Why should anyone have to study mathematics?

In Fall 2003, I gave the question above to my Honors Calculus III students. After some lively discussion, they were asked to write a paper on it. The requirements on the paper were very lax in terms of length and format. The main requirement was that I expected reasoned answers, whether the argument was pro- or con-.

I then solicited those students who were interested and willing to submit their papers, without correction, for this web page, with the understanding that their gender, but not their names, would appear.

Below are some of the 33 essays that I received, all of which had interesting points to make. I have only changed the formatting, since I was working in LaTeX, and most submissions were in Microsoft WORD.

- **A Mathematical Society** (female student)

  I was on the internet looking on the search engine "Google." In the little box at the top of the web site for my search topic, I typed "I hate math." Within one tenth of a second, a list of 344,000 websites became available to me all concerning "I hate math" (1). Most people claimed that they will never use the material in real life and that it is pointless, but in fact, the same math that they claim to be ridiculous and dumb is used in everyone's daily life (2). It is my opinion that students should take math courses for the following reasons: the principle of math can be satisfying for everyone, every person should develop problem-solving skills, and math is required for everyday life.

  Students in high school and college are forced to take mathematics regardless of what they wish. They are not allowed to completely skip it just because they despise the subject, as I am not allowed to completely skip over English classes, which I feel I despise equally as much. Math is important for an individual's mental activity. It challenges those

who excel in the arts to use the other part of their brain and stimulates thoughts that they may not have had otherwise. It is not calculus that is required to challenge someone or improve him, but even the basics, which may be difficult for some, can help students to achieve a personal satisfaction in accomplishing something they are not necessarily good at. This is the same satisfaction I feel when I've finished a well-written paper. It may take me ten times longer than most people to write a simple one or two page paper, but when it's done, I know I've accomplished something that took me great effort to complete. This type of personal satisfaction in others can help them to achieve goals in all areas of their life. A person can learn from this satisfaction and possibly reach a little higher for their next goal whether it is in math or not. People who are lazy and sit on the couch all evening watching their favorite television show, eating chips, and downing a couple cokes can't brag about anything that was stimulating to the brain or the body. Except for a couple pounds in weight gain and possibly a few brain cells that got a little dumber, nothing was accomplished. But if that same person were to get up off the couch the next night and go for a walk or a jog, most likely they would come in proud of himself or herself for the wonderful effort put into the night. For a student who hates math and is put in a class where the teacher makes it easier for them, they won't get the same result as if it were a challenge to their brain, similarly to the person who sits on the couch. Many teachers and students make the mistake in thinking that because a person hates the subject it should be made easier, but this will not get the student far. They will just be stuck on the couch wasting away part of their brain that they could have made great use of. Without math in the lives of students, some real life situations and problems become more difficult for them to solve.

Likewise, mathematics builds logic and pattern recognition in the brain. The structure of math helps with organizational and problem-solving skills. By learning basic math skills, students learn to look at an entire problem before attempting to solve it. They learn to state the problem, come up with possible equations or possible ways to solve it, move step by step to come to a conclusion, and lastly, evaluate the final answer. This is important for any person, whether they are an art or engineering

major. For example, in order for an artist to sell a painting, this being his stated problem, he must come up with a way to do it. First he must eliminate the worst and the best paths to choose. These are the possible "equations" for him to use. Next, he must research the best possible way to market the painting and then experiment. For example, the artist may try selling one painting on the internet and another at the mall. In the end, the artist must evaluate which way is the best and continue the better one based on his logical reasoning. By using logic and problem-solving skills, the artist can increase his profit. Had he not chosen to use this way of determining where to sell all of his art and chose one place right away, let's say the worst way to sell his art, he would make no or very little money and would have wasted both his time and resources. The situation of an artist using math is for most people difficult to imagine, but it isn't always the numbers of math, but rather the skills acquired from practice through mathematical problems. In everyday life, the numbers come in to play just as much as the skills we use from solving math problems.

With that in mind, people don't realize the obvious but unnoticed benefits of math. Everyday life revolves around math because money revolves around math. When shopping for a bargain, if people can't tell the true price difference between a two-dollar bag of 12-ounce potato chips and a three-dollar bag of 24-ounce potato chips, they will instantly go for the two-dollar bag. Thinking that it is cheaper, they don't realize that if they chose the 24-oz bag, they would pay less for the ounce! Without math, simple cooking would be a horrendous task. With the many fractions and measurements of all various foods and substances, what would a person without math do? Suppose they wanted to cook dinner for a party of 14, but the recipe was written for a meal for 12. They wouldn't want to just double the recipe; it's only two more people. Without the knowledge of fractions and multiplication, this task would be near impossible. Math can be used for these daily tasks, but what if the son of a businessman wants a bike ramp? If the businessman doesn't know what the angle or height of a reasonable ramp is, his kid could be ramping his bike off a 70-degree incline! If he builds the ramp and then realizes that it's too high, he could just go back and completely rebuild it with different dimensions and waste more time. Learning some basic

trigonometry and geometry could have saved the man much more time, but because of the difficulty of math many people would rather waste the time later in life building things twice than acquire the skills in high school or college.

