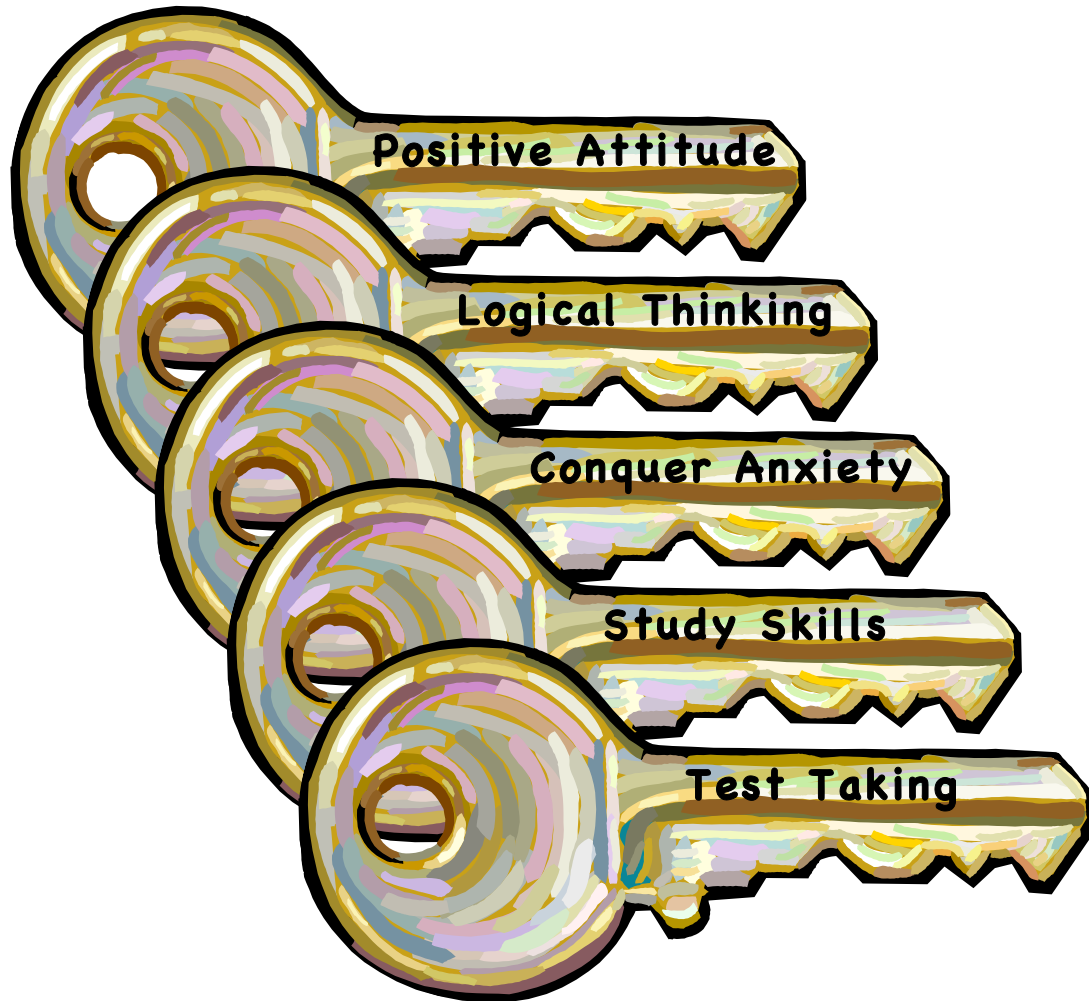


Keys to Success in Math

A Guide for Adult Learners



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Chapter 1

Introduction

So You Think Math is Different!

You are right! Doing math involves a different way of thinking and requires a different way of studying. Let's look at what makes math different and think about what that says about you and how you should study math.

Doing math is a skill. That makes math more like music, drawing, basketball, or other skills that require practice. So what? So you can learn to do math, but it takes practice. You can't learn to do math merely by watching someone else do math. Could you learn to play a musical instrument by watching someone else play? Could you learn to play the piano without regular practice? Does a football coach ever tell his players there will be no practice until the night before the game (and then maybe they can practice all night if they don't feel ready)? That is not how you should practice math either.

Of course, when you practice anything you need to practice doing it correctly; that is also true of math. Don't practice doing it wrong. Coaches are there to make sure the players are practicing the game right. Your math instructor is there to make sure you are practicing doing math right.

Don't let math become frustrating because it is "different." You can do well in math if you develop a positive attitude. The biggest obstacle to learning math is the attitude, "I can't do math." In chapter 2 we will talk about how to change that belief. Once you develop a positive attitude about math, you will be able to do well in this and future math courses.

If you have developed an artistic, musical, or athletic skill, then you have a model. Make the connection! **Think practice, think fun, think skill!**

Is it Hard to Get a Good Grade in Math?

What is your answer? _____ Our answer is, "Not unless you think it is." Are you determined to believe it's hard (as in "I have made up my mind; don't confuse me with facts.")? However, we will admit that **it is easy to fail math.**

Why include this section? An obvious reason for listing ways to fail math is to show you the pitfalls to avoid, but there is a more subtle reason. There are students (we hope this does not apply to you) who go into any math course believing they will fail. In fact, they work at avoiding success. So,

for those who have said to their friends, "I am going to fail this course," and for those who *know* they can't do math and don't want to have to admit they are wrong, we offer these suggestions.

