CollegeBoard

SAT® Math Webinar

Skills

Instructional Strategies

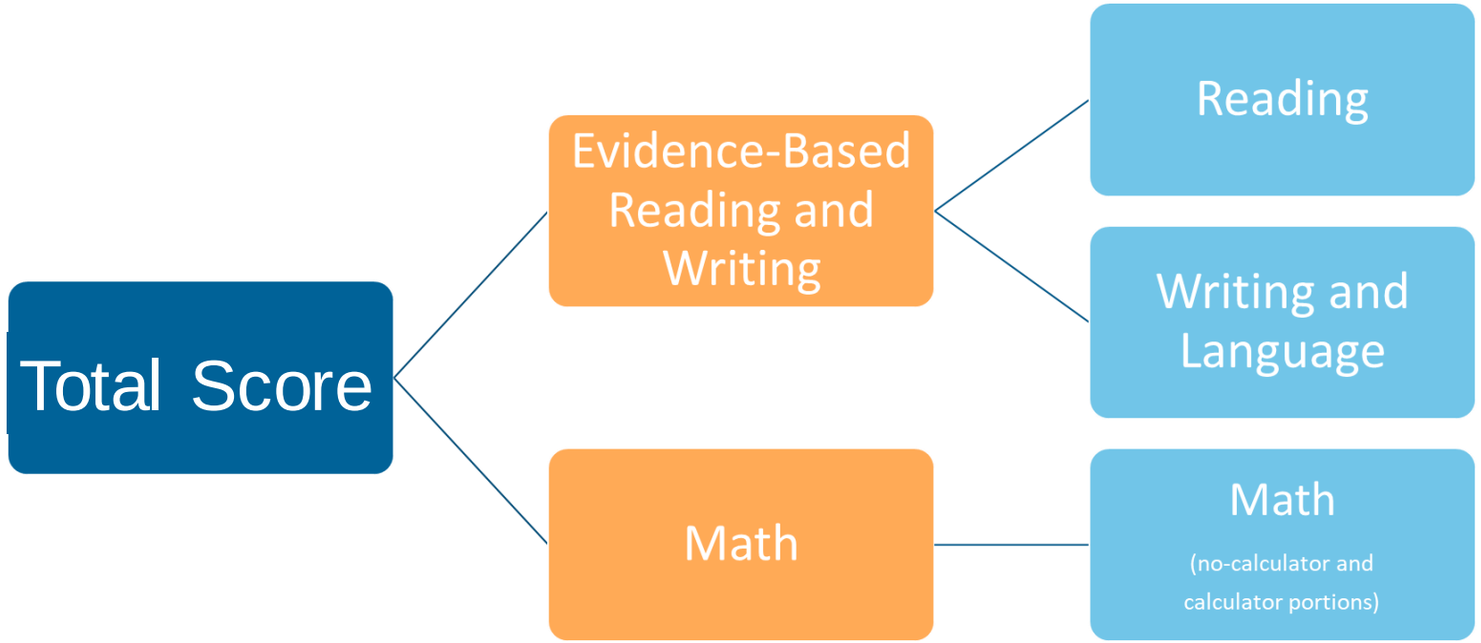
Question Analysis Report

Agenda

Here's what we'll cover today:

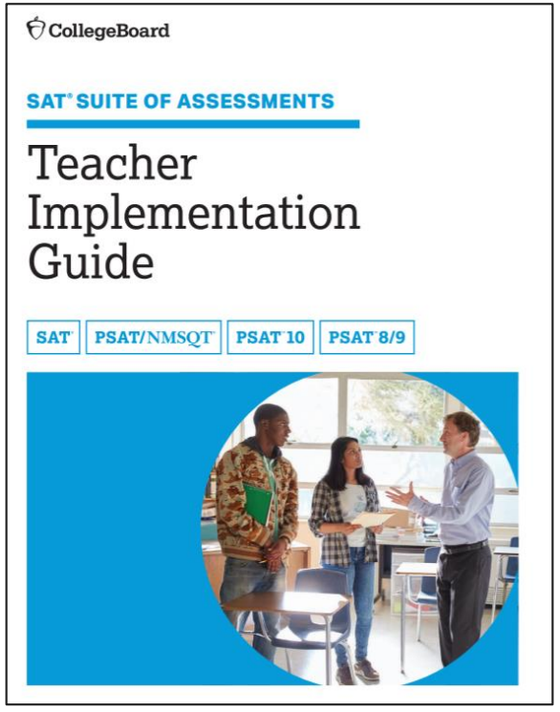
- SAT Suite of Assessments Overview
- SAT Math Domain
  - Skill Exploration
  - SAT Skills Insight
  - K-12 Assessment Reporting Portal
- Curriculum Review - Skills Analysis
  - Linear Equations
  - Interpretations of Relationships in Charts & Graphs
  - Geometry
- Question Analysis Report
- Item Analysis Report
- Instructional Strategies

About the SAT®



The Math Test

https://collegereadiness.collegeboard.org/pdf/redesigned-sat-k12-teacher-implementation-guide.pdf



The overall aim of the Math Test is to assess fluency with, understanding of, and ability to apply the mathematical concepts that are most strongly prerequisite for and useful across a wide range of college majors and careers.

The Math Test:

- rewards a stronger command of fewer important topics
- provides opportunities for students to apply mathematical concepts to richer problems
- includes a calculator portion and a no-calculator portion

The SAT® Relates to Classroom Instruction

- Aligns to state standards
- Aligns to classroom instruction
- Contains no obscure vocabulary
- Uses rights-only scoring
- Focuses on the knowledge and skills most important for success after high school:
  - Defining words in context
  - Using evidence to support arguments
  - Using ‘Standard English Conventions’ appropriately
  - Analyzing and utilizing data
  - Applying fundamental algebra concepts

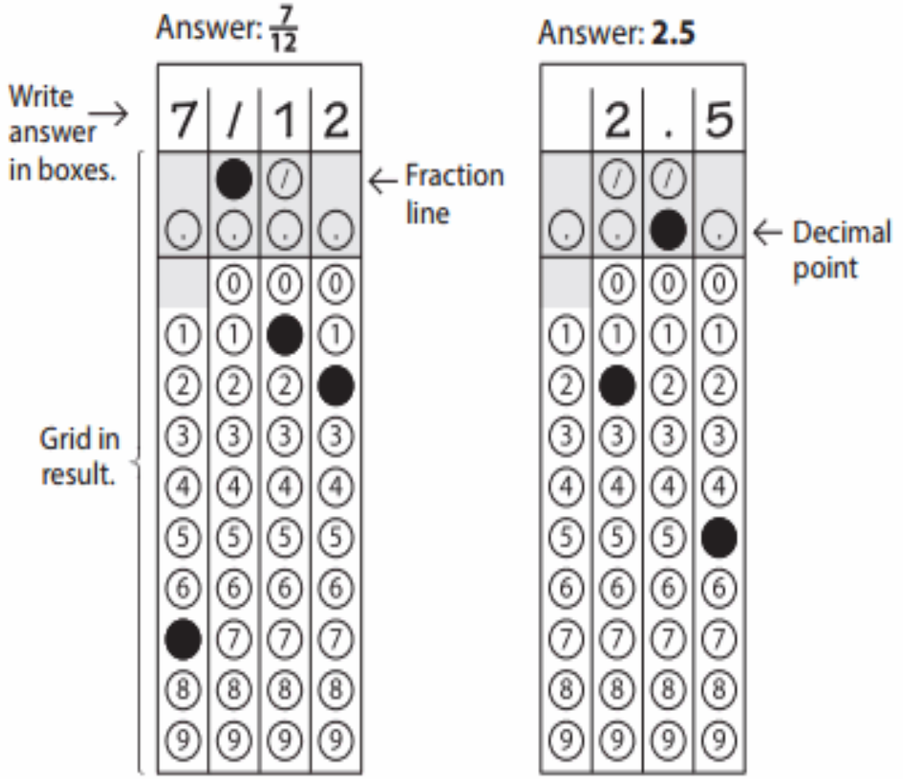
SAT® Math Test

Features

- Cross-disciplinary contexts:
  - History/social studies
  - Science
- Informational graphics
- Focus on the following:
  - Heart of Algebra
  - Passport to Advanced Math
  - Problem Solving and Data Analysis
  - Additional Topics in Math

Student-Produced Response Questions

- The answer to each student-produced response question is a number (fraction, decimal, or positive integer) that will be entered on the answer sheet into a grid such as the one shown below.
- Students may also enter a fraction line or a decimal point.



Grade-Appropriate Math

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HEART OF ALGEBRA: LINEAR EQUATIONS AND FUNCTIONS

SAT HEART OF ALGEBRA DOMAIN			
Content Dimension	**SAT Description**	**PSAT/NMSQT and PSAT 10 Description**	**PSAT 8/9 Description**
Linear equations in one variable	1. Create and use linear equations in one variable to solve problems in a variety of contexts. 2. Create a linear equation in one variable, and when in context interpret solutions in terms of the context. 3. Solve a linear equation in one variable making strategic use of algebraic structure. 4. For a linear equation in one variable, a. interpret a constant, variable, factor or term in a context; b. determine the conditions under which the equation has no solution, a unique solution, or infinitely many solutions. 5. Fluently solve a linear equation in one variable.	1. Create and use linear equations in one variable to solve problems in a variety of contexts. 2. Create a linear equation in one variable, and when in context interpret solutions in terms of the context. 3. Solve a linear equation in one variable making strategic use of algebraic structure. 4. For a linear equation in one variable, a. interpret a constant, variable, factor or term in a context; b. determine the conditions under which the equation has no solution, a unique solution, or infinitely many solutions. 5. Fluently solve a linear equation in one variable.	1. Create and use linear equations in one variable to solve problems in a variety of contexts. 2. Create a linear equation in one variable, and when in context interpret solutions in terms of the context. 3. Solve a linear equation in one variable making strategic use of algebraic structure. 4. For a linear equation in one variable interpret a constant, variable, factor or term in a context. 5. Fluently solve a linear equation in one variable.

Grade-Appropriate Math

PROBLEM SOLVING AND DATA ANALYSIS: PROPORTIONAL RELATIONSHIPS, PERCENTAGES, COMPLEX MEASUREMENTS, AND DATA INTERPRETATION AND SYNTHESIS

SAT PROBLEM SOLVING AND DATA ANALYSIS DOMAIN			
Content Dimension	**SAT Description**	**PSAT/NMSQT and PSAT 10 Description**	**PSAT 8/9 Description**
Ratios, rates, proportional relationships, and units	Items will requires students to solve problems by using a proportional relationship between quantities, calculating or using a ratio or rate, and/or using units, derived units, and unit conversion. 1. Apply proportional relationships, ratios, rates and units in a wide variety of contexts. Examples include but are not limited to scale drawings and problems in the natural and social sciences. 2. Solve problems involving a. derived units including those that arise from products (e.g., kilowatt-hours) and quotients (e.g., population per square kilometer) b. unit conversion including currency exchange and conversion between different measurement systems. 3. Understand and use the fact that when two quantities are in a proportional relationship, if one changes by a scale factor, then the other also changes by the same scale factor.	Items will requires students to solve problems by using a proportional relationship between quantities, calculating or using a ratio or rate, and/or using units, derived units, and unit conversion. 1. Apply proportional relationships, ratios, rates and units in a wide variety of contexts. Examples include but are not limited to scale drawings and problems in the natural and social sciences. 2. Solve problems involving a. derived units including those that arise from products (e.g., kilowatt-hours) and quotients (e.g., population per square kilometer) b. unit conversion including currency exchange and conversion between different measurement systems. 3. Understand and use the fact that when two quantities are in a proportional relationship, if one changes by a scale factor, then the other also changes by the same scale factor.	Items will requires students to solve problems by using a proportional relationship between quantities, calculating or using a ratio or rate, and/or using units, derived units, and unit conversion. 1. Apply proportional relationships, ratios, rates and units in a wide variety of contexts. Examples include but are not limited to scale drawings and problems in the natural and social sciences. 2. Solve problems involving a. derived units including those that arise from quotients (e.g., population per square kilometer) b. unit conversion including currency exchange and conversion between different measurement systems. 3. Understand and use the fact that when two quantities are in a proportional relationship, if one changes by a scale factor, then the other also changes by the same scale factor.