Math is important for simple daily situations such as balancing a checkbook or in the more difficult situation such as predicting an annual income due to inflation. Regardless of the need for math, it should be required that all students reach an appropriate level where basic problem-solving skills are taught and the use of addition, subtraction, multiplication, and division become second nature. Learning math has the capability to stimulate the brain in ways unlike other courses required at the high school and college level and is necessary for the improvement of the quality of life in individuals. Americans have the opportunity to improve themselves in this way and it should be required that they attempt to do so.

Works Cited: 1. www.google.com 2. www.suzannesutton.com/hatemath.htm

- **MathematicsA Life Skill?** (male student)

  Why should anyone study mathematics? Should those in high school or college be forced to take math courses, even if their intended future profession does not require higher level mathematics?

  A common argument in favor of forcing math classes to be taken is that it is a necessary part of educational process to make the individual well-rounded in all aspects including science, humanities, writing classes, language, and the other basic fields of study. While this assumption is true, this is not the main reason why mathematics should be a required part of a school's curriculum. First of all, simply removing the requirement for math classes would lower the standards for everyone either educating or being educated. Simply giving up on a generation of kids who are not good at math is definitely not the right way to go. If anything, people should be pushed harder in mathematics to do the best as possible even if that means "failing." Hopefully failure would lead persistence to succeed and motivation to do better.

  In high school, math should be required for at least three years. This is because during the high school years, a student rarely knows what future profession he or she may have. Entering high school, one may have dreaded mathematics in previous years, but upon being exposed to higher levels of math, the person might gain curiosity or even enjoyment for mathematics. Dropping the requirement may steer students away from something that they may develop to be very good at or have a future profession in. Another reason that mathematics should be a required course is that fact that it helps to develop the problem solving process. Although one may not directly use mathematics in their everyday lives, math plays an indirect role in how they make many day to day decisions such as finances or time management. The ability to problem solve is not something that can be directly taught, but is rather a discrete skill learned over many years through trial and error, past experiences, and exercises that might help to develop such a skill. Mathematics is certainly one these exercises. Math is one of the few fields of study where many facts are not necessarily memorized. Such a field where this is necessary is history, or a high school English class.

In math, one only has to know the basic operations, and symbolisms. With this limited knowledge, one can solve an infinite number of problems. Theorems may require a certain amount of memorizing, but even these can be derived from previously gained knowledge. In other words, gaining math skills does not just mean that one knows how to do math, but rather opens up the brain to all kinds skills and development.

Yet another reason why mathematics should be studied is the fact that basically anything that happens in the world can be related to mathematics. Gaining an understanding of this concept can greatly affect how one perceives the world around them. New enlightenment may come about with this understanding. Math is also the only true universal part of human culture.

Searching for some more insight on this project, I came across a quote said by James Caballero that caught my attention: "I advise my students to listen carefully the moment they decide to take no more mathematics courses. They might be able to hear the sound of closing doors. Everybody a mathematician?" CAIP Quarterly 2 (fall, 1989). I believe that what was said is very apparent. Every time we stop pursuing a subject, we lose another opportunity to develop our thinking to a greater level. Mathematics isn't just a tool for engineers, chemists, physicists, or economists. It can be used by everyone to gain problem solving skills, take care of every day tasks, understand the world around them, and to feel a sense of accomplishment. Shutting these possibilities off by not pursuing studies in mathematics severely limits a person's growth and ability, thus affecting everyone around them.

- **Why Should We Study Mathematics?"** (male student)

  Dr. Fan Chung once said, "In mathematics whatever you learn is yours and you build up- one step at a time. It's not like a real- time game of winning and losing. You win if you benefit from the power, rigor, and beauty of mathematics." ("Quotes" 1). We not only need math but we need to understand it as well. In today's world of ignorance and idiocy, many people lack the ability to think logically and analytically and those are the primary reasons that math should be a mandatory subject.

  In a general assumption, I would say that math is one of the least liked classes in school (both high school and college) because everyone eventually finds out they are not going to hold a technical job (a job that uses math) when they get older. When this realization hits them, they automatically begin to bitch and moan. Here is where their ignorance shines through because what they do not realize is that math helps people to think logically and analytically.