Five Easy Ways to Fail a Math Course

1. Convince yourself you can't do math. Just keep saying it over and over to yourself and everyone else that will listen, "I can't do math!" If you do this often enough, you will build such a complete mental block that this statement will come true.
2. Remember, you cannot hope to fail if you let yourself enjoy math. To avoid enjoying math, constantly remind yourself that this stuff is boring and that your friends will lose all respect for you if you start to enjoy math. Talk with your friends about how bad math is.
3. Skip practice. Just tell yourself that it looked easy when the instructor did it, and you can remember how it was done, and then don't bother doing practice problems. That way, you can expect to go blank on tests (a time-honored excuse).
4. Skip class. Just say to yourself, "Since the material is in the book, all I have to do is look over it the night before the test." Then when you fail, you can claim you tried.
5. Convince yourself that you already know all the math that you will ever use. To be comfortable with failing, it is important to believe that "this course has no real value." Therefore, you must avoid finding applications to problems in your planned career or personal life. This won't be easy, but if you try really hard you may succeed in blocking all evidence of any useful application.

If you use any of the above attitudes, it will certainly be easy to fail and hard to get a good grade. However, if you are willing to try, **you can develop a whole new image of math and your ability to do math.** Just imagine how people will react when you show or tell them you are doing really well in math!

Plan to Succeed in Math!

Why not? **Why plan for less than the best score?** Students who enter the course bragging that all they want to do is pass rarely do any better than that. With that attitude they will probably struggle and be more miserable earning their barely passing score.

Is it easier to succeed in a course you hate or a course you like? If you like math, you are on your way to that success. If you don't like math, why not? What is so great about hating it? Will you have more friends? Will hating

math get you the job you would like to have? **Give yourself a chance to like math.**

It is easier to enjoy math, thereby improving your chances for success, if you look for applications of math in your planned career and your daily life. This will also give you ideas for visualizing problems.

Remember that, just as in music or athletic activities, you develop math skills through practice. Consider treating yourself to something you really like whenever you experience success in math, then try to earn that treat often.

Alternatively, you might consider helping another student. **Those who teach or tutor learn more, and usually enjoy it more, than those they teach.** It is a great way to learn and those you help will appreciate it.

Consider forming a study group. Preparing for a study group helps maintain a study schedule and provides opportunities for practice. It is also a good place to share positive feelings about math.

But What if I Have Never Been Good in Math?

Start by giving up the “crutches” that you fall back on when you do poorly. Don’t make excuses in advance. It has been said that math skill is 1% inspiration and 99% perspiration. While these figures may not be accurate, they do show the lack of importance of “natural ability” in math. The excuse, “I wasn’t born with it” serves no useful purpose, so forget it. What do you gain by insisting, “I can’t do math?” Why not give yourself a chance?

Look for a strategy instead of resigning yourself to failure. If you were not capable of doing math, you wouldn’t be reading this guide. This guide will help you develop the study skills and test-taking skills you need to succeed in math.

Use the fact that math is cumulative in a positive plan instead of as a negative excuse. Don’t say, “I didn’t do well in school, so I’m years behind.” Instead, reason that math is cumulative so doing well in this course will help you with your next math course. An extra investment now may save you many more hours, and a lot of grief, later.

When Will I Ever Use Math?

Sometimes students ask when will they ever use math. Arguing, “I’ll never use this math” may have helped you to rationalize not learning it before, but it makes having to learn it now more frustrating. Besides, the simple fact is that you will probably use most of this and any other math you have learned often without even realizing you are using it.

Thinking of worthwhile applications for the principles you learn in math will make learning easier and more fun. You can think in terms of something that interests you now. For example, you can put decimal problems in terms of money (a topic in which most of us are interested), or you could visualize fraction problems by thinking of sharing pizzas with friends or using fractions in recipes. “Visualizing” problems in this manner is an effective math study technique, especially for students with a more visual learning style.

Remember that **recognizing the value of the material covered in your math course can be a big help**. If you look for interesting applications, an incredible thing is likely to happen—you will begin to enjoy math. In fact, this manual should probably have a warning label.

Warning: If you let yourself have fun when solving math problems, math might become your favorite subject.

Am I Ready for This Math?

Too often, the reaction to this question is something like “No way!” or “No, but I couldn’t put it off any longer.” Stop right there! Now let’s start over.

What can you do if you are afraid of math? **Take positive action**. When you find yourself thinking, “I can’t do this,” answer yourself with proof that you can. **Work for small successes, and then use them to build the self-confidence to achieve larger successes**. Don’t participate in the, “I hate math, I can’t do math” discussions. Remember to talk back to yourself when you hear the negatives, if for no other reason (but there really are other reasons) than to practice for test time when those negative thoughts can totally destroy you.

Do you have trouble concentrating in math class? Can you concentrate on a TV show? What about when you are shopping or attending a sporting event? Remember, you control your own mind; **blaming others because something is boring is admitting a lack of independence**. Be self-reliant enough that you are not dependent on the instructor. **Take control of your learning. Learn to think, focus, and learn on your own**.

Don’t make math any harder than it is. Start with the attitude that math isn’t that hard but don’t get too casual when it is easy. **Don’t put off study and practice** until you realize that it has stopped being easy for you. **Schedule daily study and practice time**.

Most of math is problem solving. Most of life is problem solving. Don’t let anyone, especially yourself, persuade you that math is a waste of time. **Math is an excellent preparation for life**.



Chapter 2

Developing a Positive Attitude

A positive attitude is very powerful. You have experienced success many times, whether in sports, art, music, hobbies, parenting, love, a job, or other aspects of life. Most of those successes left you feeling good about yourself and, either consciously or subconsciously, about your abilities. Many of those successes gave you such a “rush” that you looked forward to “doing that again” because you felt you could succeed again. When you feel that way, you are likely to succeed again. There is no substitute for knowing you can do it; the optimistic approach is much more likely to result in success than the pessimistic approach to the same activity.

What about math? As ridiculous as this may sound, you can become optimistic about math! You can be optimistic about math tests! Then you can expect to succeed. If you will give this book a fair chance, it will show you how.

Some famous people who obviously were very successful in at least one area have stated this idea very well:

Willie Nelson said, “Once you replace negative thoughts with positive ones, you’ll start having positive results.”

W. Clement Stone said, “There is little difference in people, but that little difference makes a big difference. The little difference is attitude. The big difference is whether it is positive or negative.”