Grade-Appropriate Math

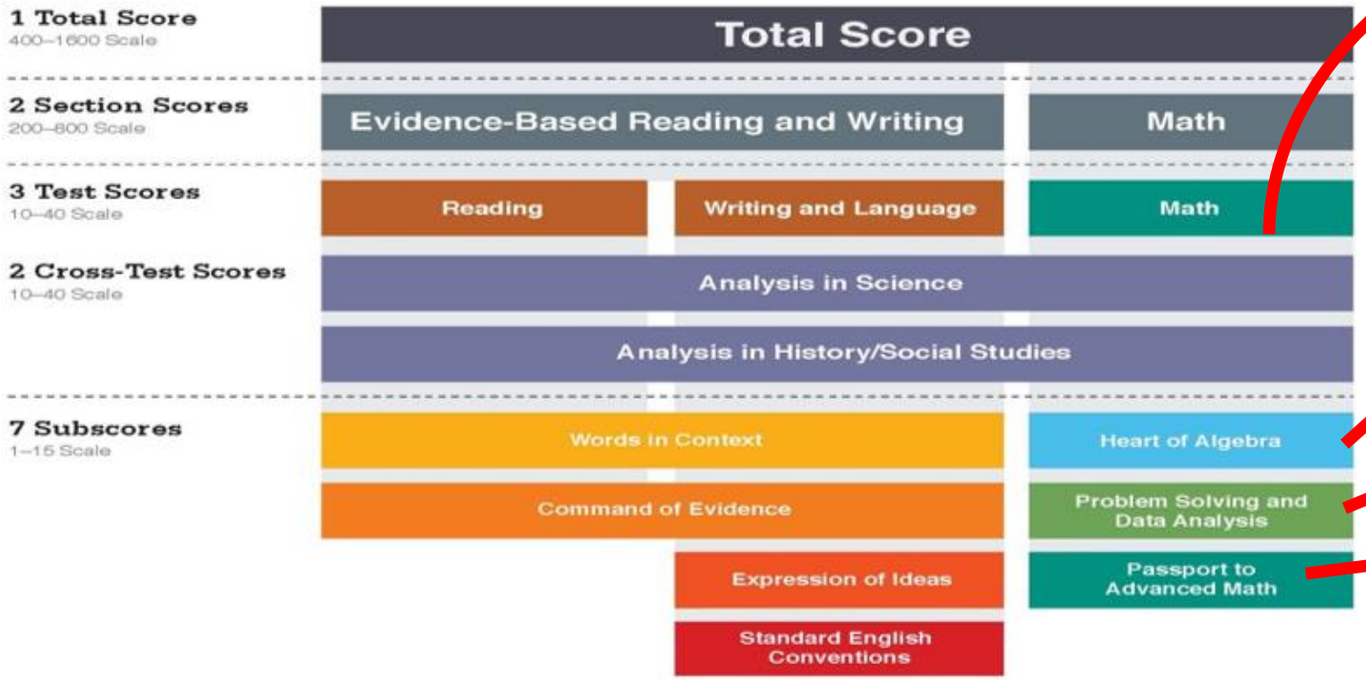
PASSPORT TO ADVANCED MATH: ANALYZING ADVANCED EXPRESSIONS

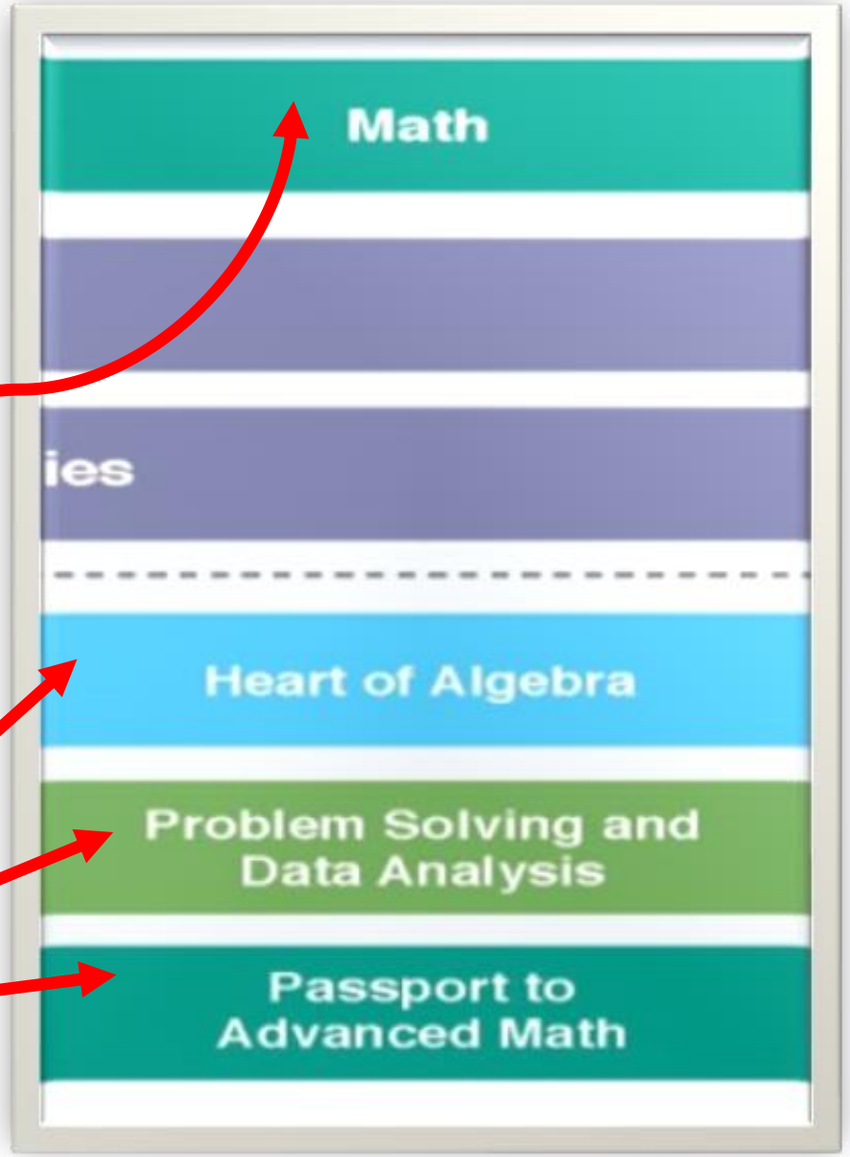
SAT PASSPORT TO ADVANCED MATH DOMAIN			
Content Dimension	**SAT Description**	**PSAT/NMSQT and PSAT 10 Description**	**PSAT 8/9 Description**
Equivalent expressions	1. Make strategic use of algebraic structure and the properties of operations to identify and create equivalent expressions, including a. rewriting simple rational expressions; b. rewriting expressions with rational exponents and radicals; c. factoring polynomials. 2. Fluently add, subtract, and multiply polynomials.	1. Make strategic use of algebraic structure and the properties of operations to identify and create equivalent expressions, including factoring polynomials. 2. Fluently add, subtract, and multiply polynomials.	1. Make strategic use of algebraic structure and the properties of operations to identify and create equivalent expressions, including factoring polynomials. 2. Fluently add, subtract, and multiply polynomials.

Scores

Math Subscores

SAT® Scores and Subscores



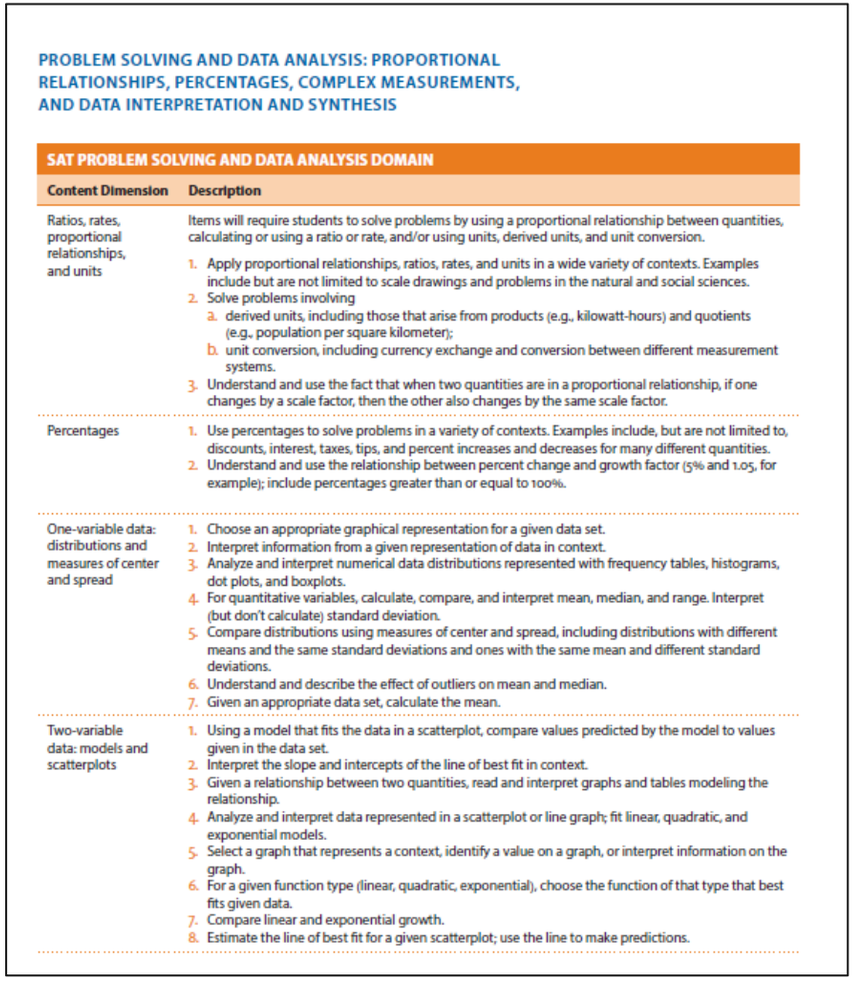


Math Test

- Heart of Algebra (HOA): Questions that assess students' ability to analyze, fluently solve, and create linear equations and inequalities. Students will also be expected to analyze and fluently solve equations and systems of equations using multiple techniques.
- Problem Solving and Data Analysis (PSD): Questions that focus on quantities and their units, proportional relationships, percentages, univariate and bivariate data analysis, probability, and core concepts of statistics.
- Passport to Advanced Math (PAM): Questions that focus on the structure of expressions and the ability to analyze, manipulate, and rewrite these expressions. Students will also be expected to analyze, fluently solve, and create non-linear equations.
- Note that some Math Test questions do not contribute to any subscore. This is not to suggest that those questions and the skills and knowledge they assess are unimportant; rather, those questions focus on other skills and knowledge important to college and career readiness.

Skill Exploration: Domains & Dimensions

SAT® Suite Domains



PROBLEM SOLVING AND DATA ANALYSIS: PROPORTIONAL RELATIONSHIPS, PERCENTAGES, COMPLEX MEASUREMENTS, AND DATA INTERPRETATION AND SYNTHESIS

SAT PROBLEM SOLVING AND DATA ANALYSIS DOMAIN

Content Dimension	Description
Ratios, rates, proportional relationships, and units	Items will require students to solve problems by using a proportional relationship between quantities, calculating or using a ratio or rate, and/or using units, derived units, and unit conversion. 1. Apply proportional relationships, ratios, rates, and units in a wide variety of contexts. Examples include but are not limited to scale drawings and problems in the natural and social sciences. 2. Solve problems involving a. derived units, including those that arise from products (e.g., kilowatt-hours) and quotients (e.g., population per square kilometer); b. unit conversion, including currency exchange and conversion between different measurement systems. 3. Understand and use the fact that when two quantities are in a proportional relationship, if one changes by a scale factor, then the other also changes by the same scale factor.
Percentages	1. Use percentages to solve problems in a variety of contexts. Examples include, but are not limited to, discounts, interest, taxes, tips, and percent increases and decreases for many different quantities. 2. Understand and use the relationship between percent change and growth factor (5% and 1.05, for example); include percentages greater than or equal to 100%.
One-variable data: distributions and measures of center and spread	1. Choose an appropriate graphical representation for a given data set. 2. Interpret information from a given representation of data in context. 3. Analyze and interpret numerical data distributions represented with frequency tables, histograms, dot plots, and boxplots. 4. For quantitative variables, calculate, compare, and interpret mean, median, and range. Interpret (but don't calculate) standard deviation. 5. Compare distributions using measures of center and spread, including distributions with different means and the same standard deviations and ones with the same mean and different standard deviations. 6. Understand and describe the effect of outliers on mean and median. 7. Given an appropriate data set, calculate the mean.
Two-variable data: models and scatterplots	1. Using a model that fits the data in a scatterplot, compare values predicted by the model to values given in the data set. 2. Interpret the slope and intercepts of the line of best fit in context. 3. Given a relationship between two quantities, read and interpret graphs and tables modeling the relationship. 4. Analyze and interpret data represented in a scatterplot or line graph; fit linear, quadratic, and exponential models. 5. Select a graph that represents a context, identify a value on a graph, or interpret information on the graph. 6. For a given function type (linear, quadratic, exponential), choose the function of that type that best fits given data. 7. Compare linear and exponential growth. 8. Estimate the line of best fit for a given scatterplot; use the line to make predictions.

SAT ® Math Domains

Full *SAT Suite Math Domains* are available in the chat feature.

Skill Exploration:

Locate the SAT **Problem Solving and Data Analysis** Domain.

Review the skills articulated in this section.

Highlight **3-5** skills that you focus on heavily in your curriculum and **1-2** skills that are not addressed in your grade-level curriculum.

What did you discover?

Overview: Math Skills

There are six score ranges for Math: Academic Skills in the Skills Insight document.