  It keeps on going from there because in math there is usually more than one way to solve a problem. It is here that math can lead to creativity, but in the end all the different paths taken must lead to the same place (the answer to the problem). The same idea also applies to science. Many students may struggle with the material being presented, but that is not the objective of the course. The objective of the course is to teach the pupil how to think logically. While the scientific method does this effectively, students are encouraged to take advanced levels of science. This is done primarily to promote proficiency at thinking logically, but it is also done in hopes that the student improves technology.

  However, some people will argue that it is not what you know that matters, it is who you know. To them math and science are worthless, and as long as they are meeting their needs, then they are as happy as can be. These types of people may lack critical decision making skills, but they do know enough people with them. They rely heavily

on communication skills to get them through life, and they are also some of the most dependent people on the face of this planet. Thomas Edison could be classified under this category. He failed to learn math, but did read many books and excelled in science. Growing up, Edison had good communication skills and was always able to surround himself with people who he thought knew more about a subject than he did ("Edison" 1- 2). Without the help of other people, I sincerely doubt that Edison could have invented all that he did.

My personal assessment is that everyone should be required to take some level of math. I do not know what level it should be, but I do know that math can only help you. In 1997, the Department of Education released the Riley report which had some interesting figures as far as post high school is concerned. The report stated that eighty-three percent of high school students who had taken both geometry and algebra went on to college. It also said that students, regardless of their chosen major, who had merely completed algebra and geometry in high school, did noticeably better at college than those who did not (Devlin 2). The bottom line is simple. For the most part, it is not the material being taught that matters. What matters is the thought process that goes with the material.

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- **"Why Should Anyone Study Mathematics?"** (male student)

  As the mathematics test scores of American high school students continue to slip further below those of other nations, questions regarding the usefulness of mathematics are becoming more topical. Many high school and college students complain that the math courses they are required to take will not be useful to them once they have graduated. Furthermore, many students have great difficulty in mathematics, creating arguments as to how much mathematics should be taught and how it should be done.

  Arguments against taking required mathematics courses can be easily dismissed as a nothing more than complaints. After all, how often are most people going to use French, Psychology or Literature after they graduate? The answer is, of course, not many. But just as these courses are required, mathematics is also an intrinsic part of our culture and society and is every bit as important as other classes. The real value of mathematics does not reside in a person's ability to remember Riemann sums or the Fundamental Theorem of Calculus. It lies more with the symbolic language of mathematical notation and the abstract logic that students gain by learning mathematics. This ability and the understanding of mathematical concepts come naturally to some students while many others struggle the whole way.

  The question therefore becomes whether everyone should be required to take a set amount of math or whether only those students most skilled at math should progress in special classes which would help them to achieve more. Either one of these can become dangerous if it is taken to extremes. Take a completely homogeneous system, for example. There are some students who simply cannot comprehend the concepts of even the most basic algebra. So if these students cannot complete algebra 1, do they drop out of high school or does everyone else stop learning math as well? If everyone is expected to study math up to a specific education level, it wouldn't be fair to have some students left behind. Likewise, to systematically separate out the mathematically inclined students from those who are less skilled is to create a type of segregation that will later cause a rift in society between those who can perform

advanced Calculus and those who can barely multiply. The "smarter" students would be placed into advanced classes with similar students and pushed to apply themselves even harder than before, while all the other students would loose all initiative to work hard in mathematics.

The system that is in place seems to be a relatively effective blending of these two divergent ideas. For both high school and college graduation, students are required to complete at least some set number of mathematics courses which teach at least a minimal competence of the subject. Students who excel at math are more often than not encouraged to take the more challenging classes in order to improve their skills. In either case, the student is allowed to progress at a rate relative to his own pace of learning. On the other hand, the surprisingly low mathematics ranking of American high school students compared to the students of other countries indicates that the general requirements need to be raised higher. The current recession in math is most likely a combination of political correctness, where the emotional feelings of the students are sometimes placed before the actual learning process, and an overwhelming complacency among American society at large. Neither of these is good to have in a world that is becoming increasingly more global and more competitive.

Aside from comparing test scores with other nations, many would argue that higher mathematics does not do much for society. This is simply not the case. Almost anyone would agree that basic arithmetic skills are required for anyone who ever hopes to pay bills, write checks, or even make change while working at Taco Bell. The argument, however, focuses mainly on higher mathematics which introduces the symbolic style of thinking that allows students to more easily comprehend abstract thought in other classes and causes trouble for many other students. Well, in a society so dependent upon technology, there has never before been such a need for a population to understand mathematics. Virtually any professional career now utilizes some form of mathematics to perform the necessary work. Students well educated in math will find these jobs much easier not because they have already been taught how to optimize an equation with thousands of variables, but because they can adapt to many different styles of mathematics once they have

been taught how to think abstractly and analytically.