Winston Churchill said, “A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty.”

And *Abraham Lincoln* said, “Most folks are about as happy as they make their minds up to be.”

It would very unfair for us to tell you that all you have to do is change your attitude. Life is not that simple. We cannot expect that reading a quote from Willie Nelson will change your performance in math. What we can do is explain why many people have math anxiety, and how knowing the reason or reasons for that anxiety can make it possible for you to change your attitude about math. In the rest of this chapter, we will consider why some people have a negative attitude about their math ability, and show you how to change that to a positive attitude. In chapter 3 we will talk more specifically about math anxiety.

The Role of the Math Teacher

We wish we could say that the role of your elementary or high school math teacher was simply to help you learn math. The problem with that description is that it ignores the usual situation in the real world where classroom teachers have to try to teach in a way that helps the most students learn. Since their students learn different concepts at different rates, teachers must choose a pace that will be too slow for some unless they choose one that is too fast for others. Even worse, people think in different ways, so math (as well as other subjects) cannot be taught to more than 2 or 3 people at a time in the way that will fit everyone's best learning style. Elementary school teachers must try to teach several students at the same time, so it is not possible for them to teach in the way and at the pace that will be best for everyone.

Think of all the implications of the previous paragraph! When you had classmates who you thought were better at math than you, maybe they weren't really better at math. Maybe their learning styles were a better match for the math instructor's teaching style. Maybe they did well because the pace of instruction kept them interested and focused without going so fast they didn't have a chance to master some basic concepts before going on to more advanced concepts. Maybe what everyone thought was math ability was, at least partly, a matter of good luck. What would that say about the students who did not do as well in those math classes? Do you see how their performance could also be a matter of luck, but for them, bad luck? Do you see that they might have been much better students if their teacher had chosen a different teaching style or pace of instruction? Of course, if the teacher had taught differently, it would not have helped everyone and would have made learning math more difficult for some.

Have you ever heard the expression, "success builds upon success?" That fits the image we hope you got from the first page of this chapter. If that expression is true, isn't it logical to say, "Failure leads to more failure?" A big reason students who were not labeled as "smart" in 3rd grade rarely move to the top of the class in 4th grade is that they no longer think of themselves as "smart." More specifically, if they do not do well in math in one grade they usually decide that they are not good at math, even though how well they did last year may have had little to do with their ability. They don't do well the following year because they don't expect to do well, then their belief that they are not capable of doing well becomes even stronger. Their beliefs may also be reinforced by friends, family, and even teachers who stop expecting them to do well. After being labeled as "not good at math" and realizing that others

doubt they will ever be good at math, most students settle for what others expect of them (and what they are “learning” to expect of themselves).

So what? How can realizing that help anyone? If the way you think is different from the way math is usually taught there is no hope for learning math is there? Yes, there is hope! We know there is hope because we have seen dozens, in fact hundreds, of students turn their expectations and their performance around after they understood the reasons for poor past performance. If we had not seen many students succeed after they turned negative thoughts and expectations into positive ones, we would not bother to write this book.

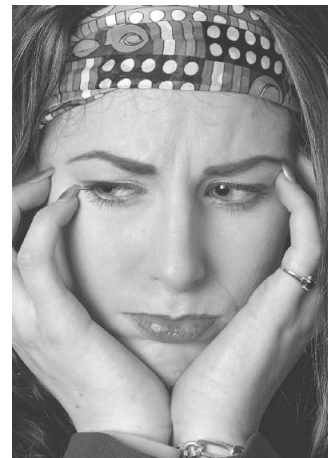
Be Optimistic

Pessimists tend to assume the reason bad things happen are their fault and won't change. Optimists tend to assume the reasons are temporary, changeable, and caused by circumstances beyond their control. For example, if a pessimist was rejected for a date, he might think he was not considered cool, but an optimist would look at it differently. The optimist might see the rejection as being due to the person being interested in someone else.

Thought stopping. Thought stopping is a technique for managing negative thoughts. Negative thoughts are thinking patterns that hurt rather than help. Thought stopping means noticing when you are having unhelpful, negative thoughts and saying, “stop!” to yourself. Of course, the negative thoughts must be quickly replaced with positive thoughts. This may take some practice. Negative thoughts become a habit, and it may take some persistence to change your thinking pattern.

Positive Self-talk. Self-talk is the talking you do in your own head about yourself and the things that happen. What you say to yourself can have a big effect on the way that you feel, and on what you can achieve. Positive self-talk can serve as an internal coach, encouraging you and boosting your confidence. Negative self-talk can destroy your best efforts and cause you to fail. Sports psychologists have long recognized the importance of positive self-talk in helping athletes achieve their potential. Positive self-talk is one tool that good athletes use.

Changing your self-talk. Changing your self-talk from negative to positive involves three steps:



Pessimists tend to assume that the reason bad things happen are their fault and won't change.

1. **Identify your self-talk.** Self-talk is often so habitual that people are unaware that they are doing it at all. Take some time to notice the things you say to yourself.
2. **Assess your self-talk.** Are you saying positive or negative things to yourself? If they are negative, ask yourself these questions:
 - a. Is there any evidence for this thought?
 - b. Is there any evidence against it?
 - c. Is this the way I would talk to a friend who was in my position?
 - d. Are there more positive ways of viewing this situation?
 - e. Am I keeping things in perspective?
 - f. Is it useful to spend my energy thinking that way?
3. **Change your self-talk.** Replace the negative thoughts with more positive ones. That will not be easy because you have practiced negative self-talk for so long. But you can change if you keep working at it.

Positive self-talk leads to a positive attitude. A positive attitude leads to happiness and success and can change your whole life. If you have had a negative attitude and have been expecting failure and difficulties, now is the time to change the way you think.

Positive thinking helps with stress management and can even improve your health. You can overcome negative self-talk by recognizing it and practicing positive self-talk.