6-14

15-19

20-24

25-29

30-34

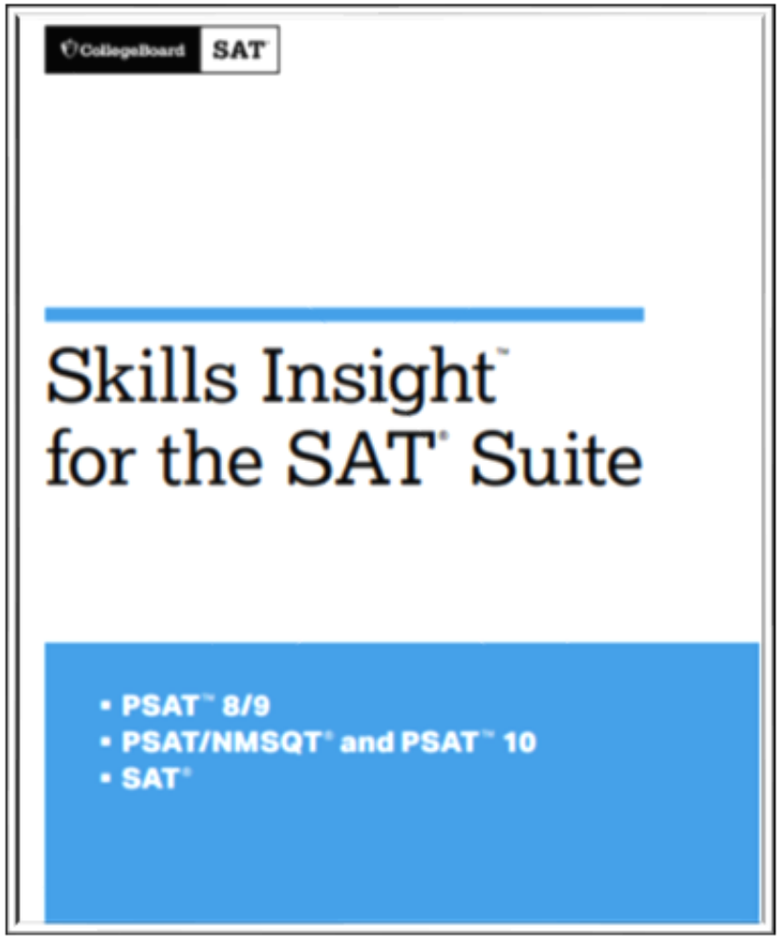
35-40

Reviewing score band 30-34, which would show a student to be college and career ready, shows that a student should typically be able to do the following:

- Create and use linear relationships to solve a problem [HOA]
- Create an inequality in one or two variables that represents a relationship [HOA]
- Interpret terms in linear relationships shown in graphs or in linear equations that are not in standard form or slope-intercept form [HOA]
- Add, subtract, and multiply polynomials using insight into the structure of the polynomial [PAM]
- Solve multistep quadratic equations [PAM]
- Distinguish between linear and exponential models from information provided verbally or in tables [PSD]
- Solve multistep problems involving interpretation of a constant rate of change associated with a percent increase or a percent decrease [PSD]

SAT®
Skills Insight

The Skills Insight document can be found at https://collegereadiness.collegeboard.org/pdf/skills-insight-sat-suite.pdf



Skill Progression

15-19	20-24	25-29	30-34
Create a simple expression in one variable that represents a context.	Create an expression or equation in one variable that models a context.	Solve a linear equation in one variable. Interpret a term from a linear equation in one variable in the form $ax + b = c$.	Determine the conditions under which a linear equation in one variable has no solution, one solution, or infinitely many solutions.

Skill Progression

15-19
Solve problems using area and volume formulas.

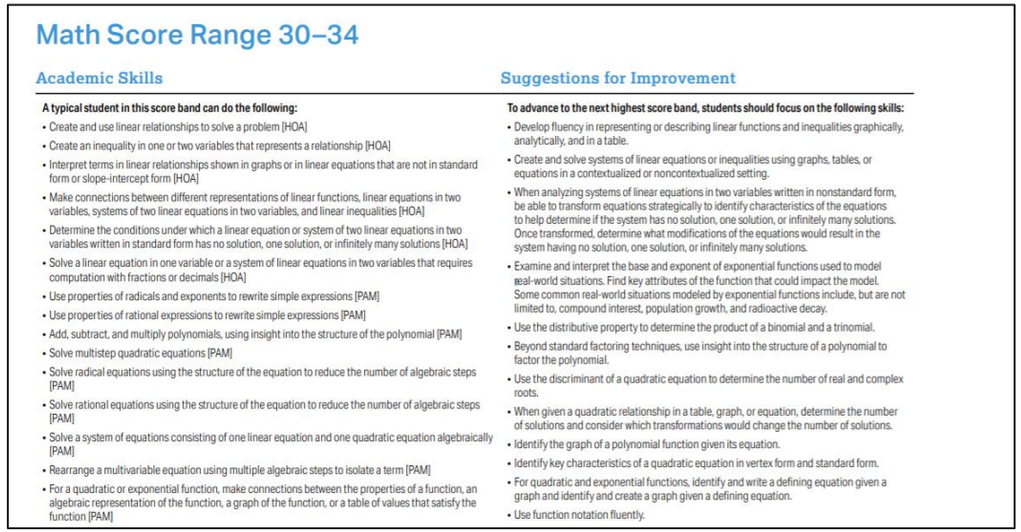
20-24
Solve moderately difficult problems using area and volume formulas.

25-29
Solve very difficult problems using area and volume formulas.

30-34
Solve real-world problems using area and volume formulas, including formulas for circular cylinders and spheres.

Using Skills Insight™ for the SAT® Suite

https://collegereadiness.collegeboard.org/pdf/skills-insight-sat-suite.pdf



Math Score Range 30–34

Academic Skills	Suggestions for Improvement
A typical student in this score band can do the following:	**To advance to the next highest score band, students should focus on the following skills:**
• Create and use linear relationships to solve a problem [HOA]	• Develop fluency in representing or describing linear functions and inequalities graphically, analytically, and in a table.
• Create an inequality in one or two variables that represents a relationship [HOA]	• Create and solve systems of linear equations or inequalities using graphs, tables, or equations in a contextualized or noncontextualized setting.
• Interpret terms in linear relationships shown in graphs or in linear equations that are not in standard form or slope-intercept form [HOA]	• When analyzing systems of linear equations in two variables written in nonstandard form, be able to transform equations strategically to identify characteristics of the equations to help determine if the system has no solution, one solution, or infinitely many solutions. Once transformed, determine what modifications of the equations would result in the system having no solution, one solution, or infinitely many solutions.
• Make connections between different representations of linear functions, linear equations in two variables, systems of two linear equations in two variables, and linear inequalities [HOA]	• Examine and interpret the base and exponent of exponential functions used to model real-world situations. Find key attributes of the function that could impact the model. Some common real-world situations modeled by exponential functions include, but are not limited to, compound interest, population growth, and radioactive decay.
• Determine the conditions under which a linear equation or system of two linear equations in two variables written in standard form has no solution, one solution, or infinitely many solutions [HOA]	• Use the distributive property to determine the product of a binomial and a trinomial.
• Solve a linear equation in one variable or a system of linear equations in two variables that requires computation with fractions or decimals [HOA]	• Beyond standard factoring techniques, use insight into the structure of a polynomial to factor the polynomial.
• Use properties of radicals and exponents to rewrite simple expressions [PAM]	• Use the discriminant of a quadratic equation to determine the number of real and complex roots.
• Use properties of rational expressions to rewrite simple expressions [PAM]	• When given a quadratic relationship in a table, graph, or equation, determine the number of solutions and consider which transformations would change the number of solutions.
• Add, subtract, and multiply polynomials, using insight into the structure of the polynomial [PAM]	• Identify the graph of a polynomial function given its equation.
• Solve multistep quadratic equations [PAM]	• Identify key characteristics of a quadratic equation in vertex form and standard form.
• Solve radical equations using the structure of the equation to reduce the number of algebraic steps [PAM]	• For quadratic and exponential functions, identify and write a defining equation given a graph and identify and create a graph given a defining equation.
• Solve rational equations using the structure of the equation to reduce the number of algebraic steps [PAM]	• Use function notation fluently.
• Solve a system of equations consisting of one linear equation and one quadratic equation algebraically [PAM]	
• Rearrange a multivariable equation using multiple algebraic steps to isolate a term [PAM]	
• For a quadratic or exponential function, make connections between the properties of a function, an algebraic representation of the function, a graph of the function, or a table of values that satisfy the function [PAM]	

The Skills Insight™:

- Demonstrates how the SAT® Suite of Assessments (PSAT™ 8/9, PSAT™ 10, and SAT®) is linked to the knowledge and skills taught in the classroom
- Shows the academic skills typically mastered at each score band
- Provides actionable suggestions for improving skills that help students gain additional practice

Teachers can:

- Use the **Instructional Planning** reports to find the percent of students in each score band
- Develop strategies for improvement

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K-12 Assessment Reporting Portal

K-12 Assessment Reporting Portal

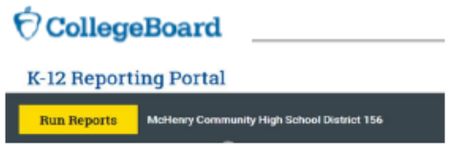
Multiple Levels of Access:

Reports Center – interactive reports showing student progress and performance

- **Summary access** – overall, cohort, and administration data
- **Detailed access** – summary data + individual student data

Reports Available:

- Demographic Report
- Growth Report
- **Instructional Planning Report**
- **Question Analysis Report**
- Roster Report
- Scores and Benchmark Reports
- Summary Report



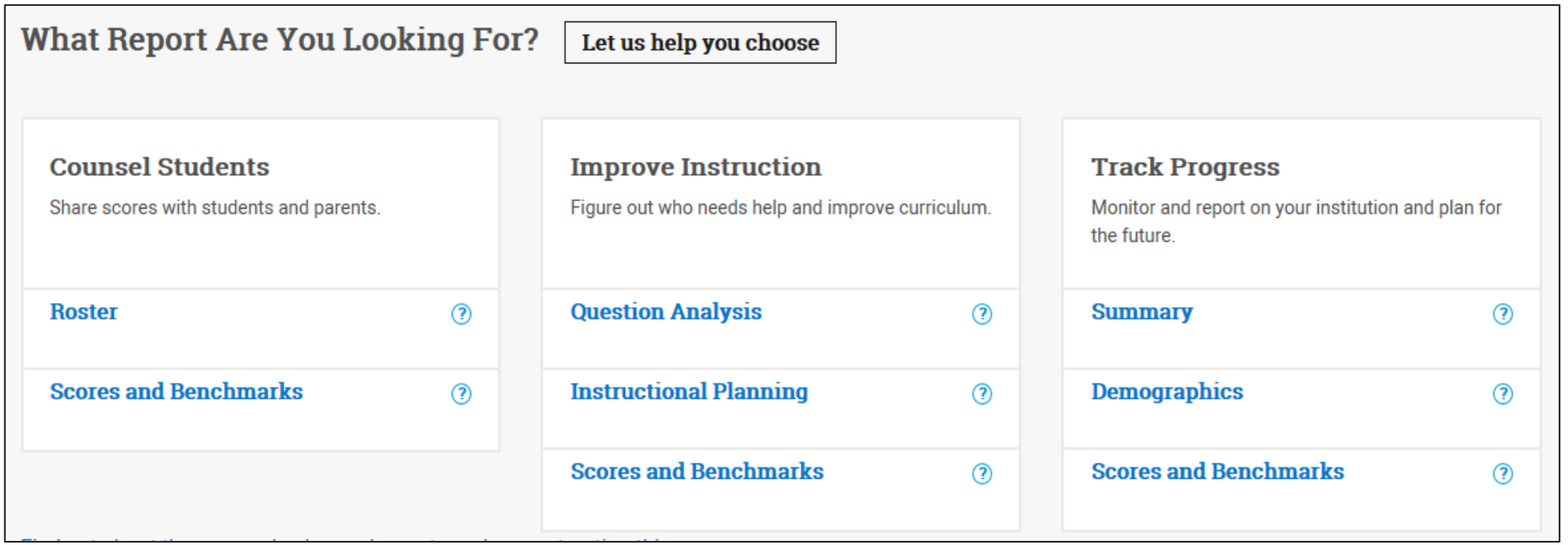
Demographic Report:	• Get a grade-level summary for each test your students took in an academic year. Only data for a test's intended grade is summarized. • **What You'll See** o Your institution's average total and section scores o The percentage of students who met benchmarks o Test taker counts
Growth Report:	• Get a grade-level summary for each test your students took in an academic year. Only data for a test's intended grade is summarized. • **What You'll See** o Your institution's average total and section scores o The percentage of students who met benchmarks o Test taker counts
Instructional Planning Report (IPR):	• Use this report to pinpoint areas of strength and weakness for lesson planning and curriculum improvement. • **What You'll See** o Benchmark data indicating college- and career-readiness in Math and Evidence-Based Reading and Writing o Color-coded test score and subscore ranges showing which skills your students have mastered and which they need to strengthen.
Question Analysis Report (QAR):	• This is a collection of reports that provides multiple choice, and essay score performance, as well as performance against the College and Career Readiness benchmarks. You can view aggregate and student level score performance, and compare overall performance of a school to their district, state, and total group.
Roster Report "Counselor Report":	• Use these reports to see comprehensive data on all tests given in the year you select. • **What You'll See** o Data on all tests in the selected academic year o Participation numbers and fee waiver data o Average scores o Benchmark data o Registration information (SAT only) and scores o Printable admission tickets (SAT only), PDF score reports, and labels o Easy data export to Excel o Access codes and registration numbers to help your students sign in to their online score reports
Scores and Benchmark:	• This is a collection of reports that provides multiple choice, and essay score performance, as well as performance against the College and Career Readiness benchmarks. You can view aggregate and student level score performance, and compare overall performance of a school to their district, state, and total group.
Summary Report:	• Get a grade-level summary for each test your students took in an academic year. Only data for a test's intended grade is summarized. • **What You'll See** o Your institution's average total and section scores o The percentage of students who met benchmarks o Test taker counts

