

# HIGH SCHOOL MATHEMATICS

## Advice from Selective Universities

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### HARVARD UNIVERSITY: How can you best prepare for Harvard?

#### Mathematics

No matter what your field of interest, mathematics will be essential for your higher education. It is the language, as Galileo put it, in which the book of nature is written. Today it is the common language describing new discoveries at the frontiers of science, of economic prediction, and of models of climate change.

To acquire the mathematical background you need at Harvard, you should study mathematics every year in secondary school. But simply taking mathematics is not enough. You should acquire the habit of puzzling over mathematical relationships. When you are given a formula, ask yourself why it is true and if you know how to use it. When you learn a definition, ask yourself why the definition was made that way. It is the habit of questioning that will lead you to *understand* mathematics rather than merely to remember it, and it is this understanding that your college courses require. In particular, you should select mathematics courses that ask you to solve hard problems and that contain applications ("word problems"). The ability to wrestle with difficult problems is far more important than the knowledge of many formulae or relationships.

By the time you get to college, the concept of a function, and its representation by a formula, a graph, or a table, should be second nature to you. For example, you should be able to sketch a graph of the time required to drive from Boston to New York as a function of average speed; or of the number of bacteria in a colony as a function of time given that each one divides in two every twenty minutes. A qualitative understanding of graphs – the ability to sketch and interpret graphs without plotting or reading specific points – is as important as the ability to draw graphs point by point. For example, does a given graph indicate that the concentration of a pollutant in a lake is leveling off, or increasing steadily?

In particular, you should be thoroughly familiar with the graphs and behavior of exponential and logarithmic functions, including doubling times and percentage growth rates. The trigonometric functions, and the ideas of amplitude, period, and phase, are important. Scientific notation and the ability to estimate orders of magnitude are frequently used. An increasing number of fields use the basic ideas of probability and statistics, such as mean, median, mode, and standard deviation.

If you are well-versed in algebra, functions, and graphing, secondary school calculus will enable you to take more advanced introductory courses in mathematics, physics, and chemistry in college. But do not rush into calculus. It may surprise you to know that success in first-year quantitative courses at college is determined more by the strength of your proficiency in algebra, functions, and graphing than by whether or not you have studied calculus in secondary school. Courses in the natural and social sciences often depend more on a real understanding of the behavior of different kinds of functions than on the ability to use calculus.

In the last analysis, however, it is not what courses you have taken, but how much you have thought about mathematics, that counts. More important than the knowledge of a specific mathematical topic, is the willingness to tackle new problems.

SOURCE: <https://college.harvard.edu/apply/preparing/index.html> (Sept 2013)

## MIT: What To Do In High School

When we admit a class of students to MIT, it's as if we're choosing a 1,000-person team to climb a very interesting, fairly rugged mountain - together. We obviously want people who have the training, stamina and passion for the climb. At the same time, we want each to add something useful or intriguing to the team, from a wonderful temperament or sense of humor, to compelling personal experiences, to a wide range of individual gifts, talents, interests and achievements. We are emphatically *not* looking for a batch of identical perfect climbers; we are looking for a richly varied team of capable people who will support, surprise and inspire each other.

Preparing yourself for MIT, then, means doing two things:

1. making sure you're ready to do the work, and
2. taking the time to really explore things that interest you, both inside and outside of school.

### Academics

A strong academic foundation in high school both improves your odds of getting into MIT and will help you make the most of the Institute when you're here. We recommend that your high school years include the following:

- One year of high school physics
- One year of high school chemistry
- One year of high school biology
- Math, through calculus
- Two years of a foreign language
- Four years of English
- Two years of history and/or social sciences

Overall, you should try to take the most stimulating courses available to you. If your high school doesn't offer courses that challenge you, you may want to explore other options, such as local college extension or summer programs.