What if your self-talk is mainly negative? That doesn't mean you are doomed to fail math. Negative self-talk just means that your own misconceptions, lack of information, and distorted ideas about math have overpowered logic and reason.

You can learn positive thinking. Instead of giving in to negative self-talk, weed out misconceptions and irrational thinking. Then challenge the irrational thinking with rational, positive thoughts. When you do this, your self-talk will gradually become realistic and self-affirming. Periodically, stop and evaluate what you are thinking. If you find that your thoughts are mainly negative, find a way to put a positive spin on them. Start by following one simple rule: Don't say anything to yourself that you wouldn't say to anyone else. Examples of typical negative self-talk and how you might be more positive include:

Negative Self-talk	Positive Spin
I've never done it before.	It's an opportunity to learn something new.
It's too complicated.	I'll tackle it from a different angle.
I don't have the resources.	Necessity is the mother of invention.
There's not enough time.	Let's re-evaluate some priorities.
There's no way it will work.	I can try to make it work.
It's too much of a change.	Let's take a chance.
I'm not going to get any better at math.	I'll give it another try.

Practice positive thinking every day. If you tend to have a negative outlook, don't expect to become an optimist overnight. But with practice, your self-talk will contain less self-criticism and more self-acceptance. Practicing positive self-talk will improve your outlook. As your state of mind becomes more optimistic, you will be better able to handle everyday stress. That ability may contribute to the widely observed health benefits of positive thinking.

7 Suggestions for Building Positive Attitudes

- In every class, look for positive people to associate with.
- In every lecture, look for interesting ideas.
- In every chapter, find important concepts.
- With a friend or classmate, explain a new math concept you've just learned.
- With every instructor, ask a question.
- With yourself, keep a list of your goals, positive thoughts, and actions.
- Remember, you are what you think.

A Way to Understand

Poor performance in math is almost always a result of learned negative feelings toward one's ability to do it. Those negative experiences probably involved a person you respected or one you viewed as being in a position of power (such as a teacher, parent, or good friend). For children, those are the people whose judgments matter most.

Consider a 2-year-old child. That child accomplishes incredible tasks—the most astounding being learning to speak at least one language. Also, note that the whole world **expects** him/her to learn to speak. (Does the whole world expect you to learn math?)

Some of your past experiences involved failures rather than successes. There may have been a time when someone (intentionally or unintentionally)

humiliated you in math class, and you decided, “I can’t do this; I hate math.” Maybe your parents said, “Don’t worry, I couldn’t do math either.” Do you see how those experiences could convince someone to avoid math because they don’t realize they have the ability to do math? However, great coaches see their players as the best, which inspires those players to play above their ability. In most cases a person will perform at a higher level if others expect performance at the higher level.

Unfortunately, in our society it is “acceptable” for a highly successful and intelligent person to be unable to do math. Students learn from this attitude that our society excuses an inability to do math. Other societies do not rationalize away a lack of math skills, and most people who live in those societies have good math skills. We think the moral of that story is pretty obvious.

Remember that you do not have to accept other peoples’ opinions of your ability, or other peoples’ attitudes toward math. **Just believe in yourself! You are ultimately in control. It is your choice to accept or reject the messages sent by other people!**

Positive Self-talk and Math Anxiety

Math anxiety is learned. It can be unlearned by using positive self-talk. We constantly talk to ourselves; unfortunately we mostly criticize and condemn ourselves. Negative self-talk is self-defeating. Consciously choose to replace negative with positive self-talk. Breathing to relax and changing negative self-talk into positive self-talk are two of the most effective ways to reduce math anxiety.

Since breathing is something we can control and regulate, it is a useful tool for achieving a relaxed and clear state of mind. Try the exercise on the next page to relax and reduce stress and anxiety. It is simple, takes almost no time, and can be done anywhere. Although you can do the exercise in any position, sit with your back straight while learning the exercise. The techniques for breathing to relax are described in the box on the following page.

Positive self-talk is telling yourself what you need to hear (and avoid telling yourself what you do not need to hear). What you need to repeat to yourself often enough that you grow to believe it depends on your personality and the origin of your math anxiety. The following list contains examples of positive self-talk statements that have worked for many students.

- I’m getting better at math every day.
- I’m starting to like doing math.
- I remember more math each day.

- There are a lot of ways to do math.
- Everybody uses math and I'm learning it too.
- I can understand math when I give myself a chance.
- Each day, math is a little easier for me.
- I'm relaxed and confident when doing math.
- Solving math problems is like doing a puzzle—it's fun.
- I'm feeling better about math.
- Knowing math helps me in everyday life.
- I'm becoming a good math student.

Use these ideas to develop your own personal self-talk statements, either by modifying them to suit you or just by gaining understanding of what positive self-talk statements might look like.

Breathing to Relax

By Dr. Andrew Weil

You will **inhale through your nose** and **exhale through your mouth**. During the exhale try keeping your lips pursed (almost like you are slowly blowing out a candle).

1. Exhale completely through your mouth making a whoosh sound.
2. Close your mouth and inhale quietly through your nose, mentally counting to four (4).
3. Hold your breath for a count of seven (7).
4. Exhale completely through your mouth, lips pursed, making a whoosh sound to a count of eight (8).
5. Steps 1-4 are one breath. Now inhale quietly again and repeat the cycle three more times for a total of four breaths.

Notes:

- Exhalation should take twice as long as inhalation.
- If you have trouble holding your breath, speed up the exercise, but keep the ratio of 4:7:8.
- Do the exercise as often as you need it, but do not do more than four breaths at one time.

This exercise is a natural tranquilizer for the nervous system. It gains in power with repetition and practice. Use it whenever anything upsetting happens or whenever you are aware of internal tension. Everyone can benefit from it.

Self-exploration

The following questions are meant to help you get to the source of your problems in math. As you answer them, take time to reflect.

Think back to your first bad experience in math.