K-12 Assessment Reporting Portal

Centralized, cloud-based portal

Interactive reports to address areas of need for students

Access to portal controlled by school



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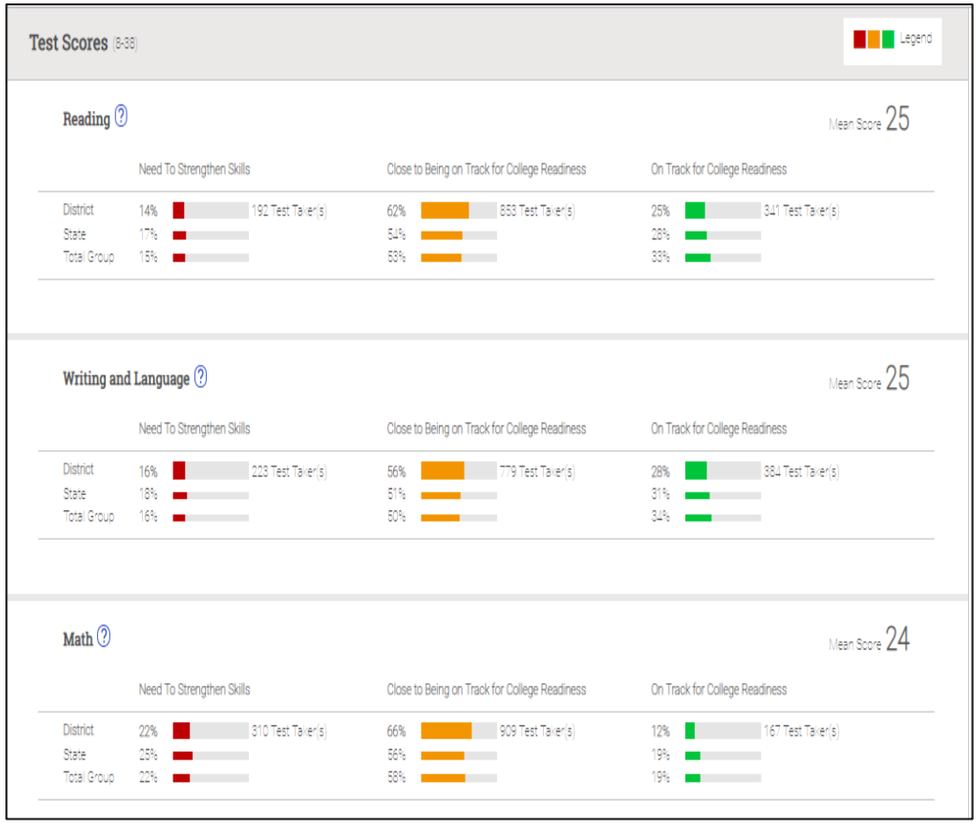
K-12 Assessment Reporting Portal

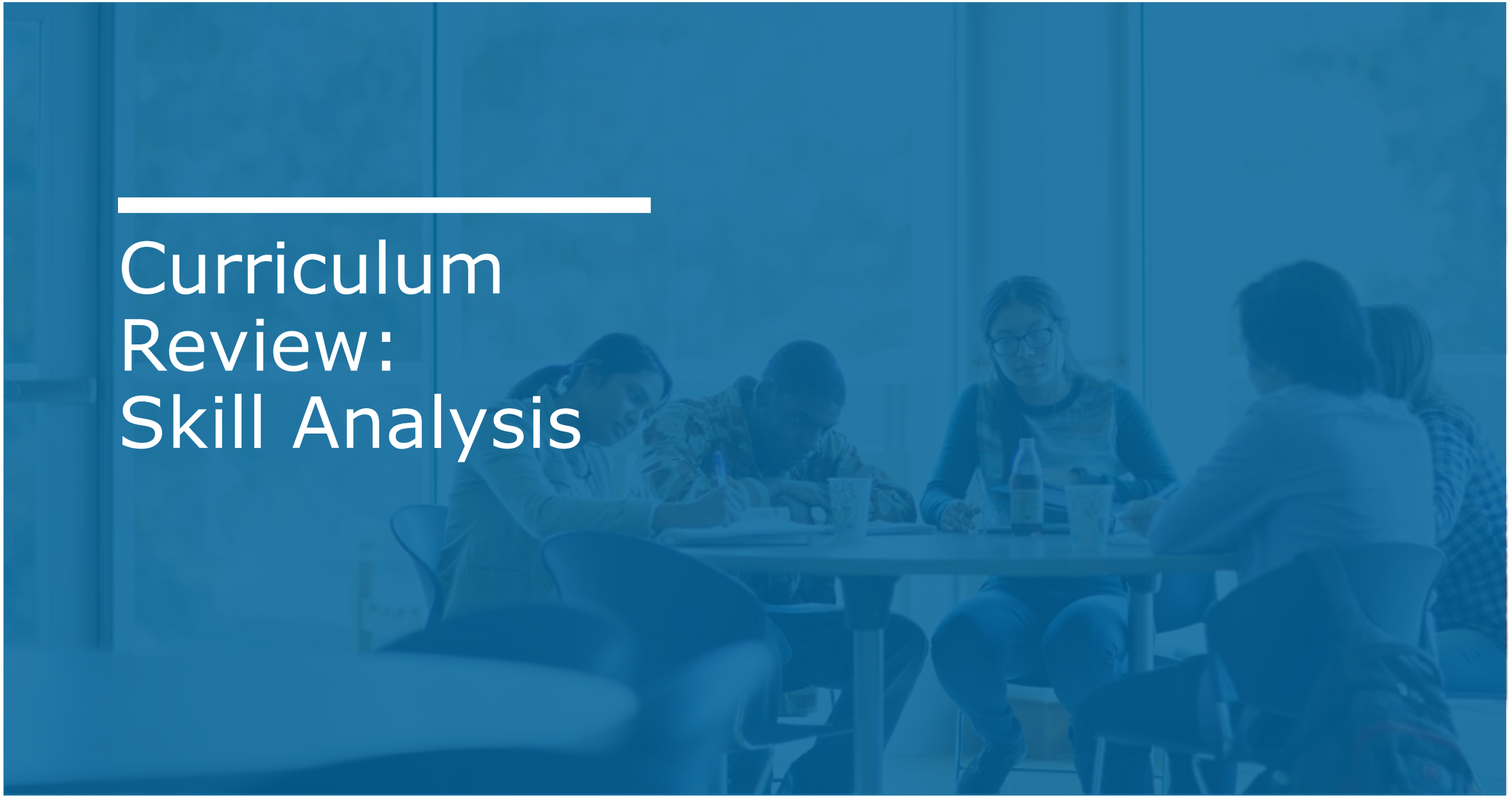
Instructional Planning Report



The instructional planning report may be used to pinpoint areas of strength and areas for growth in lesson planning and curriculum improvement.

In the report, an educator will see benchmark data, including college and career readiness in Math and Evidence-Based Reading and Writing.

Educators will also see color-coded test scores and subscore ranges showing which skills your students have mastered and which ones they need to strengthen.



Curriculum Review: Skill Analysis

How Are Students Performing?

In the spaces below, record the **mean scores** at the school and district level for the Math Test and for the associated subscores.

Instructional Planning Report

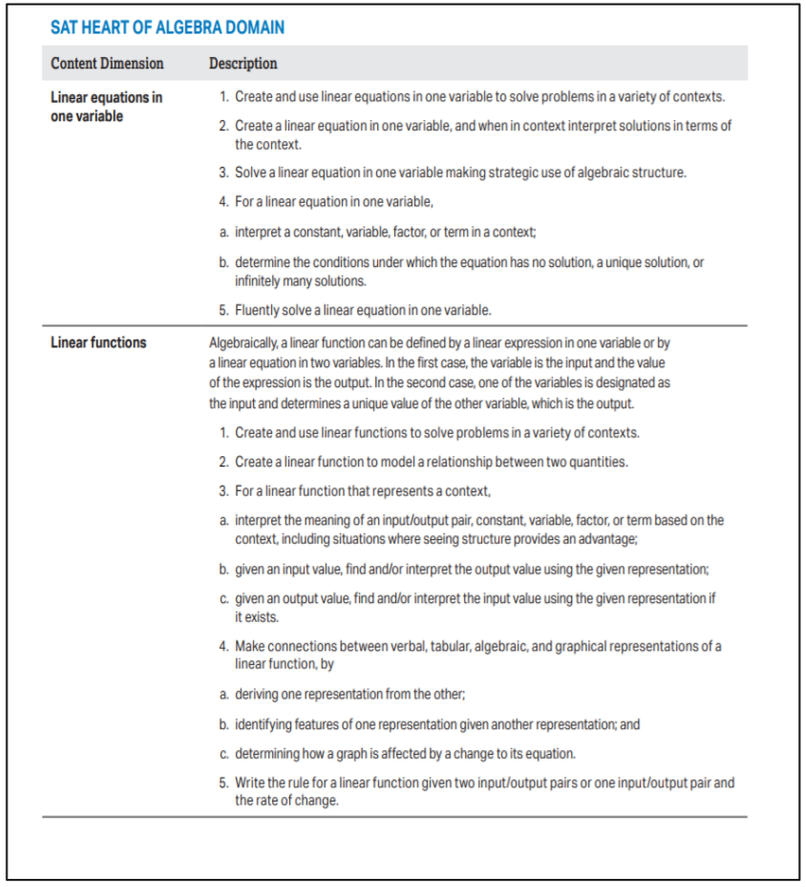
	Math Test	Heart of Algebra	Problem Solving and Data Analysis	Passport to Advanced Math
School				
District				

Linear Equations

Interpretation of Relationships in Charts & Graphs

Geometry

Linear Equations



SAT HEART OF ALGEBRA DOMAIN

Content Dimension	Description
Linear equations in one variable	1. Create and use linear equations in one variable to solve problems in a variety of contexts. 2. Create a linear equation in one variable, and when in context interpret solutions in terms of the context. 3. Solve a linear equation in one variable making strategic use of algebraic structure. 4. For a linear equation in one variable, a. interpret a constant, variable, factor, or term in a context; b. determine the conditions under which the equation has no solution, a unique solution, or infinitely many solutions. 5. Fluently solve a linear equation in one variable.
Linear functions	Algebraically, a linear function can be defined by a linear expression in one variable or by a linear equation in two variables. In the first case, the variable is the input and the value of the expression is the output. In the second case, one of the variables is designated as the input and determines a unique value of the other variable, which is the output. 1. Create and use linear functions to solve problems in a variety of contexts. 2. Create a linear function to model a relationship between two quantities. 3. For a linear function that represents a context, a. interpret the meaning of an input/output pair, constant, variable, factor, or term based on the context, including situations where seeing structure provides an advantage; b. given an input value, find and/or interpret the output value using the given representation; c. given an output value, find and/or interpret the input value using the given representation if it exists. 4. Make connections between verbal, tabular, algebraic, and graphical representations of a linear function, by a. deriving one representation from the other; b. identifying features of one representation given another representation; and c. determining how a graph is affected by a change to its equation. 5. Write the rule for a linear function given two input/output pairs or one input/output pair and the rate of change.

