

Demonstrates correct form in swimming

Demonstrates skill in driving an automobile

Repairs an electric motor quickly and effectively

Creates new ways of performing (creative dance, etc.)

In classifying questions, three factors must be considered:

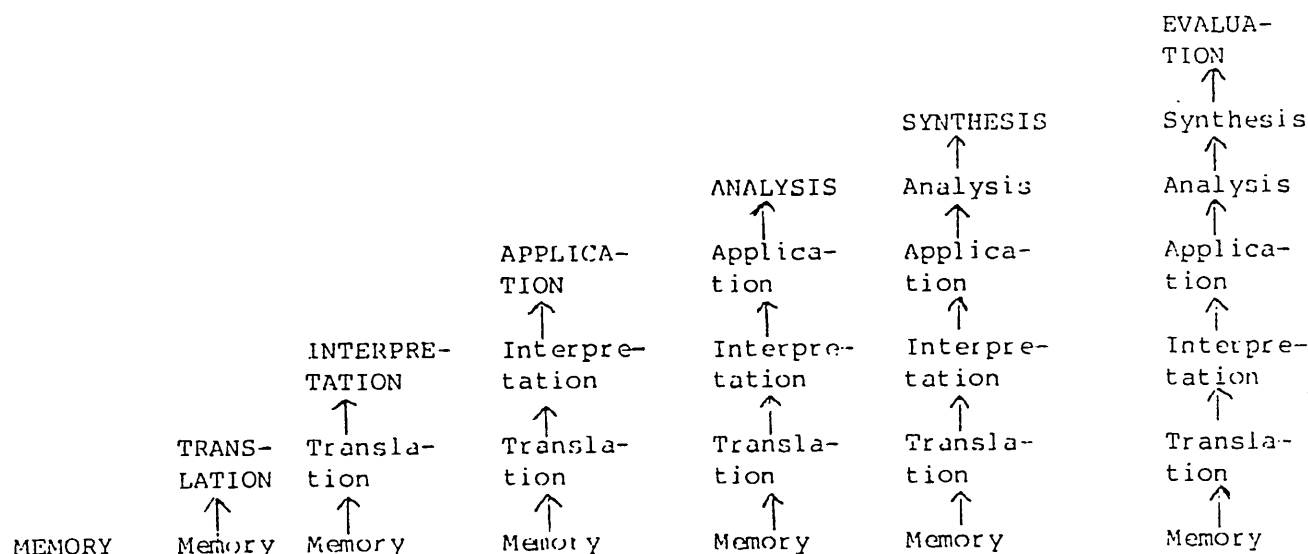
1. The nature of the question must be considered. Certain kinds of questions lead to a certain kind of thinking.
2. The student's knowledge of the subject must be considered. For example, suppose a teacher presents general differences between the beliefs of the Republican and Democratic parties and then asks students to study quotations from political speeches to determine which party's philosophy is best illustrated. A student who reads the newspaper with more than ordinary devotion might remember a quotation as being a part of speech by a well-known member of one of the parties. For this student, the question on the quotation requires only memory, although he might corroborate his answer by interpretation. Other students who had not read the speech could reach the same answer legitimately by using only the category of interpretation.
3. The third factor that enters into the classification of a question concerns the instruction that precedes the asking of a question. In a civics course, one might ask: Why might a congressman prefer a voice vote on a bill rather than a recorded vote of the "yeas" and "nays"? If the answer was given in the text or by the teacher, then only memory is required from the student. However, students who are taught the role of a congressman should be able to infer the answer without being told. For the most part, teachers can anticipate the amount of knowledge students have on a subject and the mental processes they will use to arrive at an answer. There are exceptions, however, and it is wrong to assume that a question inevitably leads to a single category of thinking or that all students are necessarily using the same mental processes to arrive at an answer. Another example of the manner in which the thinking resulting from a question is influenced by the classroom context is illustrated in this example from American history: Did the North or South have the greater strength at the beginning of the Civil War? Textbooks usually list the strengths of the North and the South, and then conclude that, although the South had certain advantages, the North had greater strength. To answer the question after reading the text requires only memory. However, the same question solicits more than memory if it is presented in a different way. Suppose the teacher assembles several pages of information concerning geography, industry, agriculture, transportation, military strength, and education of the North and the South in 1861. Some of the information would be germane to the problem and some purposely would not. Now the same question on the relative strength of the North and the South requires much more than memory. The student first determines the factors that are important in giving strength in a war fought at that time and then compares the strengths of two sides.

Failure to recognize that instructional procedures enter into the kind of thinking required by a question leads to a common fallacy in education.

³Norris M. Sanders, Classroom Questions: What Kinds? (New York: Harper & Row, 1966), pp. 8-11. Copyright © 1966 by Norris M. Sanders. Reprinted by permission of Harper & Row, Publishers, Inc.

Many educators advocate less emphasis on "what," "where," and "when" questions and more emphasis on "why" and "how" questions. The fallacy is the belief that a "why" or "how" question necessarily demands more than memory. The question: Why did the United States enter a depression in 1929 is only a memory question if the student is expected to give back the same neat little package of answers provided in the text or in the teacher's lecture. "Why" and "how" questions are excellent when they are presented in a way that leads students to figure out the answers--not simply to remember them.

The authors of the Taxonomy of Educational Objectives state that their categories are sequential and cumulative. In other words, each category of thinking has unique elements but also includes some form of all lower categories. The following chart illustrates this idea:



There are both simple and complex questions within each category. For example, the memory level includes questions soliciting a single fact: Who was the first President of the United States? At the other end of the memory scale is this question: Trace the evolution of United States tariff policy from 1789 to the present. The implication is that all teachers from the primary grades through graduate school will find it possible to use every one of the categories in their classes. The differences in the questions offered at various grade levels should be in the complexity of the thinking, rather than in the kind of thinking.

The same point applies in teaching the slow and rapid learners. A superficial appraisal of the levels of questions might lead to the conclusion that slow learners should restrict their efforts to the memory category, while the bright children should be permitted to range through all levels. This is an error, because there are simple questions in each category of thinking. The slow learners often find education frustrating and lacking in interest; these children, above all, need variety in their educational diet. Experimentation may show that students who have difficulty with memory questions will have greater success with those that provide all necessary facts and ask the students to use them.

Finally, one must remember that the words used as names of the categories have stipulated definitions that depart somewhat from common usage. Teachers who are communicating about questions must specify when they are using the specialized meaning.

The word "taxonomy" comes from science and refers to this form of a sequential and cumulative system of classification.

Placing the Taxonomy in Perspective

During the last few years, it has become fashionable to emphasize intellectual processes and subject matter in education. The taxonomy of questions fits into this trend. There is little doubt that humans exhibit rational behavior, but some irrationality is equally apparent in man. Teachers who concern themselves with the possible uses of the taxonomy of questions must not lose sight of the fact that concern for the quality of thought in the classroom is inadequate as a total philosophy of education. Psychologists have proven that emotional atmosphere in the classroom has a great deal to do with any learning that might result. The receptivity of students for any kind of classroom learning is conditioned by both in-school and out-of-school experiences. Educators took a great step forward when they discovered that they must be concerned with the whole child--not simply with his mind.