When did it happen? _____

What happened? _____

Who else was involved? _____

What did you decide about yourself? _____

Many students know the answers to these questions immediately because of an experience that has haunted them for years. If you can't answer these questions quickly, and you are thinking, "I have always done poorly in math," then ask yourself, "Do I really want to change?" Some students choose not to change; they also continue to struggle with, and do poorly in, math. It is a choice you must make.

The following questions may help you see why you decided you were not good at math.

- Has anyone ever made remarks suggesting you should avoid math?
- Has anyone ever suggested something negative with regard to your ability in math?
- Have you heard others say it is normal for people not to be able to do math?
- Were there humiliating or degrading incidences where another student was made a "star" at your expense?
- Did you feel slow in math in comparison to others?
- Were you hurt by comparisons to your siblings?
- Was your performance inconsistent; did you do well in math until a certain grade, then do unexplainable poor work in the next grade?

Remember, you don't lose your intelligence as you walk into math class. In fact, you have successfully solved math problems on many occasions, often without realizing you were doing math. That may have happened

during construction or home decorating projects, while reading the sports page, or while shopping. Hey! That means you can do math!

List evidence of your ability in math _____ _____ _____

If what you are reading sounds like “the power of positive thinking,” it is, but it is much more than that. Understanding what led you to lack self-confidence in math, and perhaps in other aspects of life, can help you regain both self-esteem and confidence in your math ability. When you do that you stop the subconscious mind from telling you that you lack the ability to do math.

This approach to developing math skills has worked with many of our students who saw themselves as “hopeless,” and who believed they were “just not good in math.” The most important step in becoming better at math is realizing it is not a lack of ability that is keeping you from succeeding in math.



Chapter 3

Developing Logical Thinking

Do you know people who seem to always be organized, and others who are never organized? Do you know people who are artistic and others who certainly are not? Many researchers have shown that people can be divided into different groups based on their preferred way of thinking. One explanation for differences in the way people think is the interaction between the two sides of the brain.

The thinking part of the brain, which is named the *cerebrum*, consists of two sides, called hemispheres. The two hemispheres have very different functions. For example, the ability to put thoughts into words and words into grammatically correct sentences is almost always localized to the left side (so a stroke in the left hemisphere may have very different and much more obvious effects on speech than a stroke in the right hemisphere). The left hemisphere is also specialized for logic and attention to detail. However, the right hemisphere recognizes faces and creates an overall picture of many other things. A simple way of describing this is to say the left brain specializes in details but the right brain creates the big picture. That explains why people who tend to think with their right brain are often artistic but disorganized. Those who have learned to rely on their left brain will be better at following directions to get to a certain place when traveling, but less likely to recognize places they have been before.

The Right Brain for Math

Oops, the right brain is not the correct brain for doing math (except for some aspects of geometry and calculus). Basic math and algebra are best done using step-by-step procedures, and that sort of logical process is what the left hemisphere is good at. What if you have been using the wrong side of your brain in math classes?

The good news is that you can develop left-brain skills. Being aware of your natural way of thinking and the approach you need to use on math tests will allow you and your instructor to work together to help you learn to use your left brain when solving math problems.

If the left-brain/ right-brain theory is true, why aren't all artists illogical and disorganized? How are scientists and mathematicians able to recognize other people when they see their faces? Obviously, both sides of everyone's brain are working (except for those with major brain damage from

stroke or injury). Even though most of us have a preference for which side of the brain we first try to use, we also have the ability to use both hemispheres.

It is true that some people are naturally right-brained thinkers; they are often artistic but at least somewhat “scatterbrained.” Other people are naturally left-brained thinkers; they are usually logical but not creative. Neither is superior to the other; they just symbolize two different ways of thinking.

Perhaps we should pause here to make sure you have accepted the right brain vs. left brain explanation. Proof is as simple as the fact that some people are left-handed (so their right hemispheres are dominant) and some are right-handed (which means their left hemispheres are dominant). We hope you have not had a close relative or friend prove that word-finding ability is in the left hemisphere by losing that ability after a stroke or other brain damage (sadly, we have). We also hope that no one close to you has lost the ability to recognize family and friend’s faces following damage to the right hemisphere, but others have had that experience.

Just as with being right or left-handed, the more we use a certain side of the brain in everyday life the more we learn to depend on that side of the brain. Some people develop a liking for using both sides, but many people spend most of their time doing things that “seem to come naturally” for them. If someone does artwork, practices music, or plays video games most of the time, she or he will become more dependent on the right brain. This is also true, perhaps even more true, of someone who avoids doing math, word problems, word puzzles, word games, or other exercises that involve logical reasoning.

Has that person lost the ability to do math? No! The authors and other math instructors have found that **success in math is dependent upon developing a certain way of thinking. You can develop skills in the left hemisphere too.** Many students who have found math difficult have never been taught that they should study math differently from history or English. Most people think that failure in math reflects a lack of ability, but failure in math usually means the student has not learned to be comfortable with the thinking processes used by the instructor. That could happen if the student was naturally a left-brain thinker and the teacher preferred to use a right-brain teaching style, but that seldom happens in math class. Most math teachers became math teachers because they were more comfortable with left-brain thinking. So, a majority of people who do not like math are naturally right-brain thinkers.

Do you see what we are saying? We are saying that your performance in a previous math course may have been totally unrelated to how smart you

are. Poor math performance may have been the result of a mismatch between your teacher's teaching style and your preferred learning style. That means you can do well in math **if you develop a new way of thinking**. Developing another way of thinking has worked for many of our students, even though they had a history of being unsuccessful in math.

Left-brain Versus Right-brain Approaches

Consider Mary. Since preschool, Mary has been puzzling to her teachers. Her teachers never quite knew whether to laugh or get mad at Mary's "off-the-wall" way of doing things. Through the years, at parent-teacher conferences the same comments were often heard: "She's always daydreaming. I'm trying to teach her math and she's drawing a picture. She just doesn't think logically." The pictures Mary drew may have been very good, but that didn't do much for her grades in English, math, and spelling. Most teachers don't know what to do with their "Mary's." Schools expect logical thinking and organization.