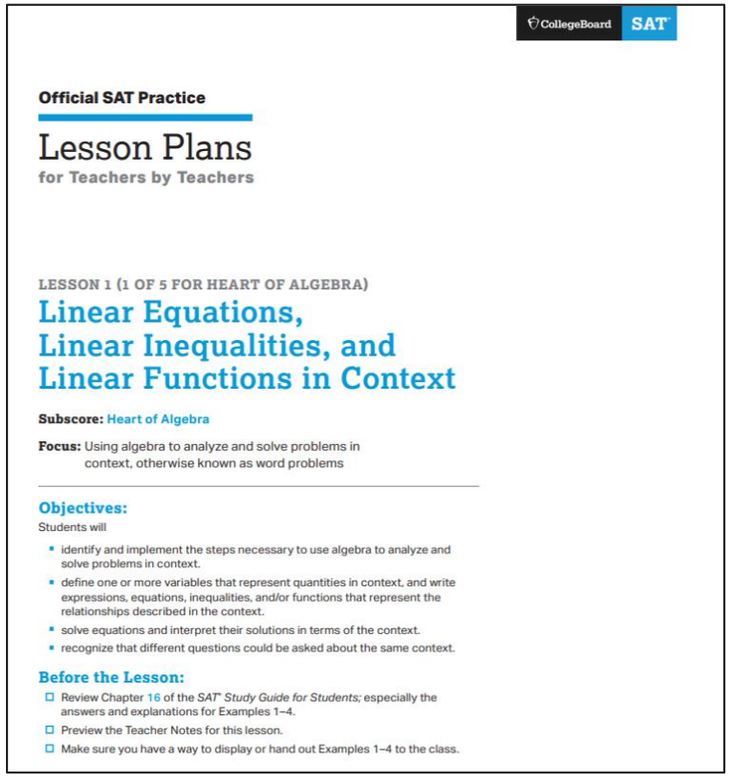
- Linear Equations in One Variable
  - An equation that represents a straight line when graphed in the coordinate plane
- Linear Functions
  - A linear expression or equation in two variables
- Linear Equations in Two Variables
  - Can be used to represent a constraint or condition on two-variable quantities in situations where neither of the variables is regarded as an input or output

Linear Equations

Is this skill/knowledge **explicitly** taught in your curriculum?			Yes	No
Score range	Sub-score	Skill/knowledge	If "yes," in which course(s)/grade level(s) is this skill/knowledge explicitly taught? When are students expected to demonstrate proficiency?	
15–19	HOA	Create a simple expression in one variable that represents a context Evaluate a one-variable expression by substituting a value for the variable		
20–24	HOA	Create an expression or equation in one variable that models a context		
25–29	HOA	Solve a linear equation in one variable Interpret a term from a linear equation in one variable in the form $ax + b = c$		
30–34	HOA	Determine the conditions under which a linear equation in one variable has no solution, one solution, or infinitely many solutions Solve a linear equation in one variable that requires computation with fractions or decimal		
35–40	HOA	Create and solve a linear equation in one variable representing a context, utilizing insight to identify the correct coefficients and constants in the equation Make connections between different representations of linear equations in one variable; these representations often include symbolic representations, which may contain variable constant		

Official SAT® Practice Lesson Plans

https://collegereadiness.collegeboard.org/sat/k12-educators/advising-instruction/official-sat-practice-lesson-plans



CollegeBoard SAT

Official SAT Practice

Lesson Plans

for Teachers by Teachers

LESSON 1 (1 OF 5 FOR HEART OF ALGEBRA)

Linear Equations, Linear Inequalities, and Linear Functions in Context

Subscore: Heart of Algebra

Focus: Using algebra to analyze and solve problems in context, otherwise known as word problems

Objectives:

Students will

- identify and implement the steps necessary to use algebra to analyze and solve problems in context.
- define one or more variables that represent quantities in context, and write expressions, equations, inequalities, and/or functions that represent the relationships described in the context.
- solve equations and interpret their solutions in terms of the context.
- recognize that different questions could be asked about the same context.

Before the Lesson:

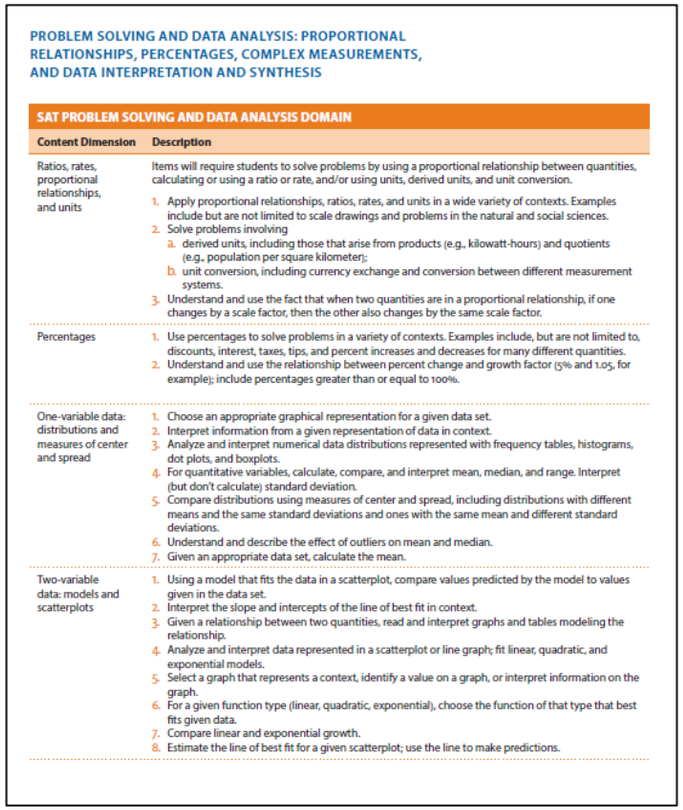
- ☐ Review Chapter 16 of the *SAT® Study Guide for Students;* especially the answers and explanations for Examples 1–4.
- ☐ Preview the Teacher Notes for this lesson.
- ☐ Make sure you have a way to display or hand out Examples 1–4 to the class.

Lesson Plan #1 of 3 for Heart of Algebra

- Objectives:
  - Students will identify and implement the steps necessary to use algebra to analyze and solve problems in context.
  - Students will define one or more variables that represent quantities in context and write expressions, equations, inequalities, and/or functions that represent the relationships described in the context.
  - Students will solve equations and interpret their solutions in terms of the context.
  - Students will recognize that different questions could be asked about the same context.
- Before the Lesson
- Introductory Activity
- Class Discussion
- “On Your Own”
- Mathematical Term Review
- Homework

https://collegereadiness.collegeboard.org/pdf/official-sat-practice-lesson-plan-math-linear-equations-part-one.pdf

Interpretation of Relationships in Charts & Graphs



PROBLEM SOLVING AND DATA ANALYSIS: PROPORTIONAL RELATIONSHIPS, PERCENTAGES, COMPLEX MEASUREMENTS, AND DATA INTERPRETATION AND SYNTHESIS

SAT PROBLEM SOLVING AND DATA ANALYSIS DOMAIN

Content Dimension	Description
Ratios, rates, proportional relationships, and units	Items will require students to solve problems by using a proportional relationship between quantities, calculating or using a ratio or rate, and/or using units, derived units, and unit conversion. 1. Apply proportional relationships, ratios, rates, and units in a wide variety of contexts. Examples include but are not limited to scale drawings and problems in the natural and social sciences. 2. Solve problems involving a. derived units, including those that arise from products (e.g., kilowatt-hours) and quotients (e.g., population per square kilometer); b. unit conversion, including currency exchange and conversion between different measurement systems. 3. Understand and use the fact that when two quantities are in a proportional relationship, if one changes by a scale factor, then the other also changes by the same scale factor.
Percentages	1. Use percentages to solve problems in a variety of contexts. Examples include, but are not limited to, discounts, interest, taxes, tips, and percent increases and decreases for many different quantities. 2. Understand and use the relationship between percent change and growth factor (5% and 1.05, for example); include percentages greater than or equal to 100%.
One-variable data: distributions and measures of center and spread	1. Choose an appropriate graphical representation for a given data set. 2. Interpret information from a given representation of data in context. 3. Analyze and interpret numerical data distributions represented with frequency tables, histograms, dot plots, and boxplots. 4. For quantitative variables, calculate, compare, and interpret mean, median, and range. Interpret (but don't calculate) standard deviation. 5. Compare distributions using measures of center and spread, including distributions with different means and the same standard deviations and ones with the same mean and different standard deviations. 6. Understand and describe the effect of outliers on mean and median. 7. Given an appropriate data set, calculate the mean.
Two-variable data: models and scatterplots	1. Using a model that fits the data in a scatterplot, compare values predicted by the model to values given in the data set. 2. Interpret the slope and intercepts of the line of best fit in context. 3. Given a relationship between two quantities, read and interpret graphs and tables modeling the relationship. 4. Analyze and interpret data represented in a scatterplot or line graph; fit linear, quadratic, and exponential models. 5. Select a graph that represents a context, identify a value on a graph, or interpret information on the graph. 6. For a given function type (linear, quadratic, exponential), choose the function of that type that best fits given data. 7. Compare linear and exponential growth. 8. Estimate the line of best fit for a given scatterplot; use the line to make predictions.

Make an accurate, somewhat subtle or complex interpretation of data in an informational graphic, such as a table, graph, or chart.

For example, a student will compare results in terms of two variables or will recognize an implication of values as represented on a table.

Two-Variable Data: Models & Scatterplots

Is this skill/knowledge **explicitly** taught in your curriculum?			Yes	No
Score range	Sub-score	Skill/knowledge	If "yes," in which course(s)/grade level(s) is this skill/knowledge explicitly taught? When are students expected to demonstrate proficiency?	
15–19	PSD	Read information presented in simple tables of simple graphs		
20–24	PSD	Read and interpret contextual information presented in a graph or table Identify the shape of a graph from a verbal description of some of its points Use information about a directly proportional relationship to describe the graph of the relationship		
25–29	PSD	Interpret the association shown by a scatterplot and, when applicable, use a line of best fit to make prediction Identify a graph of a nonlinear relationship between two variables based on a verbal description Evaluate a conclusion about information presented in a graph Recognize common characteristics of linear or exponential models based on a verbal description of a situation		

Two-Variable Data: Models & Scatterplots (continued)

30–34	PSD	Analyze data presented in a scatterplot and draw conclusions from the trend shown Identify the equation of a line that best fits the data in a scatterplot Identify an appropriate inference or conclusion based on information from a graph or table Distinguish between linear and exponential models from information provided verbally or in tables	
35–40	PSD	Analyze complex data displays Analyze graphs of nonlinear relationships between two quantities, including relationships that are not represented by a linear, quadratic, or exponential equation Use scatterplots to make predictions	

Official SAT® Practice Lesson Plans

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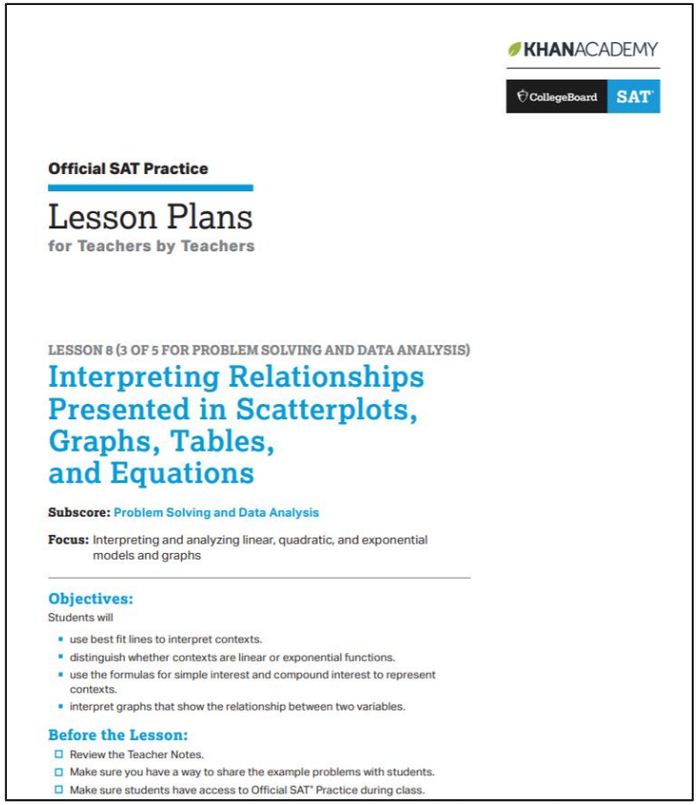

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Lesson Plans

for Teachers by Teachers

LESSON 8 (3 OF 5 FOR PROBLEM SOLVING AND DATA ANALYSIS)

Interpreting Relationships Presented in Scatterplots, Graphs, Tables, and Equations

Subscore: Problem Solving and Data Analysis

Focus: Interpreting and analyzing linear, quadratic, and exponential models and graphs

Objectives:

Students will

- use best fit lines to interpret contexts.
- distinguish whether contexts are linear or exponential functions.
- use the formulas for simple interest and compound interest to represent contexts.
- interpret graphs that show the relationship between two variables.

Before the Lesson:

- ☐ Review the Teacher Notes.
- ☐ Make sure you have a way to share the example problems with students.
- ☐ Make sure students have access to Official SAT™ Practice during class.