So yes, students should be forced to take more mathematics credits in order to complete their formal education. Years ago higher math may have only been necessary to a few isolated groups of people, but now that complex math is being used to improve the efficiency and scope of virtually every field of work, it is inescapable. In order for students to be prepared for the real world they should have a strong understanding of mathematics. By challenging students to work hard in mathematics, they become well rounded in all subjects, not just the ones that are easiest to understand. Literacy, after all, is challenging to some students, but everyone would agree that it is important for all members of society to be literate, so it only makes sense that everyone should be capable of mathematics as well.

- **'e' Is Not for Everyone** (female student)

  As everyone remembers from his childhood, the traditional primary school curriculum is often casually summarized as the "three R's reading, 'riting, and 'rithmetic." Even excluding the irony of using a common habit of illiteracy to describe curriculum, this simplified list is hardly appropriate to summarize what modern standards require in a good education. Among students, parents, and educators alike, the two former are generally acknowledged to be indispensable, while the latter is often viewed with suspicion and hatred. More recently, other subjects such as personal health, social studies, and the sciences have become important components in instruction for students of all ages. The reception of the various newer subjects has been mixed, but the reaction to mathematics has remained consistent. Writing and reading are accepted without question as necessary in order to function in society, but though they were once afforded an equal third in the old maxim, the relevance of the maths and the justifications for their requirement are constantly called into question.

  Mathematics have developed so far through history that it is now possible for someone with limited knowledge of arithmetical concepts to perform all needed calculations using simple technology, and for this reason the majority of the population will never put into practice any further mathematics learned. The focus of education has not always been on practical application, however; classical education, which was in some ways the ideal, served to better the mind regardless of applicability or usefulness. An educational theory that emphasized the permanent intellectual benefits of sophisticated thought, and connected the various subjects with their collective need for logic and analysis, would both require and justify the teaching of mathematics to everyone.

  In medieval universities, curriculum was separated into two groups: The trivium: grammar, rhetoric, and logic; and the quadrivium: arithmetic (number in itself), geometry (number in space), music (number in time or harmony), and astronomy (number in space and time). Together these disciplines formed the seven liberal arts, which were very heavily focused on philosophy, and consequently logic and math. The

name given these subjects is significant, as the artes liberales were used to prepare the free man for sophisticated but passive science and philosophy. At a time when only the wealthiest families could afford to educate their children, it seems ironic that these students would never use their knowledge in any kind of work. The majority of the population, serving and producing for a living, was trained in apprenticeship or raised in a family trade, and never learned to read or write. In this manner, social mobility was nonexistent, as the lower classes could not afford the means to improve themselves, regardless of virtue and determination.

In the United States and in most modern democracies, the leisure class no longer exists in theory. Wealth and power are supposed to be spread more evenly among the people, with the former having no relationship to the latter. Public institutions such as education, accessible to all people, serve to equalize the opportunities of each citizen, and required curriculum must be justifiable for the majority. Despite well-reasoned attempts to distribute equality, in the form of "liberty and justice for all," capitalistic societies still separate into socio-economic classes. People are fundamentally different by nature and ability, and their wealth, influence, and personal success, with exceptions, ultimately depend on their choice of occupation and level of education. While there is certainly more justice in allowing society to divide into classes based on merit, rather than on the illicit relationship of an ancestor with some member of the royalty, modern social theory discourages any kind of class system. Though capitalism and democracy are the most popular combination among the world's powerful nations, one seems to encourage economic differentiation while the other proclaims equality. In order to make both ideals possible, education would have to develop the skills of all citizens to the same extent, either by limiting the more gifted students or by forcing slower students to master a thorough range of difficult concepts, including advanced mathematics.

