



Grade 6

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. Through weekly experiences with strategies designed to improve achievement, students can “break” the habit of guessing answers for test items and 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 ideas. 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:

If 25% of a number is 10, what is 50% of the number?
 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 4
- B 5
- C 20
- D 40

Problem:
If 25% of a number is 10, what is 50% of the number?

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 mistakes represented in the answer choices. Test writers often anticipate common student errors and include them as answer choices.

- **Question:** What is being asked?
- **Possible Response**
What is 50% of the number?
- **Question:** What information do you know?
Possible Response
25% of the number is 10.
0.25 of the number is 10.
 $\frac{1}{4}$ of the number is 10.
10 is half of the answer.
- **Question**
What do you need to do to solve the problem?
Possible Response
Figure out the number and take half of it.
 $4 \times 25\% = 100\%$; $100\% \div 2 = 50\%$;
 $4 \times 10 = 40$; $40 \div 2 = 20$
or
Figure out 50% of the number another way.
 $2 \times 25\% = 50\%$; $2 \times 10 = 20$

- **Question**
Will the answer be greater than or less than 10? How do you know?

Possible Responses

Greater than 10.

25% is less than 50%.

25% of the number is 10; 50% of the number must be greater than 10.

One Model for the problem:

If 25% of a number is 10, what is 50% of the number?

The number			
25%			
10			
50%			
?			

- **Question:** What do you know about 25%?

Possible Responses

$\frac{1}{4}$ of a whole

Equal to 0.25

Less than 1

Half of 50%

Half of 0.50

A quarter of a dollar

- **Question:** What do you know about 50%?

Possible Responses

$\frac{1}{2}$ of a whole

Equal to .50 or 0.5

Less than 1

$\frac{1}{4} + \frac{1}{4}$

$0.25 + 0.25$

Half a dollar

- **Question:** Why would “D” (or “A” or “B”) not have been a reasonable choice?

Possible Response

“D” (40) is the whole (see visual model).

- **Question:** How do you know that 50% of the number is 20?

Possible Response

If 25% of the number is 10, 50% of the number would be double (see visual model).

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.

For example:

Wendy wants to take a survey to determine which flavor of ice cream is the most popular at her school. Which of the following methods is the *best* way for her to choose a random sample of the students at her school?

- A selecting ten students from each homeroom**
- B selecting members of the girls' softball team**
- C selecting members of the boys' basketball team**
- D selecting students who like her favorite flavor of ice cream**

2. Ask students to turn to a partner to justify why they believe their answer is the correct answer.
3. Facilitate a conversation about the reasonableness of each choice. Possible teacher questions and possible student responses might include the following:

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 mistakes represented in the answer choices. Test writers often anticipate common student errors and include them as answer choices.

- **Question**
What is being asked?

Possible Response

Which method is the best way to choose a random sample at Wendy's school.

- **Question:**
What do you know about *sample*?

Possible Response

A number of people, objects, or events chosen from a given population to represent the entire group.

- **Question**
What do you know about *random sample*?

Possible Response

*A random sample is a sample in which every person, object, or event in the population has an **equal chance** of being selected for the sample.*

- **Question:**
Which responses could you eliminate and why?

Possible Responses

"B" because the population is made up of all of the students at school, not just the students on the girls' softball team. This would leave out a large number of students (boys, and girls who do not play softball on the team).

"C" because the population is made up of all of the students at school, not just the students on the boys' basketball team. This would leave out a large number of students (girls, and boys who do not play basketball on the team).

"D" because the population is made up of all of the students at school, not just the students who like her flavor of ice cream. This would leave out a large number of students (students who like other flavors of ice cream).

- **Question:** Which response makes the most sense and why?

Possible Response

"A" because by randomly selecting ten students from each homeroom, each student (boys, girls, basketball players, softball players, students who prefer different flavors of ice cream) has an equal chance of being selected for the sample.

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

Cumulative Benchmark Assessments (given quarterly) will be in multiple-choice format. 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 Cumulative Benchmark Assessment that indicate fragile student understandings.

Harcourt Math

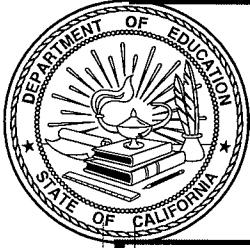
Harcourt Math provides the following assessment resources in multiple choice format:

- Chapter Tests in the Assessment Guide (Form A)
- Unit Tests in the Assessment Guide (Form A)
- Chapter/Review Tests in the textbook
- End-of-Year Test (Form A) in the Assessment Guide.

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 examples 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*.

