

# A Student's Guide to High School Mathematics:

## Placing the Focus on Reasoning and Sense Making

In today's highly technological world, having a solid preparation in mathematics is increasingly important. *Focus in High School Mathematics: Reasoning and Sense Making* provides a new set of guidelines from the nation's leading advocate for more and better mathematics, the National Council of Teachers of Mathematics (NCTM).

### Why a strong background in mathematics is important for high school students

Having a strong background in mathematics prepares high school students for success, regardless of what they aspire to do in the future. Success in mathematics opens doors, putting high school graduates in the best position to perform well in college, trade school, employment, or the military. Mathematics is central to many scientific and technical careers and increasingly important in a wide range of areas as diverse as finance, sports journalism, and computer graphics. The Internet has catalyzed an explosion of new careers in mathematics and statistics for those who have the skills to analyze and harness the huge amount of data at people's fingertips.

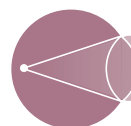
Moreover, all students need a solid background in mathematics to become effective citizens who can make informed and reasoned decisions about personal finances, public policies that deserve support, and cost-effective insurance or health plans. An inadequate preparation in mathematics often rules out certain careers or forces students who want to pursue them to complete years of make-up work. Insufficient understanding may also make it easier for others to take advantage of them in their personal lives.

### Why reasoning and sense making are important in high school mathematics

*Reasoning* means drawing logical conclusions on the basis of assumptions and definitions, and seeing not just *how* something works, but also *why*. *Sense making* means developing an understanding of a situation, context, or concept by connecting it with existing knowledge to reveal the “bigger picture.” Reasoning and sense making help students think about and use mathematics in meaningful ways.

Simply learning how to perform procedures or recall facts is not enough. Students need to be able to analyze, interpret, and think critically about the mathematics that they are learning. If someone can't apply what they know, what good is their so-called knowledge? Students need to develop a useful and usable knowledge of mathematics. Reasoning and critical thinking skills are important for success in mathematics—and in all other areas of life and learning. The most important goals of mathematical study go far beyond the aim of preparing for the next mathematics course or standardized test.

Research shows that students who understand why mathematics works remember it longer and understand it more deeply than those who simply memorize ways of solving certain types of problems. Mathematical fluency includes not only knowing how to carry out basic procedures (such as solving quadratic equations), but also grasping the reasoning behind the procedures. Without that understanding, students may have difficulty in determining which procedure to use in an unanticipated situation, or their seeming “knowledge” may evaporate when they face more complicated situations. Because students who understand what they are learning are more



likely to remember it and use it appropriately, they are more likely to do well in college-level courses and to use mathematics effectively in other future endeavors.

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### How a “reasoning and sense making” mathematics classroom might look

In classrooms emphasizing reasoning and sense making, students are actively involved in thinking deeply about mathematics. They expect to work on problems that take time and effort and to explain their thinking—what did they do, and why? Teachers who focus on reasoning and sense making pose interesting questions, may at times ask students to work in groups, and always expect their students to justify their work and ask questions of one another and the teacher. The emphasis is on understanding the mathematics—exploring not just the *how*, but also the *why*.

Although homework assignments are sometimes typical worksheets or problem sets, at other times they include problems or situations for students to explore without having been shown what to do. The students must come up with their own solution methods and share their ideas with their classmates the next day. Like homework, tests may include some “routine” problems that let students show mastery of skills, but they also include items that require students to come up with their own ideas and explanations.

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### How you can be sure to get the mathematical background that you need for the future

A few “rules of thumb” can help you decide what courses to take:

- To keep your future options open, take more than just the required mathematics courses. Many people regret later not taking more mathematics in high school.
- Take a full four years of mathematics in high school. Research shows the value of enrolling in mathematics every year, continuing beyond a second year of algebra and a year of geometry.
- “Skipping” mathematics in your senior year may put you at a disadvantage when you apply for and enter college. Taking this year off may allow your skills to become rusty, and this could show up on your college entrance exams and college mathematics courses.
- Take precalculus or calculus in high school if you intend to major in a technical or scientific field

(including mathematics) in college. If you intend to pursue other interests, senior-level courses in statistics or other areas of mathematics may be more useful. Statistics is increasingly important in fields from business to medicine to the social sciences, and some background is essential for all adults to function effectively in society.

- Be sure that any college-level course that you take adheres to high standards, such as those of the Advanced Placement Program. Less rigorous courses that do not focus on reasoning and sense making may not provide a foundation for further success in mathematics.
- Challenge yourself to take as much mathematics as possible, at the highest possible level. Although an honors class may seem like more work than a lower-level class, students who take more challenging classes will probably learn more and be better prepared for college or other options.

To succeed in the courses that you take, consider the following advice:

- Regardless of whether your family members did well in mathematics, challenge yourself to do well and expect that you will succeed. Evidence shows that *effort is a major factor* in students’ mathematical success. In fact, with effort and support, all students can succeed.
- As you complete your homework or prepare for a test, explain to someone else—a family member or a friend—what you are doing and why it makes sense. Remember, simply finding the answer to a problem is not enough; you also need to understand how you found it and why your method works.
- Keep in mind that you are not just learning mathematics for the next test; you are learning mathematics for life! Take the time to see how the topic that you are studying connects to what you have learned in the past.
- If you find yourself struggling with some of your homework assignments, do not give up! Contact your teacher for help outside of class—he or she will be happy to assist you.

Above all, remember—although getting right answers is important, it is not enough. Learning to reason about and make sense of mathematics means that you will not only get correct answers now but also develop a deep and lasting understanding of mathematics that will benefit you for the rest of your life.