



Pre-Algebra

Mathematics Routines

Developing Effective Strategies for Multiple Choice Tests

Purpose

- To teach students strategies for selecting correct responses on multiple choice tests
- To teach students to use reasoning skills as they solve multiple choice items
- To provide students opportunities to develop and use the mathematical language that may be encountered on multiple choice tests
- To give students experiences with similar types of questions that may be on multiple choice tests
- To provide students the opportunity to review and expand on important mathematical ideas
- To improve students' number and operational sense

Rationale

Some students with solid mathematical understanding do not do as well as they should on multiple choice tests. Through explicit teaching using the multiple choice format, students will improve their test-taking skills and enhance their understanding of important mathematical ideas and standards.

An important aspect of this process is that students take the time to think and reason about the problem before they choose an answer. Thinking and reasoning must become a "habit of mind" that students use whenever they are confronted with a multiple choice problem to solve. Beginning very early in the school year, using this routine once a week, students will learn to "break" the habit of guessing and will learn strategies designed to improve performance on multiple choice tests.

Success on multiple choice assessments requires:

1. A solid understanding of the mathematics concepts, skills, and applications that will be tested.
2. Familiarity with the kinds of tasks and language that will be seen on the test.
3. Strategies for approaching those tasks so that students can show what they know.
4. Ability to demonstrate understanding in a variety of ways.

Description

- The teacher poses one multiple choice problem to the students.
- The problem might be taken from any of the previously administered Multiple Choice Module Assessments, Cumulative Benchmark Assessments, Harcourt Math assessments or CST released items.
- The students think about the problem in a way that makes sense to them, decide on the answer, and then select the correct A, B, C, or D response.
- Students share their thinking with a partner.
- The teacher leads students in a conversation focused on the mathematical content as well as possible strategies for determining the correct response.
- Students analyze the reasonableness of each of the responses.
- This is an opportunity for students to re-visit mathematics concepts and also learn the strategies and self-questions necessary for analyzing and successfully selecting a multiple choice response.

Strategies

Multiple choice questions have one, and only one, correct response. The task is to uncover the one right choice hidden among three wrong choices. Consider the following strategies as you “unpack” the problem and question students:

Understanding and Solving the Problem

1. Read the problem.
What is being asked?
2. What do you know?
What information do you need to know?
What information is not important?
3. What do you need to do to solve the problem?
(If stumped, would it help to solve a simpler problem by changing the numbers?)
4. Solve the problem.

Estimating

Estimation is a way of finding an approximate answer when working with numbers and operations. Estimation helps you:

- Eliminate wrong answer choices.
- Narrow the number of reasonable answers.
- Save time by avoiding lengthy calculations.
- Check your answer.

Two estimation strategies:

- Compatible Numbers (friendly, benchmark)
 - $98 + 27$ can be thought of as $100 + 25$.
- Rounding
 - Make a number a multiple of 10 or 100 so that it is easier to work with.
 $98 + 27$ can be rounded to $100 + 30$.

Eliminating Unreasonable Answers

- Rule out answer choices that you know are not reasonable, do not make sense, or are just wrong.
- Even though you may not understand all of the words, you may still understand the mathematics. Do not give up.

Working Backwards

When solving for the value of a variable, as in $6y=12$, one strategy is to work backwards from your answer choices. You can find the correct answer by substituting the numbers one at a time into the equation.

1. Select an answer choice and substitute it for the variable.
2. Work the problem to see if both sides balance.
3. If it does not produce a balanced equation, eliminate that choice and try another.
4. If it produces a balanced equation, you are finished.

Using Models

A model for a mathematical concept refers to any mental image object, picture, or drawing that represents the concept or onto which the relationship for that concept can be imposed.

Models are a testing ground for emerging ideas.

- Models may help students develop new concepts or relationships.
- Models may help students make connections between concepts and symbols.
- Models may help students to show their understanding without words.
- Models may help the teacher assess students' understanding.

Models could include:

- Drawing pictures
- Using manipulative models
- Writing symbols
- Using oral language
- Relating to real-world situations

A variety of models should be available to help students make meaning of the important mathematical idea. Students use models to help them work through the problem or idea. Students select models that make sense to them. While the teacher can offer a model, it must be remembered that this is the way the teacher makes sense of the idea and it may not be the way the student makes sense of the idea.

Suggested Materials

- Chart paper, document camera, overhead projector, white board or chalkboard
- Individual white boards, scratch paper or journals
- Items from Multiple Choice End-Of-Module Assessments, Cumulative Benchmark Assessments, Harcourt Math, or CST released items.

Time

- 15 minutes maximum

Directions

Example 1: Solving Problems Not Using A, B, C, D Responses

REMEMBER TO THINK ABOUT THESE STRATEGIES:

- Understanding and Solving the Problem
- Estimating
- Eliminating Unreasonable Answers
- Working Backwards
- Using Models

1. Write a problem on chart paper, overhead transparency, or a piece of paper (for document camera). The problem should be a multiple choice problem. Do not show the students the A, B, C, D responses.

For example:

The sum of a number (n) and 16 is 64.

“Think about how you would write this equation.”