Lesson #3 of 5 for Problem Solving & Data Analysis

- Objectives:
  - Students will use best fit lines to interpret contexts.
  - Students will distinguish whether contexts are linear or exponential functions.
  - Students will use the formulas for simple interest and compound interest to represent contexts.
  - Students will interpret graphs.
- Before the Lesson
- Introductory Activity
- Class Discussion
- “On Your Own”
- Mathematical Term Review
- Homework

https://collegereadiness.collegeboard.org/pdf/official-sat-practice-lesson-plan-math-interpreting-relationships.pdf

Geometry

ADDITIONAL TOPICS IN MATH

SAT ADDITIONAL TOPICS IN MATH DOMAIN

Content Dimension	Description
Area and volume	1. Solve real-world and mathematical problems about a geometric figure or an object that can be modeled by a geometric figure using given information such as length, area, surface area, or volume. a. Apply knowledge that changing by a scale factor of k changes all lengths by a factor of k, changes all areas by a factor of k^2, and changes all volumes by a factor of k^3. b. Demonstrate procedural fluency by selecting the correct area or volume formula and correctly calculating a specified value.
Lines, angles, and triangles	1. Use concepts and theorems relating to congruence and similarity of triangles to solve problems. 2. Determine which statements may be required to prove certain relationships or to satisfy a given theorem. 3. Apply knowledge that changing by a scale factor of k changes all lengths by a factor of k, but angle measures remain unchanged. 4. Know and directly apply relevant theorems such as a. the vertical angle theorem; b. triangle similarity and congruence criteria; c. triangle angle sum theorem; d. the relationship of angles formed when a transversal cuts parallel lines.
Right triangles and trigonometry	1. Solve problems in a variety of contexts using a. the Pythagorean theorem; b. right triangle trigonometry; c. properties of special right triangles. 2. Use similarity to calculate values of sine, cosine, and tangent. 3. Understand that when given one side length and one acute angle measure in a right triangle, the remaining values can be determined. 4. Solve problems using the relationship between sine and cosine of complementary angles. 5. Fluently apply properties of special right triangles to determine side lengths and calculate trigonometric ratios of 30, 45, and 60 degrees.
Circles	1. Use definitions, properties, and theorems relating to circles and parts of circles, such as radii, diameters, tangents, angles, arcs, arc lengths, and sector areas, to solve problems. 2. Solve problems using a. radian measure; b. trigonometric ratios in the unit circle. 3. Create an equation to represent a circle in the xy-plane. 4. Describe how a. a change to the equation representing a circle in the xy-plane affects the graph of the circle; b. a change in the graph of the circle affects the equation of the circle. 5. Understand that the ordered pairs that satisfy an equation of the form $(x-h)^2+(y-k)^2=r^2$ form a circle when plotted in the xy-plane. 6. Convert between angle measures in degrees and radians. 7. Complete the square in an equation representing a circle to determine properties of the circle when it is graphed in the xy-plane, and use the distance formula in problems related to circles.
Complex numbers	1. Apply knowledge and understanding of the complex number system to add, subtract, multiply, and divide with complex numbers and solve problems.

On the Math Test, questions that require geometry-based skills and abilities take various forms:

- Questions may provide a figure and ask students to use geometric properties to find missing information.
- Questions may provide given information and ask the student to identify another statement that must be true.

Area and Volume

Is this skill/knowledge **explicitly** taught in your curriculum?			Yes	No
Score range	Sub-score	Skill/knowledge	If "yes," in which course(s)/grade level(s) is this skill/knowledge explicitly taught? When are students expected to demonstrate proficiency?	
15–19		Solve problems using area and volume formulas		
20–24		Solve moderately difficult problems using area and volume formulas		
25–29		Solve very difficult problems using area and volume formulas		
30–34		Solve real-world problems using area and volume formulas, including formulas for circular cylinders and spheres		
35–40		Solve area or volume problems by applying standard formulas to objects that can be modeled by rectangles, circles, triangles, right rectangular prisms, and right circular prisms		

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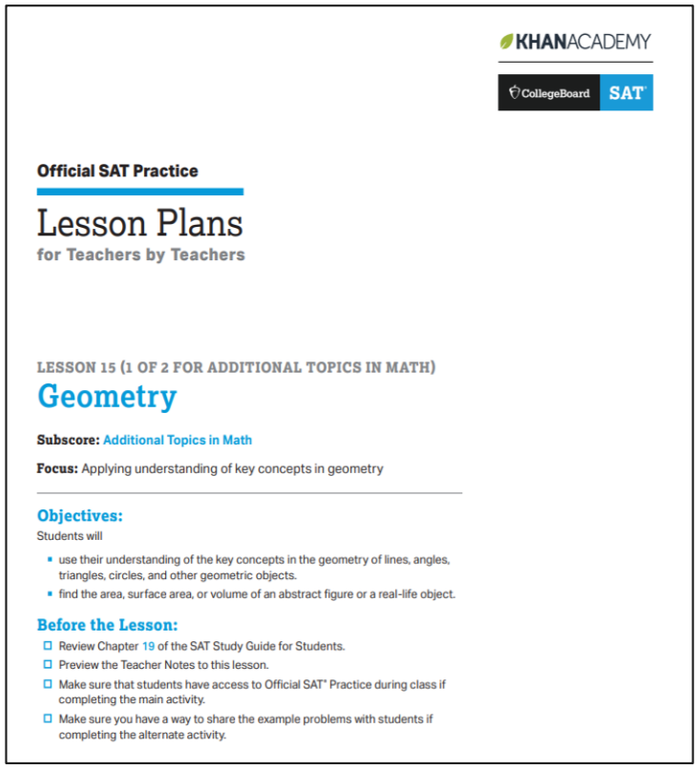

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for Teachers by Teachers

LESSON 15 (1 OF 2 FOR ADDITIONAL TOPICS IN MATH)

Geometry

Subscore: Additional Topics in Math

Focus: Applying understanding of key concepts in geometry

Objectives:

Students will

- use their understanding of the key concepts in the geometry of lines, angles, triangles, circles, and other geometric objects.
- find the area, surface area, or volume of an abstract figure or a real-life object.

Before the Lesson:

- ☐ Review Chapter 19 of the SAT Study Guide for Students.
- ☐ Preview the Teacher Notes to this lesson.
- ☐ Make sure that students have access to Official SAT® Practice during class if completing the main activity.
- ☐ Make sure you have a way to share the example problems with students if completing the alternate activity.

Lesson #1 of 2 for Additional Topics in Math

- Objective:
  - Students will use their understanding of the key concepts in the geometry of lines, angles, triangles, circles, and other geometric objects.
  - Students will find the area, surface area, or volume of an abstract figure or a real-life object.
- Before the Lesson
- Introductory Activity
- Class Discussion
- “On Your Own”
- Mathematical Term Review
- Homework

https://collegereadiness.collegeboard.org/pdf/official-sat-practice-lesson-plan-math-geometry.pdf

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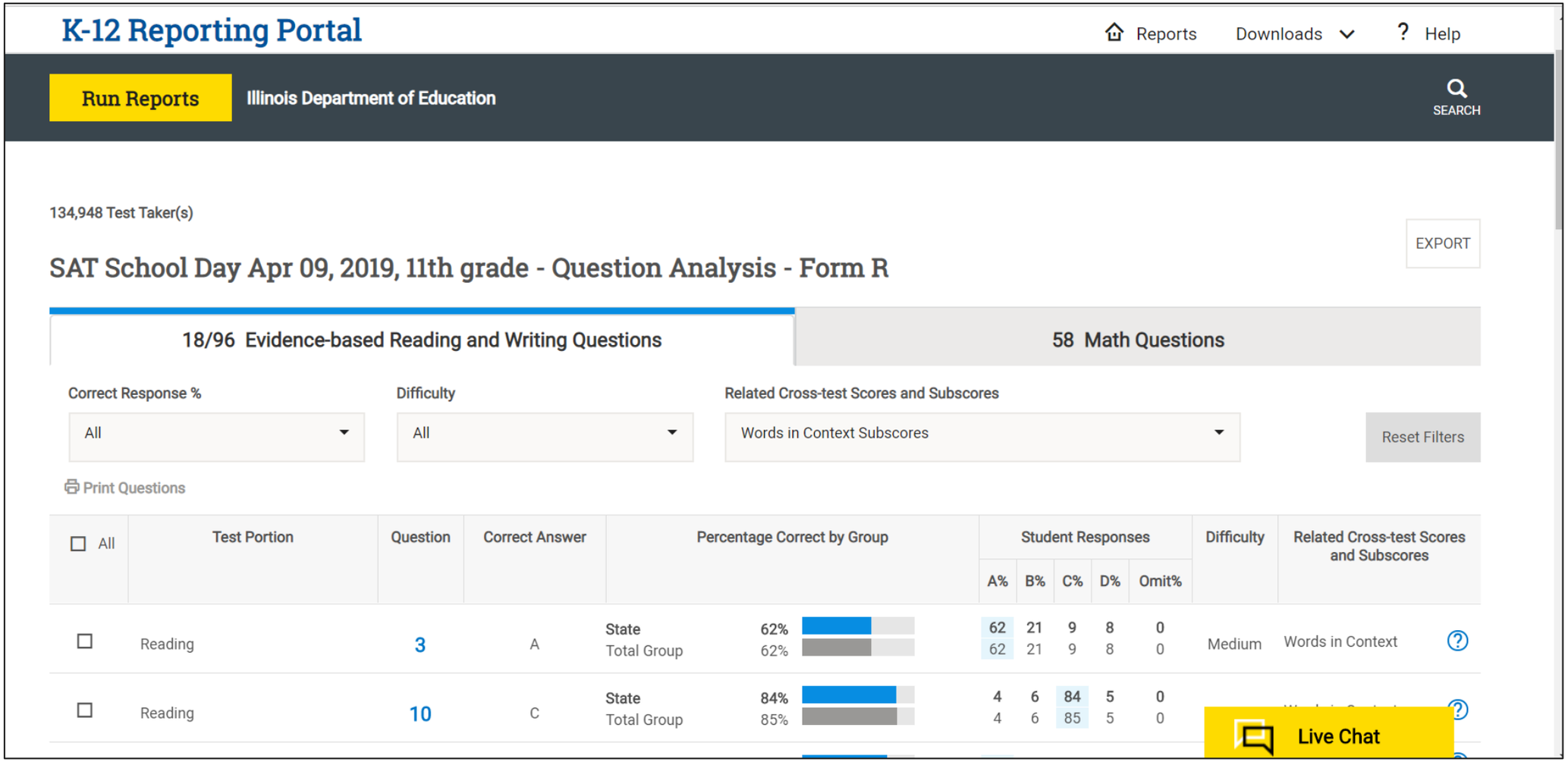
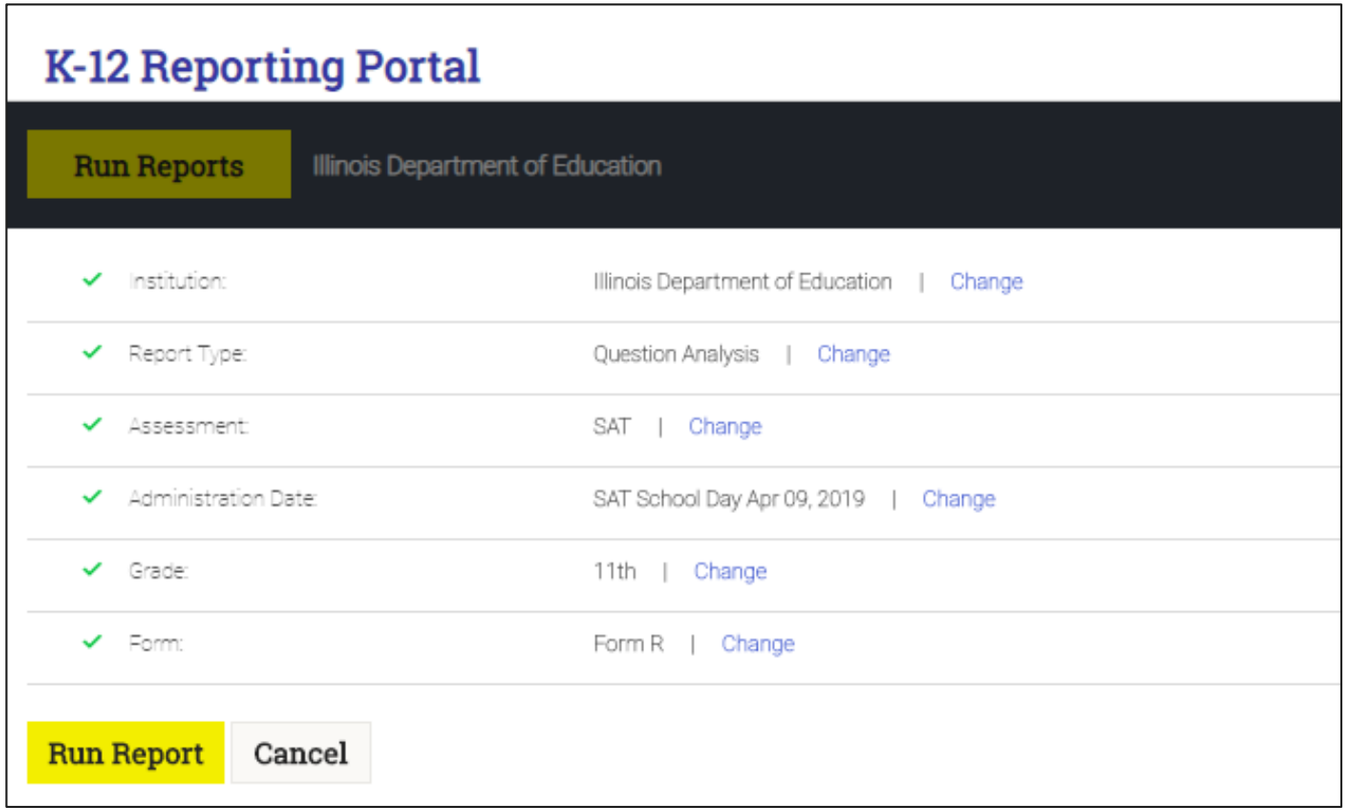
Question Analysis Report

