Family Guides to Support Learning

ABOUT THIS GUIDE

Parents and caregivers want their teens to succeed in school – to be engaged and excited about learning; to build strong relationships with their teachers and peers; and to learn each year the knowledge and skills they need to be successful academically.

But it hasn't always been easy for parents and caregivers to figure out what teens should know and be able to do by the end of each grade – and how to discuss these topics with their children and their teachers.

Moreover, while families are usually able to help if kids get stuck in the early grades, the content gets more challenging as students get older, and students gain more ownership over their learning. Suddenly, parents and caregivers may feel like they don't have much help to offer. But that's not the case. Research confirms that families still have a big role to play in helping students learn. It's just a different role.

In addition to providing encouragement, a study of more than 50,000 students found that relating what middle and high school kids are learning in school to their future life goals is one of the most effective ways families can help. What doesn't work? Trying to be directly involved with schoolwork. It can feel to high school students like you're interfering or even confusing them. And this IS the time to encourage students to take more responsibility and be more independent; helping them take charge of their learning is important.

This Guide was developed so students and their families understand the most important math content and skills that students should learn in high school.

[i]Harvard Graduate School of Education (2009). Hill: Parents need to link schoolwork to future goals. http://www.gse.harvard.edu/news/09/05/hill-parents-need-link-schoolwork-future-goals.
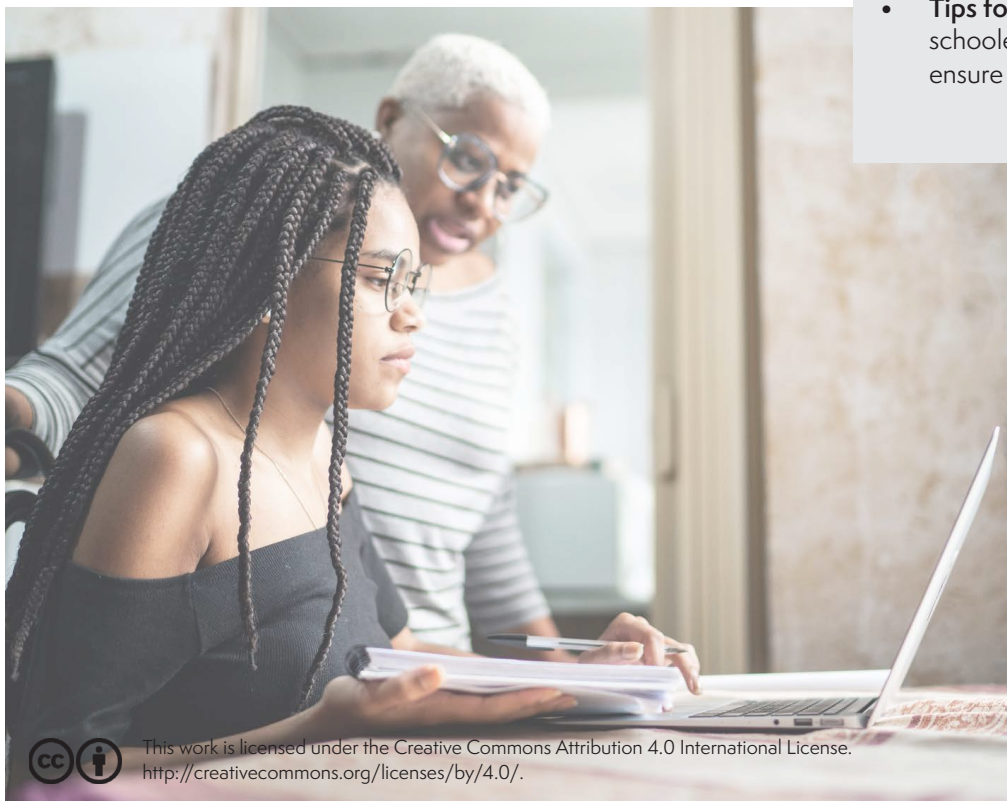
HIGH SCHOOL
Math

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Every child, every chance, every day.

THIS GUIDE INCLUDES

- **What High Schoolers Are Learning** – What experts say is the most important content (knowledge and skills) for students to learn in math during high school – and a few internet resources to help learn it.

- **Talking About Math with your High Schooler** – Ideas for families and their teens to talk about school.

- **Tips for Talking with Teachers** – How high schoolers, parents, and teachers can work together to ensure success.

STUDENT ACHIEVEMENT PARTNERS

INTEGRATED COURSE SEQUENCE

INTEGRATED MATH I: WHAT HIGH SCHOOLERS ARE LEARNING

Students taking Math I will spend the most time working on the following topics. By the end of the year, they should understand the topics well to provide a foundation for success in additional coursework and as preparation for both college and career.