Though it is the most often, mathematics is not the only subject that can be challenged in schools for applicability. The natural sciences required for graduation from public secondary schools in the United States include biology and chemistry in some detail. Students are

exposed to molecular processes of the cell and atomic structure and property, topics that are not only invisible, but also certainly useless in a large majority of professions. However, the fact that such processes are occurring in and around a person seems to justify their inclusion. The highest level of mathematics required for graduation from most American public secondary schools is a second year of algebra. This generally involves functions that are more complicated, and further analysis, matrices, algorithms, and formulas. The two previous years of math are geometry and Algebra I. The former is notorious for complicated proofs and theorems, the latter for word problems. Unfortunately, math in American high schools, and apparently in many universities, is handled in a manner similar to the instruction of foreign language, particularly the "dead" languages. Formulas and theorems are presented as established conventions already in use, defined and unchangeable. Applications are isolated from concepts, extremely simplified, and exist only in theory. It is not difficult to understand why most students cannot see the relevance of this kind of math to their futures. However, there are many generic benefits of mathematics that support its inclusion in curriculum regardless of actual application. Especially when numbers are treated as a living entity, whose properties can be discovered and explored rather than memorized, much of mathematics can even attract and interest the average person. The reasoning involved in solving complicated mathematical problems can be applied to other subjects, and the structure of rational thought can make everyday decision-making more organized. Many functions in algebra model real-life situations, such as economic and population growth, and reports containing this kind of information depend upon the audience's comprehension of mathematical principles.

The necessity for mathematical ability can be argued on many levels. Most people in their lifetime will use only basic arithmetic, and a four-function calculator for that. A person need only understand the concepts of additions, subtraction, multiplication, and division to use a calculator. Mathematics uses word problems to teach these concepts students must apply given information to find an unknown. In the simplest forms, one need only determine the arithmetic required, and then plug numbers into a calculator. Beginning with algebra, quantities

are given in symbolic form or in terms of the other quantities or unknowns. At first, these are simply fit into memorized formulas, which are then solved arithmetically. Eventually, students must determine the relationship between quantities and unknowns, creating their own equations to solve. Recognizing the numerical meaning and relationship of quantitative statements is a skill necessary to read and understand many articles in a newspaper (which, interestingly, is written at a fifth to eighth grade reading level).

Though it is not unacceptable for adults to refer this kind of simple reasoning and calculation to others, this is inefficient and unnecessary. There are people (called accountants) who spend their lives and make their living managing other people's finances. It is true that doing so has become complicated, and that many probably could not perform the task without serious error. This does not necessarily excuse lack of the ability. Circumstances of real life are constantly reduced to numerical analysis and comparison; even understanding the evening economic reports involves more than arithmetic, as much of the real meaning of numbers presented comes from speculation and prediction.

It can also be argued that people who depend on technology to substitute for their mathematical inability ought to understand the mathematics that make the technology possible. Some teachers, particularly of gifted young people, maintain that students should not be allowed to use formulas and theorems until they have demonstrated their understanding. Granted, the mathematicians whose names grace the pages of our math texts likely spent years researching and speculating to develop their theorems, and even more time finding ways to prove them afterward. Still, most of the more intelligent students, if led by a careful teacher, will be able to make the necessary connections leading to mathematical discovery, and, in some cases, may even succeed in defining and proving properties using critical logic, previous knowledge, and a bit of ingenuity. Of course, even with gifted students, the only efficient way to ensure universal understanding is testing, which may be inconclusive, as such students are also usually gifted at memorization. If such a process could be carried on one-to-one, so that each student could follow through every connection on his own, this would be the

ideal way to educate. Clearly, this is not possible. In the same way, it may not be realistic to require people to understand complicated mathematical processes when such comprehension is not necessary for operation. As it is, most students simply memorize theorems and properties, without really grasping their meaning, and still pass the required math classes, which to most is sufficient to imply that an education has in fact been received. Progress and improvement, which are now tied closely to technological development, require that some number of people achieve the highest possible mathematical understanding, but the rest of the world would prefer to trust these people's intelligence, rather than verify anything for themselves.

It is a common habit to simplify the second law of thermodynamics to a statement that any system will naturally tend toward the lowest possible energy state and the highest level of disorder. While humans are very complicated biological systems, their rationale is often quite simple. Man, when left to himself, will choose the path of least resistance; humans are inherently lazy and selfish. True liberty suggests allowing this to happen, with the expectation that nature and society will provide the motivation for necessary action in an independent system. If this idea is followed through to completion, however, the world will certainly achieve maximum chaos, and even the select intelligentsia, who will lead and control at first, will eventually decay into indolent and useless consumptive bodies. Even disregarding progress - if only to maintain our present lifestyle, every student cannot receive only the education that he desires; at least some number of people must be pushed to excel, and everyone else must achieve at least some level of literacy, including numeric. Mathematics through algebra and geometry, if taught correctly, can be useful to everyone; everything further is pleasure, interest, life and living to the rest of us.