Question Analysis Report



Question Analysis Report



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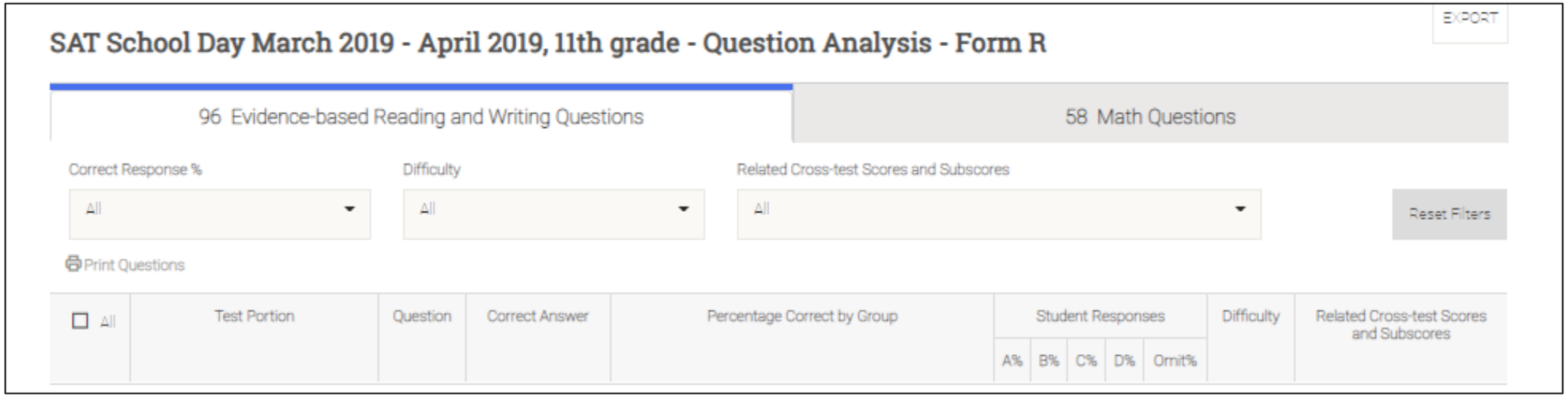

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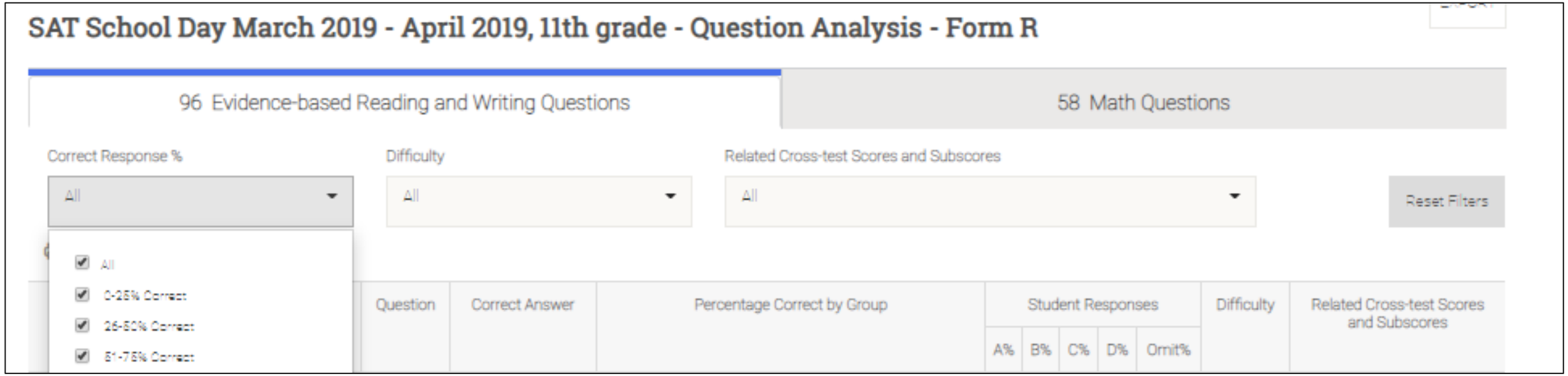

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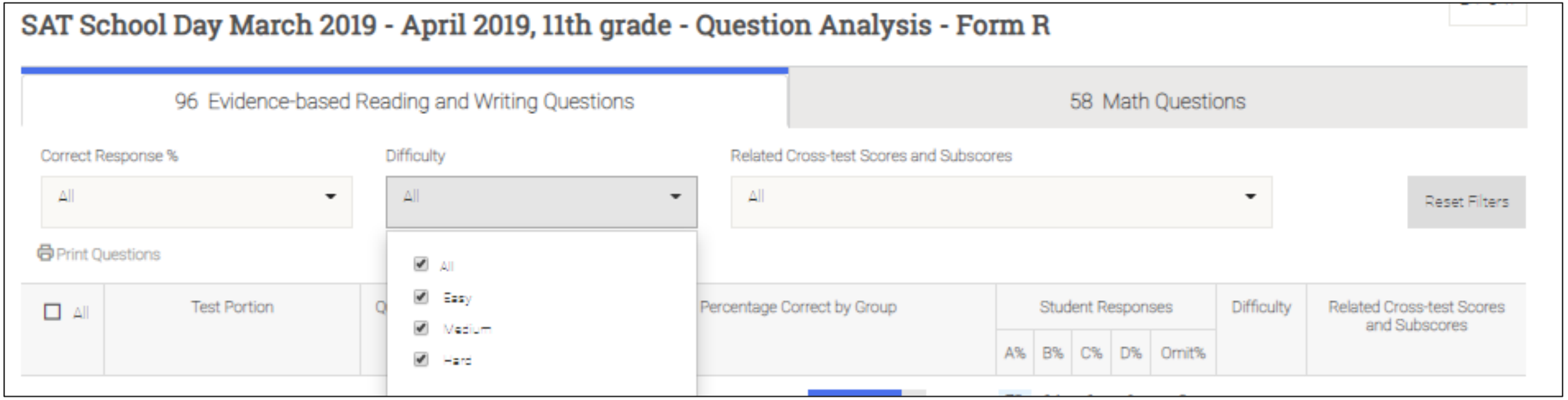

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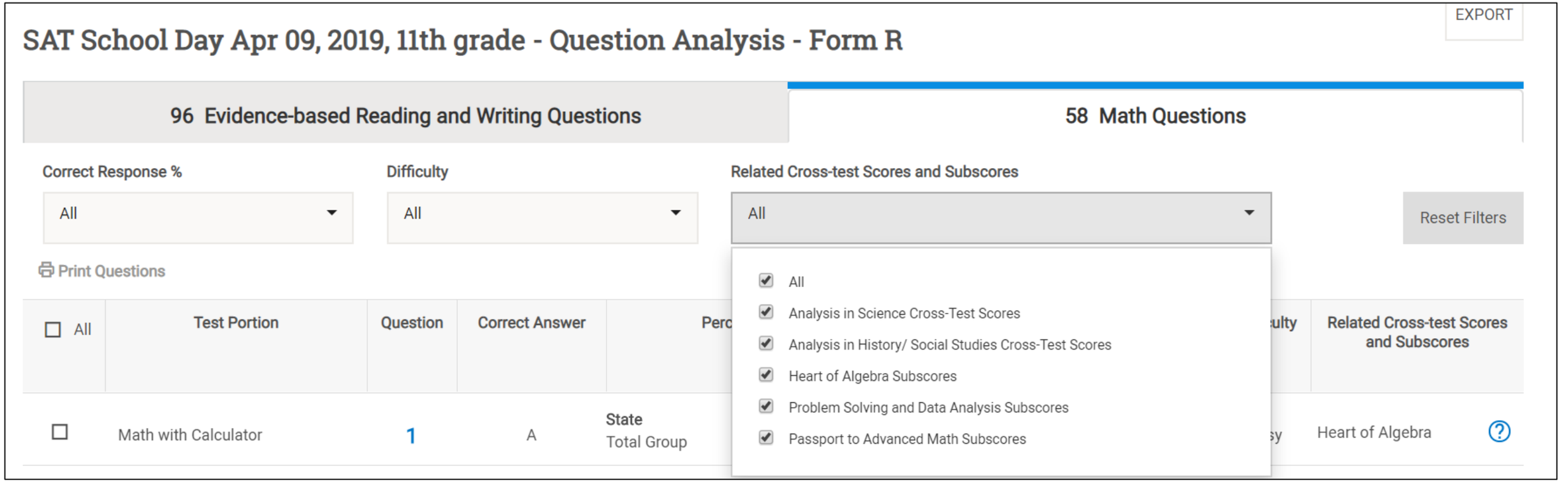

Question Analysis Report

Heart of Algebra

This component of the SAT focuses on the assessment of students' skills with linear equations and systems of linear equations. The Heart of Algebra score is the number of questions you answered correctly converted to a scale score. It is a separately scaled score and is not used to compute other scores.

Related Standards:

A-REI.12	A-REI.6	G-GPE.5
8.EE.7	A-SSE.1	F-IF.9
F-IF.7	F-IF.1	A-REI.10
F-LE.1	F-BF.1	A-CED.1
F-IF.4	F-IF.6	A-REI.3
F-IF.2	F-LE.5	F-BF.3
F-LE.2	S-ID.7	A-SSE.2
A-CED.2	A-CED.3	F-IF.5

See Standards

Question Analysis Report

Print

Heart of Algebra

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F-BF.1	A-CED.1	F-IF.4	F-IF.6	A-REI.3	F-IF.2	F-LE.5	F-BF.3	F-LE.2	S-ID.7
A-SSE.2	A-CED.2	A-CED.3	F-IF.5						

A-REI.12

12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Item Analysis: Linear Equations

Math Test
Heart of Algebra

Spring 2019 – PSAT™ 8/9

Question Difficulty:

Medium

With Calculator

22 If $x-1=5$, what is the value of $8x-8$?

The correct answer is 40. Multiplying both sides of $x-1=5$ by 8 yields $8(x-1)=5(8)$, or $8x-8=40$.

Math Test
Heart of Algebra

Spring 2019 – PSAT™ 10

Question Difficulty:

Medium

Without Calculator

11

$$2x + 7y = 9$$
$$8x + 28y = a$$

In the given system of equations, a is a constant. If the system has infinitely many solutions, what is the value of a ?

A. 4

B. 9

C. 36

D. 54

Choice C is correct. A system of two linear equations has infinitely many solutions if one equation is equivalent to the other. This means that when the two equations are written in the same form, each coefficient or constant in one equation is equal to the corresponding coefficient or constant in the other equation multiplied by the same number. The equations in the given system of equations are written in the same form, with x and y on the left-hand side of the equation and a constant on the right-hand side of the equation. The coefficients of x and y in the second equation are equal to the coefficients of x and y, respectively, in the first equation multiplied by 4: $8 = 2(4)$ and $28 = 7(4)$. Therefore, the constant in the second equation must be equal to 4 times the constant in the first equation: $a = 9(4)$, or $a = 36$.

Choices A, B, and D are incorrect. When $a = 4$, $a = 9$, or $a = 54$, the given system of equations has no solution.

Math Test
Heart of Algebra

Spring 2019 – SAT ®

Question Difficulty:

Medium

Without Calculator

9 For a ride, a taxi driver charges an initial fare of $3.00 plus $0.40 for each $\frac{1}{5}$ of a mile driven. If the total charge for a ride is $27.00, what is the distance traveled, in miles?