Some people have trouble accepting the idea of left-brain/right-brain thinking until they see how those who think in different ways might approach problems differently. The following example illustrates how a naturally right-brain thinker, like Mary, could have difficulty with a problem that seems so easy to those who approach it in a left-brained way.

Consider the problem, "Find 125% of 80." The right-brain process is to visualize that 25% is $\frac{1}{4}$ and $\frac{1}{4}$ of 80 is 20, then add 20 to 80 to get the answer of 100. The right-brain thinker sees no need to write anything down but the answer; in fact, she or he probably won't be able to identify the steps used to get the answer. That student is lost when the instructions say, "Show your work" and won't have a clue on the next problem if it is something like, "Find 13% of 76." A student like Mary might guess once she becomes familiar with how much 10% and 20% are, but she probably would never get that far; she is more likely to give up and draw a sketch of a boy she likes.

For the naturally left-brain thinker, the above problems have about the same degree of difficulty. A naturally left-brain thinker will not be able to "picture" the answer and will not know how to approach the problem until she or he learns the steps for finding percentages. Then solving either of those problems becomes easy just by following the same step-by-step process.

<p><i>What is 125% of 80?</i></p> <p>$? = 1.25 \times 80$</p> <p>$? = 100$</p> <p><i>125% of 80 is 100.</i></p>	<p><i>What is 13% of 76?</i></p> <p>$? = .13 \times 76$</p> <p>$? = 9.88$</p> <p><i>13% of 76 is 9.88.</i></p>
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A student who used a calculator to do the multiplication is just as likely to have gotten the first question wrong as the second (by hitting the wrong key or getting the decimal point wrong). The left brain thinker may tell you that a dealer who has 76 cars and sold 13% of them last month, sold 9.88 cars, without ever considering how you would look driving around in .88 (88%) of a car (hopefully the missing 12% would not include the wheels ☺).

A Brief Look at the Brain and How You Think

Of course, thinking and learning differences are very complex, and calling people “left-brained” or “right-brained” is an oversimplification that ignores the fact that everyone uses both hemispheres of their brain. Still, even though it is not a very sophisticated explanation, left-brain/right-brain theory can lead to a basic understanding of differences in ways of thinking.

Addressing these differences has worked for many students in math.

After brain specialists began seeing differences in the function of the two hemispheres in the 1800’s when they observed that people with damage to a certain part of the brain would lose specific abilities, left-brain/right-brain theory was born. Since then, research has shown that the two hemispheres have many other specific specialties. The results of that research support the description that the left hemisphere is sequential and processes in a step-by-step manner. Therefore, the left-brain dominant thinkers will naturally read directions and follow the solution steps for a math problem. Whereas the left-brain thinker might be described as analytical, the right-brain thinker is more often described as intuitive, artistic, or creative. The right hemisphere is good at recognizing objects, but it is not good at naming those objects or identifying sequence and detail. It specializes in combining parts into a “whole” and seeks, recognizes, and constructs patterns and relationships; i.e., it looks for the “big picture.” It can be a big help in visualizing geometric figures.

What Should a Right-brain Thinker Do?

To do math, you must:

1. Read directions.
2. Begin at the beginning of each problem and proceed using logical steps.
3. Take notes neatly during class. Don’t depend solely on listening and remembering.

These are left-brain thought processes. Consider how naturally you do each of these, and continue working on doing them. The following will help you to appreciate the importance of each of these three processes.

Read directions. Right-brain thinkers usually don't read directions, and really don't see why they should. The directions to a math problem tell you to do something very specific. A good example is the instruction, "reduce." Is $9/8$ reduced? ____ If you answered "no," you gave an incorrect answer, probably because your right brain didn't like the looks of $9/8$. To the right brain it looks like there is something wrong and the right brain wants to "fix it" by changing it to $1\ 1/8$. However, $9/8$ is reduced, and that's what the instructions said to do. Concentrate on finding specific words in the instructions and do what they say.

Begin at the beginning of the problem and proceed using logical steps. The left brain begins at the beginning and moves logically through the problem in a step-by-step manner. Who knows where the right brain will begin! It looks for some intuitive answer, or at least some magic step to get there. If your right brain wants to make a guess, let it; then tell it to "take a break" while your left brain completes the logical steps to find the solution.

It's okay for the right brain to question the answer the left brain finds. That will sometimes help you find simple mistakes and correct "silly" answers (such as "it will take 2 square feet of carpet to carpet a large room). But don't let the right brain overrule the left brain—the left brain did the work so use the answer it found logically unless you can find a mistake.

Even though the right brain doesn't follow sequential steps, it will often search for another problem that looks like this one and mimic the steps. "Mimicking" is not understanding. If you mimic without understanding you are not learning. Another thing the right brain will want to do is try different ways of solving the problem until you get an answer that "looks right." Don't let it. While your left brain is solving a problem, keep your right brain "on break." You can do that if you learn the logic involved and the sequential solution steps.

Take notes neatly. Don't depend on listening and remembering. The right brain "catches on" quickly. Everything seems clear to the right brain. That's because it can't be bothered with details if the answer "makes sense." You must let the left brain learn the logic and sequencing for solving that type of problem. People who don't test well in math may not have learned the logic and reasoning involved in what they studied. Most of a math class is devoted to that critical logic—don't let the right brain "tune you out."

Remember you can't learn to do math by watching someone else do math any more than you can learn to play the piano merely by watching

other people play. Just as with physical activities, your left brain needs to practice. When a person gets nervous, he usually reverts to his most comfortable way of thinking. You must practice left-brain techniques or you will “forget” to use them on math tests.

Keep your left brain working while you are studying math. Don't let your right brain persuade you to do the homework without reading the assignment; allow your left brain to get organized. Read your book, review your notes, and learn the logical and sequential solution steps and when they should be used before attempting homework. That is all it takes for you to master the math you need.