- **The Need for Math** (male student)

  I doubt you would ever have to convince anyone who is truly competent in

  mathematics just how valuable it really is for someone to understand. The problem lies in showing and convincing someone who is not very educated in mathematics that a high level of math is almost necessary for education and prosperity on the whole. Problem solving skills, time management, critical thinking, and analysis for business decisions: they all rely heavily on an advanced understanding of mathematics. However, when faced with the current math crisis in the education system today, many people are trying to reform the ways we teach math and the expectations we have for students in mathematics. As this progresses, though, you see just how harmful those ideas can be.

  It is an undeniable fact that math scores are down all across America. C. Bradley Thomson cites how a 1996 international test ranked US seniors near the bottom of all countries. A test since the turn of the century has our 8th grade students below many third world countries. Where do we place the blame and what do we do about it? We certainly cannot just place the blame on the students' lack of intelligence and potential. A lack of motivation may play a part in it, but it is far from the decisive factor. The truth is, those who do not have an understanding of math are directly to blame, lowering their standards and then after the problem arises, trying to come up with solutions that in the end only make matters worse. Many advocates of a "new" math in schools promote a system that encourages students to come up with their own interpretation and understanding of math, often times leading to a guess and check method of solving math problems. What they continually bash, though, is the necessity for the basic skills and logic of math to be instilled in the children first; they see math as arbitrary and open to interpretation. Children are taught that random, made up strategies, no matter what the resultant answer, are just as worthwhile as straightforward, logical approaches that give correct-no-matter- how-you-look-at-it answers.

Here is where the real problem comes in. Allowing those who have no desire for math at all to quit math at a certain level may end up being justifiable by only causing them to ultimately hurt themselves while detracting from society. But when you stop the progression of every child at an early age, and teach them these worthless ideas, ruining their potential and scarring their learning ability almost to the point it is unrepairable, what happens when a child grows up to be an engineer or a mathematician? Would you like someone who "guessed" at how to do the math designing the next skyscraper you walk into? Maybe the car you drive? How about the plane you fly across the ocean or the country in? I sure would not feel safe.

Truth be told, you may find it obvious that this way of thinking makes sense then. But to many, it still does not. No matter how low the test scores go, they still do not see the hard facts that the new approaches to math simply cannot cut it. Only the time proven strategies will work, because math is not arbitrary. Math is an exact science; there is no gray area. Just like any other area of study, we must first learn the fundamentals to go farther. Even art requires a basic understanding of paints, brushes, backgrounds, expression, composition, and a lot more. Very rarely can someone just make it up to get by. The same goes for math. Very rarely can you just make something up, "guess," and get by.

But teaching math is one problem in itself. We first need to establish a certain level of achievement before worrying about getting there. The most commonly heard phrase out of a high school or college math student has to be "I'll never use this stuff." But the truth is, math influences what we do everyday, whether we know it or not. Everything from balancing a checkbook, making a choice of what item to buy at the store based on the better value, knowing if you have enough money for something, knowing how much something costs on discount, how to spend our time wisely, when to leave for work, and almost everything else we do all the way down to cooking. So how can we expect people to do these things well when that cannot add without their fingers and find it impossible to divide fractions?

When it comes to math, the more you know the better off you are in life. Being self-reliant means you can live without relying on someone else to make the tough decisions, or even the small ones for you, saving you time, and hopefully saving you money as well. More importantly, the global economy is becoming more and more centered on science and technology. Moreover, in order to function in that economy, you must have a good understanding of mathematics, the root and basis of all science and technology. Sure, you can simply learn how to do something and get by, but truly understanding how something works leads to much easier work and often times greater achievement and understanding in other areas.

In the end, it is simple: we simply cannot allow the level of achievement in math to continue to falter. As the trend continues in both math and science, America becomes less and less able to compete in the global economy, and individuals become more and more apt to be out of work and a strain on the country. No matter if someone thinks they will use math or not, the simple truth is they will. We must show them that math is important to them and then force them to go on to a higher level of learning. As long as we, the taxpayers, can be held responsible for unemployment and underachievement, we should also be able to force a higher level of learning on people. We should not allow laziness and stupidity to be an excuse for someone receiving special benefits form the government at the cost of the hard working, intelligent, taxpaying individuals who foot the bill and are constantly penalized for their superiority. This is unacceptable. We must make people responsible for their actions and we cannot allow those actions to affect the wellbeing of others.

- **Why People Need Math** (female student)

  Why people need math is just a cover-up of the real issue, which is that the people who utter this cry really don't understand the concepts of mathematics. The people who understand math won't cry "When will I use this information?" because that is the excuse of people who have trouble understanding. With that trouble, they just can't seem to grasp the concepts and can't see the use in understanding math. And there is use in understanding math, even if people do not use higher math in everyday life.