### Extracurricular Activities

Some students feel so much pressure to get into the "right" college that they want to make sure they do everything "right" - even do the "right" extracurricular activities. Fortunately, the only right answer is to do what's right for you - not what you think is right for us.

Choose your activities because they really delight, intrigue and challenge you, not because you think they'll look impressive on your application. Go out of your way to find projects, activities and experiences that stimulate your creativity and leadership, that connect you with peers and adults who bring out your best, that please you so much

you don't mind the work involved. Some students find room for many activities; others prefer to concentrate on just a few. Either way, the test for any extracurricular should be whether it makes you happy - whether it feels right for you.

By the same token, some applicants struggle to turn themselves into clones of the "ideal" MIT student - you know, the one who gets triple 800s on the SAT. Fortunately, cloning is still for sheep. What we really want to see on your application is you being you - pursuing the things you love, growing, changing, taking risks, learning from your mistakes, all in your own distinctive way. College is not a costume party; you're not supposed to come dressed as someone else. Instead, college is an intense, irreplaceable four-year opportunity to become more yourself than you've ever been. What you need to show us is that you're ready to try.

SOURCE: <http://mitadmissions.org/apply/prepare/highschool>

# Stanford University

## Academic Preparation

There is no magic formula for getting into college. It is true, however, your college search has the potential to be enjoyable and successful if you have:

- taken full advantage of the opportunities available to you in high school
- achieved at a high level all four years
- consulted early on with your secondary school counselor

## Recommended High School Curriculum

We respect the responsibility that high schools, principals and teachers should have in the development of courses and curricula for their students. For that reason, we do not have a set of required courses for admission to Stanford. We have found, though, that a curriculum emphasizing depth and breadth across the core academic subjects is the best preparation for the academic rigors at Stanford. Our experience has suggested that students who excel in a curriculum like the one below are well-suited for the demands of college academics:

- **English:** four years, with significant emphasis on writing and literature.
- **Mathematics:** four years, with significant emphasis on fundamental mathematical skills (algebra; trigonometry; plane, solid, and analytic geometry).
- **History/Social Studies:** three or more years. Such courses should include the writing of essays.
- **Science:** three or more years of laboratory science (including biology, chemistry and physics).
- **Foreign Language:** three or more years of the same foreign language. Your study of a foreign language ought to include the development of four basic skills: reading, writing, speaking and listening comprehension.

## Choosing Courses

We expect applicants to pursue a reasonably challenging curriculum, choosing courses from among the most demanding courses available at your school. We ask you to exercise good judgment here, and to consult with your counselor, teachers and parents as you construct a curriculum that is right for you. Our hope is that your curriculum will inspire you to develop your intellectual passions, not suffer from unnecessary stress. The students who thrive at Stanford are those who are genuinely excited about learning, not necessarily those who take every single AP or IB, Honors or Accelerated class just because it has that name.

## Advanced Placement Courses and Scores

Our admission process allows—and indeed encourages—the flexibility of a high school to design the most appropriate curricular offerings and opportunities for its students. What a course is named or whether it concludes with a standardized test is considerably less important to us than the energy a student contributes to the learning process and the curiosity with which he or she investigates questions and pursues ideas. Sometimes this challenging high school course load will include Advanced Placement classes; other high schools choose to offer equally demanding courses that neither carry the AP designation nor lead to an AP exam.

We want to be clear that this is not a case of "whoever has the most APs wins." Instead, we look for thoughtful, eager and highly engaged students who will make a difference at Stanford and the world beyond, and we expect that they have taken high school course loads of reasonable and appropriate challenge in the context of their schools.

As a result, we do not require students to submit AP scores as part of our admission process. AP scores that are reported are acknowledged but rarely play a significant role in the evaluation of an application. Grades earned over the course of a term, or a year, and evaluations from instructors who can comment on classroom engagement provide us the most detailed insight into a student's readiness for the academic rigors of Stanford.

SOURCE: <http://www.stanford.edu/dept/uga/basics/selection/prepare.html>