Now Put It All Together

Are you a right-brain thinker? If you are still not sure, look around your room. Right-brain people usually have everything out in the open where they can see it. Left-brain people like to have things neatly put away, and they like to concentrate on one thing at a time. Do you prefer to have many things going on at once (that's another indication your thinking preference is right-brained)? If your thinking preference is right-brained, you have to learn a different way of thinking to do well in math, especially algebra.

Fortunately, it is not hard to do. You just need to understand how to do it, then make the effort. This chapter has presented some clues to learning a different way of thinking. It hasn't given you all the answers, so **continue to adjust your way of thinking as your math course progresses, and seek help from your instructor to help you learn to use your left brain.** Your effort will be rewarded because understanding why math was hard for you in the past helps you to understand that you can do math. An even greater benefit can evolve as you become a more complete thinker by learning to use both sides of your brain. Understanding left-brain/right-brain theory can help you to better understand yourself and become a better student.

Improve your study skills. To get maximum benefit from a new attitude toward math and an improved self-concept, you should evaluate and improve your study skills. Chapter 5 is designed to help you with study skills. If you have been doing poorly in math, you may have developed poor study skills without realizing it. Learning and maintaining good study skills should go hand-in-hand with the positive thoughts prescribed by Willie Nelson (and many other people). Before dealing with study skills, some readers will need to address their math anxiety.



Chapter 4

Conquering Math Anxiety

Math anxiety is an emotional reaction ... which harms future learning. A good experience ... can overcome these feelings and ... future achievement in math can be attained.

--Ellen Freedman

What is math anxiety? It is often described as

- An intense emotional feeling that some people have about their ability to do math;
- An irrational dread of mathematics that interferes with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations;
- A feeling of tension and apprehension that interferes with the manipulation of numbers and the solving of mathematical problems in a variety of academic and ordinary life situations; or
- A clear-cut, negative, mental, emotional, and/or physical reaction to mathematical thought processes and problem solving.

Do You Have Math Anxiety?

Some of you know the answer to that question immediately. Others may be wondering, "Why am I reading this?" Before you decide to skip the rest of this chapter, you should ask yourself if you exhibit any of the following symptoms of math anxiety:

- **Going Blank** – At the mention of math, suddenly you cannot reason or remember anything, as though a tall wall has been built between the world and your brain.
- **Tension** – Your body tightens up, your neck gets stiff, your hands shake, and/or your stomach gets queasy.
- **Paranoia** – You think everyone can figure this out but you, and they know they can and you can't.
- **Tuning Out** – You start thinking about what you are going to have for supper, or you wonder how the coffee stain got on your sleeve.
- **Guilt** – You feel that you have been found out. The illusion that you are a functioning adult has been breached, and the little math you thought you knew is a fraud.

- **Panic** – Your pulse races, and you perspire. Disaster looms, and you will be destroyed.
- **Avoidance** – When math enters the scene, you remember that phone call you have to make or a friend who is really good at this sort of thing and would love to do it for you.

Do You Have Math Anxiety? A Self-test						
Rate your answers from 1 (disagree) to 5 (agree).						
		<i>Disagree</i>			<i>Agree</i>	
1.	I cringe when I have to go to math class.	1	2	3	4	5
2.	I am uneasy about going to the board in math class.	1	2	3	4	5
3.	I am afraid to ask questions in math class.	1	2	3	4	5
4.	I am always worried about being called on in math class.	1	2	3	4	5
5.	I understand math now but I worry that it is going to get really difficult soon.	1	2	3	4	5
6.	I tend to zone out in math class.	1	2	3	4	5
7.	I fear math tests more than any other test.	1	2	3	4	5
8.	I do not know how to study for math tests.	1	2	3	4	5
9.	It is clear to me in math class but when I go home it is like I was never there.	1	2	3	4	5
10.	I am afraid I will not be able to keep up with the rest of the class.	1	2	3	4	5

Add answers to find your total score. **Total Score** _____

Check score below:

40 – 50 Sure thing, you have math anxiety.

30 – 39 No doubt! You are still fearful about math.

20 – 29 On the fence!

10 – 19 Wow! Very little anxiety here.

Adapted from Freedman, E. (2003). Mathpower.com. Retrieved November 10, 2004, from <http://www.mathpower.com/anxtest.htm>

You Are Not Alone

You may believe you are the only one who has ever developed a particular physical symptom or had an emotional reaction to math. Thinking your reaction to math is unusually extreme will reinforce your belief that math is especially difficult for you, and add to your conviction that you are not capable of doing math. Guess what! You are not the only one who reacts to math that way. In fact, many people have learned to dread math so much that they get very nervous, and even physically ill, when facing a math test.

Arem (1993) begins the preface to her self-help workbook, *Conquering Math Anxiety*, by telling about a student who would run from the math classroom and vomit uncontrollably. That student reported dreaming that numbers were chasing her, trying to hurt her. You are not the only one with math anxiety and your math anxiety is not as extreme as some other cases.

The good news is that you can overcome this fear of math. We have helped or watched many students conquer their fear of math and then conquer math.



Signs of Math Anxiety: going blank, paranoia, tuning out, quilt, panic, and avoidance.

Do Many People Have Math Anxiety?

Instructors often hear that math stands in the way of their students completing their goals. For too long, our society has excused math failure with statements like: "My parents couldn't do math either," "Most people that learn math never use what they learn," or "A lot of very successful people can't do math." It is no wonder that so many careers are limited by inadequate understanding of mathematics. The tragic fact that Americans practically brag about their lack of math abilities is a big reason there is so much math anxiety.

Many students are convinced they are not good in math, a conviction that often results from a history of painful and embarrassing failures. Too often those convictions were fortified by hearing one or more of the quotes given in the previous paragraph. It is very important that you change those beliefs so that you can succeed in math.

Why Do Some Students Have Math Anxiety?