- Creating equations and **systems of equations** to solve problems in context. For example, on June 21st, the day was four and a half hours longer than the previous night. How long was the previous night? Present the steps clearly and logically so that your classmates can follow along with your solution.

- Creating, analyzing, and applying functions. This work involves using equations, graphs, and tables that represent functions in different ways. The emphasis is on **linear** and **exponential functions.**

- Reasoning **quantitatively** and using units to solve problems. For example, a nurse needs to know how much of a medicine to give a child who weighs 10 kg. The child should receive 25 mg of medicine for each kg of body weight. The medicine is packaged in bottles of liquid with 750 mg of medicine per 15 ml of liquid. How many ml of liquid should the child receive?

- Interpreting and comparing **shape, center** and **spread** of realistic data sets to summarize, represent, and interpret **categorical** and **quantitative data.**

- Understanding **congruence** and **similarity** in terms of plane **transformation.** Using **congruence** and **similarity** concepts to prove theorems, especially theorems about **transversals,** triangles, and **quadrilaterals.**

INTEGRATED MATH I: TOOLS AND RESOURCES TO HELP

- Videos on how to solve **systems of equations** using various methods
  http://www.mathtv.com/topic/algebra/systems-of-equations
- Practice activities to write **linear functions** based on a graph
  https://www.desmos.com/calculator/d0kidwd2uw
- Here is a game to engage with transformations or a combination of transformations
  https://nrich.maths.org/transformationgame

INTEGRATED MATH II: WHAT HIGH SCHOOLERS ARE LEARNING

Students taking Math II will spend the most time working on the following topics. By the end of the year, they should understand the topics well to provide a foundation for success in additional coursework and as preparation for both college and career.

- Creating equations and **systems of equations** to solve problems in context.

- Interpreting and identifying ways to rewrite expressions, such as the difference of squares, factoring out a common **monomial,** or regrouping while writing expressions in equivalent forms to solve problems. For example, rewriting $2x^23x^3y^2$ as $6x^5y^2$ or rewriting $(3t^2 + t) + (2 + t^2)$ as $4t^2 + t + 2$.

- Relating zeros of polynomials to their factors. For example, to solve the equation $9x = x^3$, one can first rewrite the equation as $9x - x^3 = 0$. Next, one can factor the left-hand side to produce the equation $x(3 + x)(3 - x) = 0$. This form of the equation implies there are three solutions, $x = 0$, $x = 3$, and $x = -3$. The equation $9x - x^3 = 0$ can also be analyzed using a graph of the function $y = 9x - x^3$. (A graph of this relationship can be seen at https://www.desmos.com/calculator/x4nalzravs.)

- Understanding **congruence** and **similarity** in terms of plane **transformation.** Using **congruence** and **similarity** concepts to prove theorems, especially theorems about **transversals,** triangles, and **quadrilaterals.**

- Using area and **volume** formulas to solve real-world and mathematical problems of geometric measurement. For example, using **volume** formulas for cylinders, pyramids, cones, or spheres to solve problems, and applying geometric concepts to model situations.

- Defining **trigonometric ratios** and solving real-world problems involving right triangles.

- Working with geometric **shapes** in the coordinate plane.

- Understanding **independent** and **conditional probability,** and using them to interpret data and compute probabilities of **compound events.**

INTEGRATED MATH III: WHAT HIGH SCHOOLERS ARE LEARNING

Students taking Math III will spend the most time working on the following topics. By the end of the year, they should understand the topics well to provide a foundation for success in additional coursework and as preparation for both college and career.

- ○ Creating equations and **systems of equations** to solve problems in context. For example, at the circus, tickets are half price for kids younger than age 12. Our school bought tickets for 14 kids younger than age 12 and for 20 kids aged 12 and older. The total cost of the tickets was $108. How much is a circus ticket for a kid younger than age 12? Show the algebra steps you took to solve the problem. Present the steps clearly and logically so that your classmates can follow along with your solution.

- ○ Interpreting and identifying ways to rewrite expressions, such as the difference of squares, factoring out a common **monomial,** or regrouping while writing expressions in equivalent forms to solve problems. For example, rewriting $2x^23x^3y^2$ as $6x^5y^2$ or rewriting $(3t^2 + t) + (2 + t^2)$ as $4t^2 + t + 2$.

- ○ Interpreting and identifying ways to rewrite expressions, such as when simplifying **rational expressions.** For example, rewriting $\frac{x}{(x^2+3x)}$ as $\frac{1}{(x+3)}$.