2. Give students time to think about a reasonable solution to the problem. They may choose to use mental math or to solve the problem on their white board, scratch paper, or in their journal.

3. After the students have had time to think about the problem, show the four possible answers using an A, B, C, D format. Students are to select the answer that they feel is the correct answer (or closest to their thinking). Students write the letter on their white board, scratch paper, or in their journal.

For example:

- A $16n = 64$
- B $16 + n = 64$
- C $64 + n = 16$
- D $16 - n = 64$

Problem:
*The sum of a number (n) and 16 is 64.
Which equation shows this
relationship?*

4. Ask students to turn to a partner to justify why they believe their answer is the correct answer.

I chose letter (A, B, C or D) because

5. Facilitate a conversation focused on the reasonableness of each choice. Possible teacher questions and possible student responses might include the following (not in any particular order):

Note: Ask follow-up questions that will support student thinking and will promote as many strategies as possible to be shared publicly (i.e. “Can you explain to us how you know? How did you think about it?”; “Does anyone have another idea or approach?”).

Take time to analyze common choices. Test Writers often anticipate common student errors and include them as answer choices.

- **Question:** What is being asked?

Possible Response

How to write the equation that describes the statement “The sum of a number (n) and 16 is 64.”

- **Question:** What information do you know?

Possible Response

The addends are 16 and n.

The sum is 64

The operation is additio

- **Question:** What is the operation? How do you know?

Possible Response

Addition because sum implies addition.

- **Question**
What are some relationships between n , 16, and 64?

Possible Response

*n is less than 64. 64 is greater than n . n plus 16 equal 64.
16 is less than 64. 64 is greater than 16.*

- **Question**
What choices could you have eliminated immediately? Why?

Possible Response

A, and D can be eliminated because A is a product and D is a difference.

- **Question**
Why would A not have been a reasonable choice?

Possible Response

A is a product rather than a sum.

- **Question**
Why would D not have been a reasonable choice?

Possible Response

D is a difference rather than a sum.

- **Question**
How do you know that the addends are n and 16?

Possible Response

The problem tells us that we are combining n and 16 (The sum of a number (n) and 16 is 64).

- **Question**
How do you know that the sum is 64 rather than 16?

Possible Response

*The problem tells us the sum is 64 if we eliminate the prepositional phrase (**The sum is 64**).*

Example 2: Using A, B, C, D Responses to Solve the Problem

REMEMBER TO THINK ABOUT THESE STRATEGIES:

- **Understanding and Solving the Problem**
- **Estimating**
- **Eliminating Unreasonable Answers**
- **Working Backwards**
- **Using Models**

1. Some problems do not lend themselves to students reasoning through the problem *before* they see the A, B, C, D, response. For these problems, students think about the problem, the mathematical language and which response makes the most sense.
2. For example:

The absolute value of a negative integer is always ____? ____.

- A negative***
- B zero***
- C positive***
- D neutral***

3. Ask students to turn to a partner to justify why they believe their answer is the correct answer.
4. Facilitate a conversation about the reasonableness of each choice.
5. Take time to analyze common mistakes represented in the answer choices. Test Writers often anticipate common student errors and include them as answer choices.

Questions might include the following:

- **Question**
What is being asked?

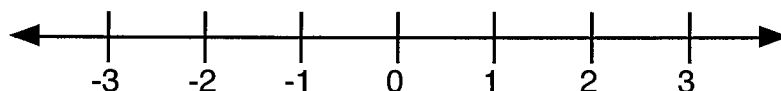
Possible Response
Which word makes the statement true.

- **Question**
What important information is given?

Possible Response
We have to think about absolute value
We have to think about a negative integer
Always means that it is a pattern that is always true

Question
What do you know about integers?

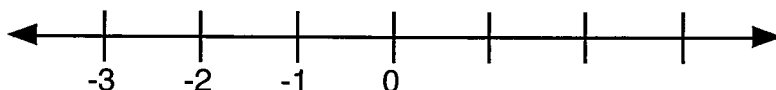
Possible Response
Whole numbers including zero, and their opposites.



- **Question**
Use the number line to tell me what you know about negative integers.

Possible Response

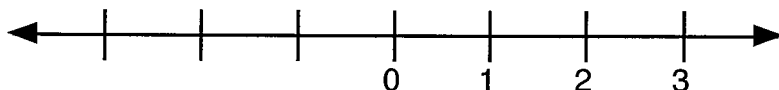
To the left of zero



- **Question**
Use the number line to tell me what you know about positive integers.

Possible Response

To the right of zero.



- **Question**
What do you know about absolute value?

Possible Response

A number's distance from zero on the number line.

It does not matter if the number is negative or positive.

Opposite numbers (i.e. 3, -3) have the same absolute value (i.e. $|3|$ and $|-3|$ have the same absolute because they are both 3 units from zero).

- **Question**
What is the relationship between a positive integer, a negative integer and a neutral integer?

Possible Response

A positive integer is to the right of zero, a negative integer is to the left of zero, and a neutral integer is neither positive nor negative and describes the distance from zero.

- **Question**
Why wouldn't A or C be correct responses?