A. 3

B. 8

C. 12

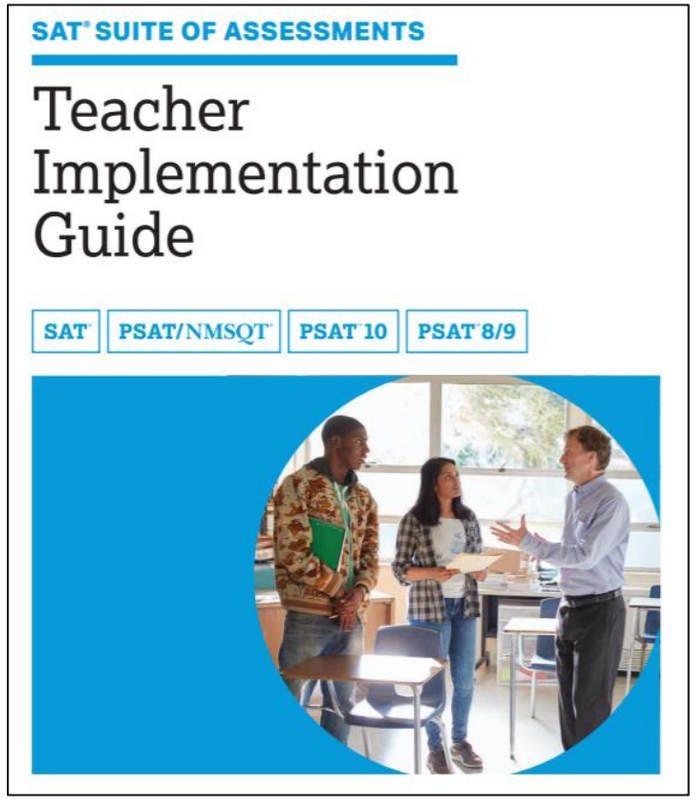
D. 15

Choice C is correct. It's given that the taxi driver charges an initial fare of $3.00 plus $0.40 for each $\frac{1}{5}$ of a mile driven and that the total charge for the ride was $27.00. The rate given of $0.40 for each $\frac{1}{5}$ of a mile driven is equivalent to charging $\$0.40(5)$, or $2.00, for each mile. If m is the number of miles driven, then the term $2.00m$ represents the amount charged for the miles driven. This plus the initial fare of $3.00 must equal the total charge for the ride ($27.00). Thus, $3.00+2.00m=27.00$. Subtracting 3.00 from both sides of this equation yields $2.00m=24.00$. Dividing both sides of this equation by 2.00 yields $m=12$. Therefore, the distance traveled is 12 miles.

Choice A is incorrect. This is the value of the initial fare, not the distance traveled. Choices B and D are incorrect and may result from not setting up the equation correctly or from making calculation errors.

Instructional Strategies

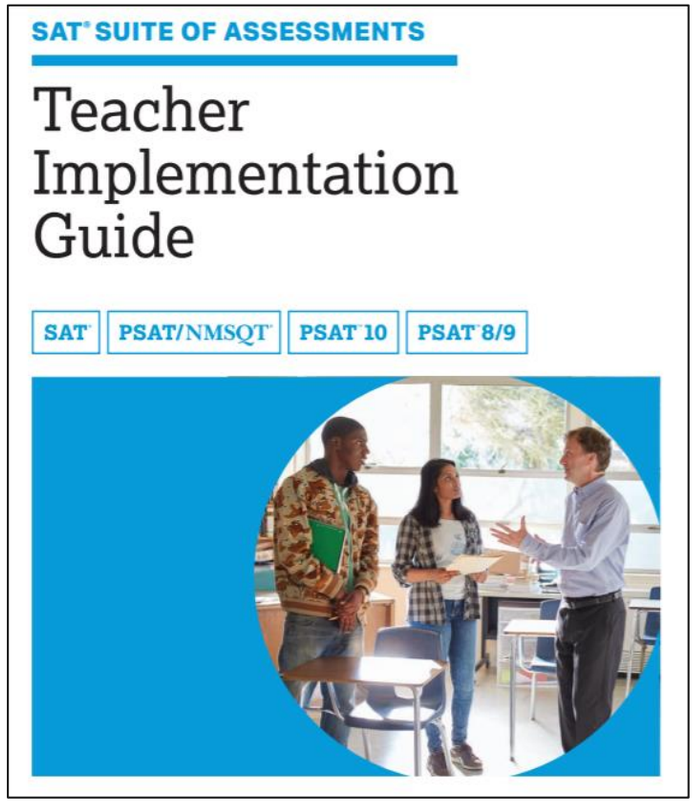
General Math Strategies



Instructional Strategies for Math:

- Ensure that students practice solving multistep problems.
- Encourage students to express quantitative relationships in meaningful words and sentences to support their arguments and conjectures.
- Separate students into small working groups. Ask them to discuss how to arrive at solutions.
- Vary the types of problems in assignments so that students aren't always using the same strategy to find solutions.
- Assign students math problems or create classroom-based assessments that do not allow the use of a calculator.
- Develop interest and facility in math by providing frequent opportunities for students to interpret and apply mathematical skills and concepts in real-world contexts, particularly in the sciences and social studies.

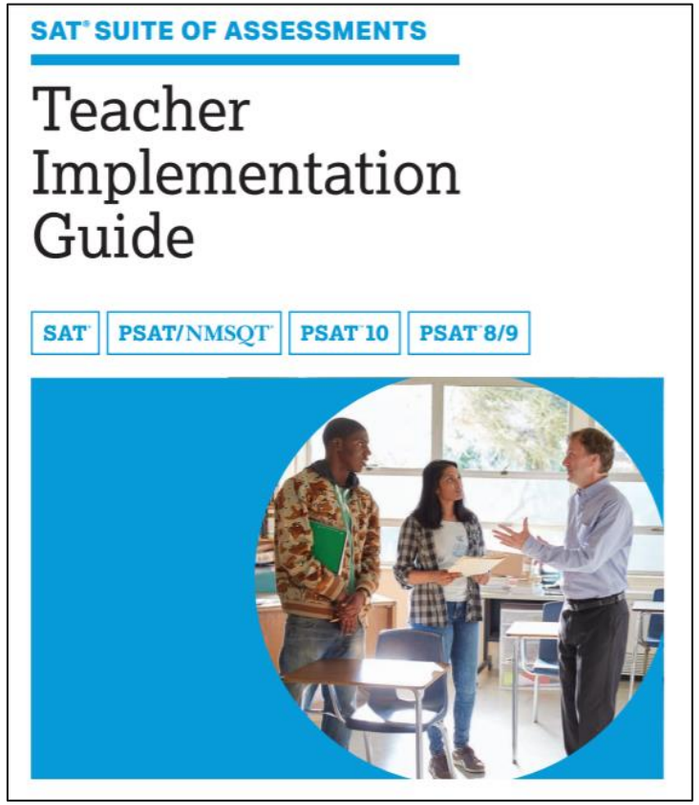
Math: Skill-Building Strategies



Skill-Building Strategies for Math:

- Provide students with explanations and/or equations that incorrectly describe a graph.
- Ask students to create pictures, tables, graphs, lists, models, and/or verbal expressions to interpret text and/or data to help them arrive at a solution.
- Ask students to solve problems that require multiple steps to arrive at the solution.
- Facilitate discussions in which students communicate their own thinking and critique the reasoning of others as they work toward a solution.
- Ask open-ended questions.
- Direct students' attention to real-world situations to provide context for the problem.

Math: Skill-Building Strategies



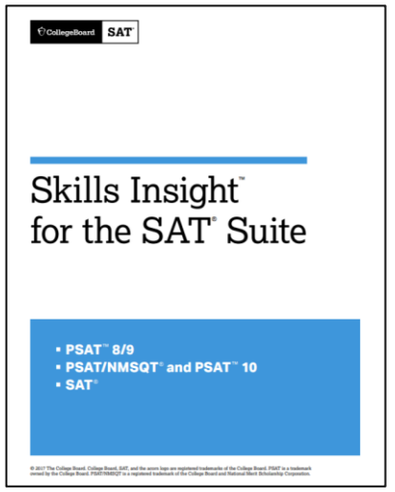
Skill-Building Strategies for Math (continued)

- Help students strengthen their skills in problem solving and data analysis by reading and understanding graphs in many contexts.
- Challenge students to dig deep into the data and the purpose of the graphic, and then ask meaningful questions about it.
- Provide opportunities for students to present purposely incorrect interpretations, and then ask the class to correct their analyses.
- Use “Guess and Check” to explore different ways to solve a problem when other strategies for solving are not obvious.
- Assign math problems for students to solve without the use of a calculator.
- Assign problems for which the calculator is actually a deterrent to expedience, and give students the choice whether to utilize the calculator.

Instructional Strategy Supports

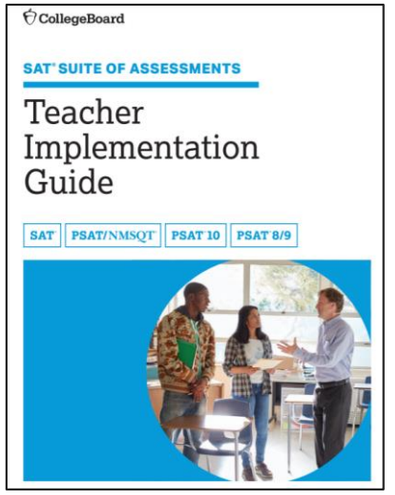
Skills Insight

Educators can use Skills Insight to see the academic skills typically mastered at each score band and develop strategies for improvement. It also provides actionable suggestions for improving skills that help students gain additional practice.



Teacher Implementation Guide

The Teacher Implementation Guide has been created for teachers and curriculum specialists to generate ideas about integrating SAT ® practice and skill development into challenging coursework through curriculum and instruction.



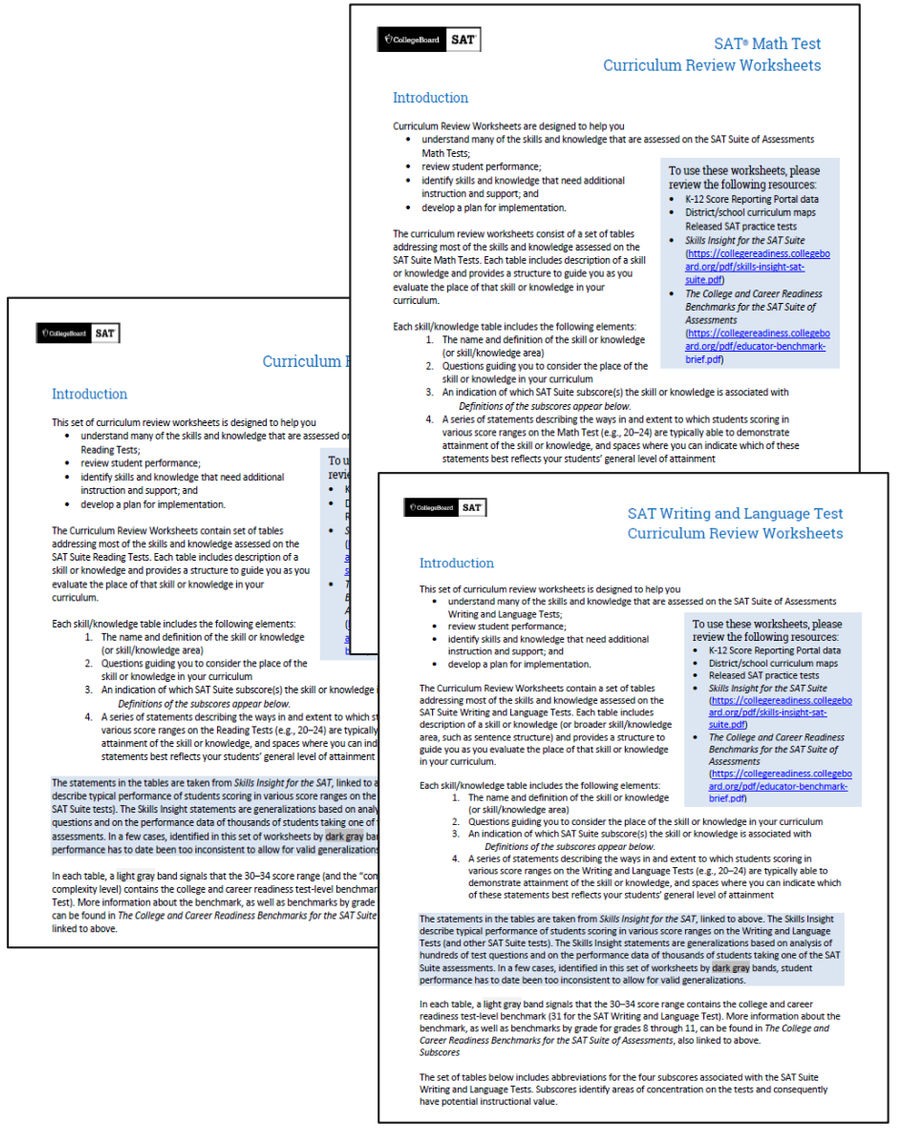
Curriculum Worksheets

The curriculum review worksheets are designed to help teachers

- understand many of the skills and knowledge that are assessed on the PSAT™ 8/9, PSAT™ 10, and SAT®;
- review student performance;
- identify skills and knowledge that need additional instruction and support; and
- develop a plan for implementation.

The curriculum review worksheets contain sets of tables addressing most of the skills and knowledge assessed on the PSAT™ 8/9, PSAT™ 10, and SAT® (Reading, Writing & Language, and Math Tests).

Each table includes a description of a skill or knowledge and provides a structure to guide educators to evaluate the placement of that skill or knowledge within the curriculum.


SAT® Math Test
Curriculum Review Worksheets

Introduction

SAT Writing and Language Test
Curriculum Review Worksheets

Introduction

Thank you!

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