- ○ Creating, analyzing, and applying functions. This work involves using equations, graphs, and tables that represent functions in different ways. The emphasis is on **polynomial, exponential,** and **trigonometric functions.** For example, Susanna heard some exciting news about a celebrity. Within a day she told 4 friends who hadn't heard the news yet. By the next day, each of those friends told 4 other people who also hadn't yet heard the news. By the next day, each of those people told 4 more, and so on. Assume the news continues to spread in this way. Let N be the function that assigns to d the number of people who hear the news on the dth day. Write an expression for $N(d)$. On which day will at least 100,000 people hear the rumor for the first time? Show the algebra steps you took to solve the problem. Present the steps clearly and logically so that your classmates can follow along with your solution.

- ○ Working with geometric **shapes** in the coordinate plane, including by deriving the equation of a **circle**.

- ○ Using the **mean** and **standard deviation** of a data set. Understanding and evaluating random processes underlying statistical experiments, and drawing conclusions based on graphical and numerical summaries.

TALKING ABOUT MATH WITH YOUR HIGH SCHOOLER:

High school is an opportunity for students to take more ownership of their learning. The content students learn will become increasingly sophisticated. Acknowledging your teen's interests throughout this time can help to engage them in the study of mathematics.

Below are a few tips on how parents can encourage teens to engage with high school mathematics:

- Talk about the math your student is learning. What makes them feel successful? What new concepts are they learning? Where do they feel they need an additional math challenge or support?

- Find resources together that they feel are relevant and helpful to their course of study. Suggest that they talk to their teachers about the resources, extensions and practice activities they find.

- Ask students to name topics of study that are directly relevant to their world. For example,

  - In Math I, students can use exponential equations to understand and represent repayment models on future school loans.

  - In Math II, students can use probability to plan around how likely it is that they will need to file an insurance claim based on the percentage of drivers that hit a deer within the last year.

  - In Math III, students can use trigonometry and technology to graph sine and cosine functions that model sound waves in order to adjust **volume** and pitch.

- Encourage students to think about careers they might like to have when they are an adult. Help them learn about how math is a part of these jobs.

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Every child, every chance, every day.
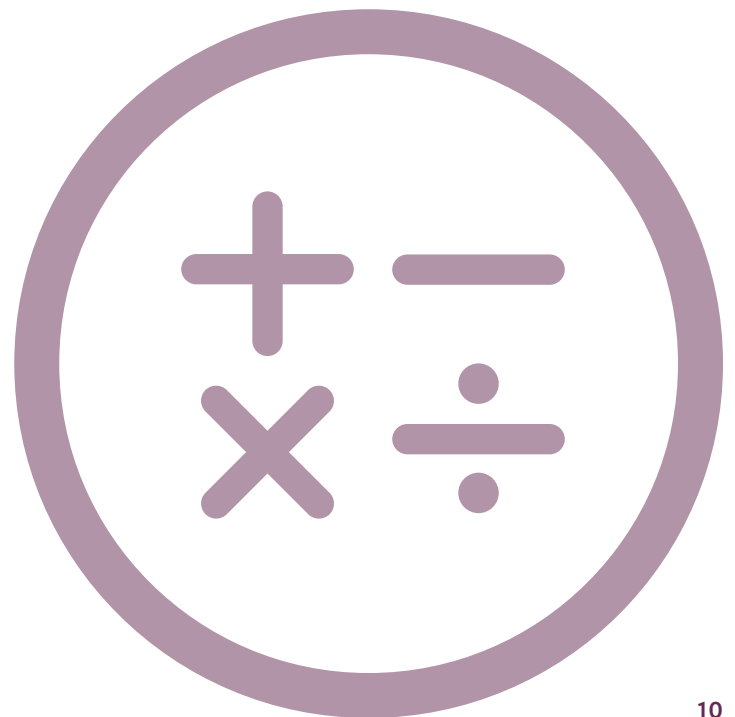
TIPS FOR TALKING WITH TEACHERS

All students, particularly high schoolers who are engaged in more complex and sophisticated areas of study, should feel empowered to engage in conversation with their teachers about their progress and the content they are learning. Throughout the school year, students can use the following questions to ask teachers about their performance and self-assess:

- How can I apply what I already know to the content in this course?

- What are the expectations for success in this class? How do these criteria balance between effort and achievement?

- What do you see as areas of strength for me as a mathematician?

- Are there specific resources that I should be aware of to support my learning this year?

Families can also inquire about the content students will learn in class and how to provide support:

- What new content will be learned throughout the year? Which are the most important topics?

- Does my high schooler do better on problems involving more concrete tasks involving numbers or more abstract mathematical concepts?

- Are there topics that students are currently studying or will be learning about that connect to math they've already studied?

- Are there concepts that my teen may not fully understand that they should go back and review in order to be successful in later units of study?