  There are many different ways to teach math in today's modern classrooms, some good and others not as good. The new-new math is the latest craze to sweep classrooms across the country. This form of math involves lots of group work, no textbooks or "guided texts", and discussions of the steps needed to get the solution. There is little of the original arithmetic, basic tools such as compasses and protractors, and practicing of skills. Calculators play a heavier role in the classroom, teachers telling the students what buttons to push to get the correct answer rather than teaching students how the device arrives at the correct answer. Professionals rationalize this by saying that children learn better by finding the answers on their own, rather than rely on a teacher to provide information. But amidst the math journals and reports on "feelings" of the problem, where do the students learn their math?

  In the states that have tried this see a steep decline in standardized math test scores and an increase in remedial math in their local colleges. It seems as if the new-new math, which relies on have each person teach themselves math rather than the teacher teach the class and students come up for individual help if needed, isn't really helping the students, and it may even turn some against math. The students under this kind of teaching are sadly lacking in the basic math skills such as such as column addition, multiplication of two digit numbers, long division, the division of fractions, and procedures for solving algebraic equations.

The benefit of the new-new math was that the concepts that one did grasp, he or she understood it fully. Older people today cannot remember most of what they were taught in their high school or college math courses, and what they do remember, they have no idea how to apply it. The new-new math is correct in trying to get students to understand concepts instead of memorizing facts that are seemingly unrelated except by chapter placement. Mathematics, especially the higher maths such as trigonometry, calculus, and differential equations, rely heavily on understanding basics concepts and knowing or willing to learn how they all apply to each other, then using that information to solve other real-life problems. But the new-new math doesn't focus on memorizing the basic relationships between numbers or concepts. It just tries to have students struggle through problems in groups. Although I am for learning concepts and not steps, I also acknowledge the fact that I need to memorize some basic relationships before I can fully understand the concepts.

Studying mathematics gives a student the keys to understanding the way the world works, from saving with a coupon to paying for college to planning a retirement fund. Most students stop learning after the basic arithmetic and primitive algebra because they seem to think that the information will never be used. They fail to think that the logical step by step approach of solving word problems can give them the approach to solve bigger problems. The question about how much fence does Sally need to corral 5 acres on her cattle ranch in reality is very similar to figuring out how much paint is needed to cover a new apartment's walls. The question about the two trains leaving from New York and Los Angeles on the same track and where they will crash is close to how fast a person must drive if they leave for work ten minutes later. The questions in basic algebra with solving for a single variable come close to rearranging the budget to afford the new cars being showed across the country in auto shows.

With the new-new math that is being taught in schools across the country, there is a de- emphasis on basic skills, and a new emphasis on discovery. Most of the discoveries that teachers are trying to have students each took hundreds of years by countless intellectuals, not

pre-teens in a class working in groups. This starts the downslide on basic concepts and understanding of the principles of mathematics and prompts the question of "when will I use this material?". Teachers need to give students a strong background in concepts followed by where this can be applied in real life, and teachers need to start this early on in each student's educational journey. If they fail to do this, most students will not learn what they need to survive in college math courses, and possibly their futures.

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- **Do Not Teach It** (male student)

  I think that math should not be force taught in schools. If math is not taught then other subjects should also not be taught, like reading and history. As people stop learning these things then society as a whole will get dumber. As everyone becomes less educated then they are much more likely to be influenced by someone that has been educated. In this way we can bring back the old ways and have dictators again. I will finally be the ruler of everyone.

  Dictators have been using this method of controlling their subjects for a very long time. Kings could keep the peasants in line because none of them were smart enough to oppose their rulers. The peasants did not have an opportunity to get an education. They did not realize that they out number the rulers. If only they could count then they could have mustered up an army of everyone in the land. They could have easily bettered their lives if they had an education. If we start to make our society dumber, then I can rise to a dictator's position. It is much easier to influence dumb people then it is to influence smart ones. The Catholic Church used to do this to their subjects. The Bible was written in Latin, most people could not read Latin at the time so they just had to take the priests word as true. There will of course be other intelligent people, but once I have the dumb people under my fist I will force the smart ones to do my bidding.

  Keeping math from the masses is an important part of this process of becoming a dictator. When people stop learning math then they must depend on others to do it for them. They will have to trust someone to take care of their money and to do the math that they need for their everyday lives. Soon the number of people that know how to do math will be so low that the people that do will control everyone. They will control all the money and all the power. This control will start to happen in other subject areas too. Sciences for one thing will be greatly hurt by the loss of a math conscious society. People who cannot do math will no longer care whether or not there is a science program. That will be a real problem until I am king. I will force the smart people to learn these things and to do research. Once I

am a dictator then I can control what people learn. I will control the education system and outlaw the teaching of math to my subjects. I will only teach a select group of individuals. We will not fall behind as a society. Frankly I believe that we would be better off as a society that doesn't learn math.