Possible Response

Because absolute value only describes the distance from zero. It does not matter whether the distance is to the left or right on the number line.

- **Question**
Is zero a reasonable response? Why or why not?

Possible Response

No. The question asks about a negative integer and zero is neither positive nor negative.

- **Question**

Why is D a reasonable response?

Possible Response

Absolute value is neutral because it describes the distance from zero and does not consider whether it goes to the right of zero (positive) or left of zero (negative).

Which Multiple Choice Items to Use

As you select items for the Multiple Choice Routine, think about the following:

- Which multiple choice item will help students build a solid understanding of a mathematics concept, skill or application with which they are struggling?
- Which multiple-choice format will help students become familiar with the kinds of tasks and language that will be seen on the test?
- Which multiple-choice item will help students learn strategies for approaching tasks so that they can show what they know?

Sources for multiple-choice items could include:

- Items from the Multiple Choice End-of-Module Assessments (following administration)
- Items from the Cumulative Benchmark Assessments (following administration)
- Released test items from the California Standards Test
- Multiple choice items from Harcourt.

Multiple Choice End-of-Module Assessments

Analyzing how students respond to the items (following administration) will give an indication about the mathematical ideas with which students continue to grapple. Select items from the Multiple Choice End-of-Module Assessment that indicate fragile student understandings.

Cumulative Benchmark Assessments

Analyzing how students responded to the items (following administration) will give an indication about the mathematical ideas with which students continue to grapple. Select items from the Multiple Choice Benchmark Assessment that indicate fragile student understandings.

Prentice Hall Pre-Algebra

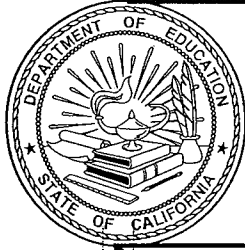
Prentice Hall Pre-Algebra provides the following assessment resources in multiple choice format:

- Cumulative Review at the end of each chapter in the text.
- Cumulative Review in each Chapter Support File.*
- Chapter Assessment in each Chapter Support File (Forms A & B).*
- Quarterly Assessments (Forms A & B) in the Cumulative Assessment booklet.*
- Cumulative Assessments (Forms A & B) in the Cumulative Assessment Booklet.*
- End of Course Assessments (Forms A & B) in the Cumulative Assessment Booklet.*

*CA Teaching Resources Kit

Released Test Items from the California Standards Test

- The California Department of Education has released a sample of California Standards Test questions. The state has provided guidelines for use of released items. In summary, these guidelines discourage the use of test items as a practice test or to predict performance on the CST. However, the use of the items as a teaching tool (as described in this routine) is a practice that is encouraged.
- The released items can be an example of the kinds of tasks and language that will be seen on the test. Individual test items can be used to help students learn strategies for approaching tasks so they can show what they know.
- To assist the teacher in selecting items for Multiple Choice Routines, the released items have been organized by module. The released items organized by module are attached.



Guidelines on Academic Preparation for State Assessments

The best academic preparation for state assessments is good instruction. This can be broadly defined as instruction in the content specified in California's academic content standards, employing the instructional principles and practices set forth in the content-area frameworks. It is the standards and frameworks, not the tests, that guide instructional programs. Instructional programs are designed to ensure that students master the standards at their own and earlier grade levels. Instructional programs also ensure that students are able to demonstrate mastery of the content standards in multiple formats; for example, multiple choice, short answer, and essay.

Statement of Regulation

Appropriate academic preparation for state assessments must be designed to allow students a fair opportunity to prepare academically while ensuring that such preparation does not invalidate test results.

Regarding advance preparation for state tests, the *California Code of Regulations, Title 5*, Section 854 (a) states:

Except for materials specifically included within the designated achievement test, no program or materials shall be used by any school district or employee of a school district that are specifically formulated or intended to prepare pupils for the designated achievement test. No administration or use of an alternate or parallel form of the designated test for any stated purpose shall be permitted for any pupils in grades 2 through 11, inclusive.

This regulation is based on the California *Education Code*, Section 60611, which prohibits "any program of specific preparation for the statewide pupil assessment program or a particular test used therein."

The *Standards for Educational and Psychological Testing*, also states, "the integrity of test results should be maintained by eliminating practices designed to raise scores without improving performance on the construct or domain being tested" (Standard 15.9).

Further, the National Research Council, in *High Stakes Testing for Tracking, Promotion, and Graduation* (1999), recommends that "all students are entitled to sufficient test preparation so their performance will not be adversely affected by unfamiliarity with item format or by ignorance of appropriate test-taking strategies. Test users should balance efforts to prepare students for a particular test format against the possibility that excessively narrow preparation will invalidate test outcomes."

Determining Appropriate Academic Preparation for State Assessments

To help determine whether their academic preparation practices for state assessments are appropriate, school and district personnel may find it useful to answer the questions noted below. Those who can answer "yes" to all five questions are likely using academic preparation practices for state assessments that are consistent with the *California Education Code* and *California Code of Regulation, Title 5*, Section 854. However, schools and districts are expected to monitor their preparation practices to ensure that they are consistent with the *California Education Code* and *California Code of Regulations, Title 5*.