If we were to stop learning math, then for a while, before I am king, we will start to fall behind the other countries. Their math skills will be much higher than ours. Once their math skills are better then ours, other skills will start to become more advanced. Their science programs will become far more advanced then ours is. If their science program is more advanced then ours then their defense program will become more advanced. They will be able to come up with new weapons and new tactics that could be our down fall. There will be a time before I am king where we will be very vulnerable to attack. However once I come to power we will be the strongest nation ever.

If we do not force people to learn math then that will cause a course of events that will be the decline of our society. With our country being so weak, we will need a powerful leader, me. So if you do not want me to be the supreme ruler of the world then I suggest you continue to teach math.

- **"Why Should Anyone Study Mathematics?"** (male student)

  One need not venture far from the bellows of the math and engineering departments to realize that a remarkably large portion of Americans hate math. However varied the people and the atrocities that they have suffered at the hands of mathematics, though, all of the complaints seem to boil down to either or both of two common points: math is simply "too hard" or "too useless".

  Granted, math can be hard. Many mathematical concepts, even those as fundamental as algebra, took thousands of years and countless brilliant minds to develop. It would be practically impossible for the common person to derive something more abstract than arithmetic without proper guidance. This is where educators (should) come in.

  The alleged uselessness of mathematics, however, is unjustified. Choose John Doe such that John Doe those who say math is useless. Ask Mr. Doe to describe how useless math is. Odds are that he will respond along the lines of "Math is as useless as" or "Math is more useless than" or "Math is the most useless" In his own dissent lies a contradiction that shows how essential math is: one cannot even describe the uselessness of math without introducing some comparison of degree, which is invariably mathematical in nature.

  Math has a variety of uses more practical than rhetoric. Consider either finances or the physical world. Everybody wants to get the most of their money, yet many people are incapable of comparing the prices of different size packages at the grocery store. Math is the best way of dealing with all levels of finances.

  The physical world is governed by a tremendous amount of mathematical relations. Quantities are conserved, rates of change vary, and effects are accumulated over time. Subatomic particles, chemical compounds, toilets, trebuchets, water balloons, car crashes, bird flight, populations, nuclear reactions, planetary orbits, and solar radiation all behave according to some mathematical model. Even the simple act of pushing or

pulling a cart can be mathematically scrutinized. Math is the best way to describe the physical world since it can concisely portray a general relation and how it varies.

Anybody with any stake in money management or in the physical world, namely everybody, should have at least a minimal understanding of money and physics. Any understanding of finance or physics requires an understanding of math.

Having established the value of math, the next question is how much math is enough. Seeking a broader range of opinions, I lured another engineering major, Megan Rohm, a history major, Jackie Trepka, and a philosophy major, Scott McKendrick, to Taco Bell and picked their brains for a couple hours. Both the philosophy and history major conceded that math up to and including Geometry, Algebra II, and Trigonometry is necessary for even those in non-mathematical fields. The other engineering major and I were undecided between Trig and Calculus I.

The reasoning behind setting the bare minimum at Trig and Calc I is that if one can succeed in either class, then they must have mastered the material leading up to it. Requiring students to use algebra and geometry in higher-level classes reinforces what was learned in the initial classes. We considered a Calc I requirement because Calc I introduces optimization, which is one of the most useful applications of math. Further, Calc I instills a new appreciation for just how much can be done with numbers.

Geometry, Algebra II, Trig, and Calc I are normally presented at the high school level. Having met these requirements, non-technical university students should still take some sort of math-related course annually in order to maintain their skills. Ideally, everybody would challenge themselves by taking a course that would expose them to new material. However, a two-credit course designed for the sole purpose of refreshing skills might be a more acceptable solution to students who are less welcoming of math.

Requiring all university students to attain some level of mathematical proficiency is absolutely appropriate. A degree is not meant to indicate knowledge of one narrow field. A degree indicates an overall degree of education with a special focus in a given area. It is impossible to consider a person educated to a university level if that person cannot balance a checkbook or figure out how many eight-packs of hotdogs and six- packs of hotdog buns are needed for a picnic with a given number of people.

Math might be hard, but it is far from useless. Everything from money to physics is dependent upon it. Due to the universal nature of the subject, all university students regardless of major should be required to attain some degree of understanding of mathematics. Specifically, university graduates should be required to be able to apply algebra and geometry and should have some understanding of trigonometry and calculus.