Some students learn to fear math after a series of bad experiences with math. Some don't actually fear math, but fear failure followed by being ridiculed by others because that is what happened to them in the past. Some learned to fear math without ever having bad experiences with math – they just listened to people they admired describe math in a way that made it sound like the worst thing anyone could ever endure. Believing the following math myths (all untrue) may have enhanced that fear and caused anxiety.

Men are better in math than women. Research has failed to show any difference between men and women in mathematical ability. Many men are reluctant to admit they have problems so they express difficulty with math by saying, "I could do it if I tried." Women are often too ready to admit inadequacy and say, "I just can't do math."

Math requires logic, not intuition. Few people are aware that intuition is the cornerstone of doing math and solving problems. Great mathematicians always think intuitively first. Everyone has mathematical intuition; but some have not learned to use or trust it. It is amazing how often your first idea turns out to be correct. It is okay to use the right side of your brain in math, as long as you don't turn off the left side of your brain.

There is a best way to solve math problems. Many math problems may be solved by a variety of methods that express individuality and originality—there is no best way. New and interesting techniques for doing all levels of mathematics, from arithmetic to calculus, have been discovered by students. The way math is done is very individual and personal; the best method is the one that makes you feel most comfortable.

It is always important to get the answer exactly right. The ability to obtain an approximate answer is often more important than getting exact answers. Feelings about the importance of the exact answer may be left over from early school years when arithmetic was taught as a feeling that you were "good" when you got the right answer and "bad" when you did not.

It is bad to count on your fingers. There is nothing wrong with counting on fingers as an aid to doing arithmetic. Counting on fingers actually indicates an understanding of arithmetic—more understanding than if everything were memorized.

Good mathematicians do problems quickly in their heads. Solving new problems or learning new material is never easy and always time consuming. The only problems mathematicians do quickly are those they have solved before. Speed is not a measure of ability. It is the result of experience and practice.

Math requires a good memory. Knowing math means that concepts make sense and rules and formulas seem natural. This kind of knowledge cannot be gained through rote memorization.

Math involves working intensely until the problem is solved. Solving problems requires both resting and working intensely. Getting away from a problem and later returning to it gives the mind time to put together ideas. Quite often, the solution seems clear when a student comes back to a problem later.

Some people have a “math mind” and some don’t. Belief in myths about how math is done leads to a lack of self-confidence. Self-confidence is one of the most important factors when doing math. We have yet to encounter anyone who could not attain his or her goals once the emotional blocks were removed.

You must always know how you got the answer. Well, not always. Getting the answer to a problem and knowing how the answer was derived are independent processes. Being able to explain how you got the answer is important if you are going to teach math or help friends, children, etc. with their math. However, if you can solve the types of math problems you are likely to encounter without struggling too much or making too many errors, you are well on your way to success.

There is a magic key to doing math. The only “magic key” to doing math is overcoming irrational fears of math. Once you defeat math anxiety, then you do math using the same skills you use to do everything else.

Identifying the Cause(s) of Your Math Anxiety

Identifying the cause(s) of your math anxiety can be very helpful as you work to overcome that anxiety. One way to do this is to write about your feelings about math. That exercise can lead you through a discovery process that may reveal a cause you have forgotten, or that you put out of your thoughts because it was so painful for you.

If you do not recall an incident that turned you against math, think about your elementary school math experiences. Was perfection demanded? Did you feel inferior because the first student to complete the problem was always recognized, making the rest of the class feel “slow”? Was your teacher impatient with those who did not “catch on quickly”? If any of those situations sound familiar, just remember that being able to solve problems rapidly is not very important. **The important thing is learning to solve the problems.** You may have felt like you were not good at math just because you were not quite as fast as other students, which probably means nothing

more than their preferred learning style was a better match for the teacher's teaching style than yours.

How Have Others Conquered Math Anxiety?

Educators have used various techniques to address math anxiety. Those who have had the most success have initiated student discussion of their attitudes toward math, and then emphasized that previous failures do not mean a lack of math ability. These instructors usually incorporate discussion of differences in learning styles, often by describing left-brain versus right-brain skills, to help students recognize that previous failures may have resulted from a mismatch of teaching and learning styles rather than a lack of ability.

Many students with math anxiety believe they cannot change until they realize so many others have changed. Perhaps your instructor can refer you to someone who was recently "in your shoes" so you can talk to that person about how he or she conquered math anxiety.

Addressing self-doubt is a critical aspect of any learning activity, but particularly so when learning mathematics. If (and while) you do not feel confident, competent, or comfortable with math, please remember that math anxiety does not mean you lack ability. It may help if you can remember when you liked math and were good at it, then write about the episode that caused you to lose confidence. This has worked for many students and one of the authors has used that technique to help many students. The same author also used a classroom activity in which she asked students to draw their "math monster." Making that freehand drawing might be a way for you to evaluate your own attitudes toward math while giving free rein to the right side of your brain.

You Can Make This Work!

Of course, you will only be able to believe in yourself and your math abilities if you are actually improving in math as you are using positive self-talk. Then you will be able to enter a "math improvement cycle" in which you achieve success in math, which shows that you can do math, which allows you to have more success in math, etc. We suspect you are thinking something like "that is easy for you to say!" Actually, it is easy for us to say! It is easy for us to say because we are convinced that it is true, and we know it is true because we have seen so many students do it. Yes, we do mean students who were as afraid of math as you are, in fact, more afraid. Yes, we do mean students whose math skills were as undeveloped as yours, in fact,

even less developed. Yes, we do mean students who were at least as convinced they could not do math as you are!

Many of you will try to convince yourself that we must be wrong (maybe even express that feeling using the words “what a load of ____”). That is a natural reaction of anyone with a major math anxiety problem. That reaction comes from your subconscious mind, which is trying to keep you from doing better in math because it “knows” you can’t do well in math and it does not like to be proven wrong. The biggest challenge you face is changing that mindset. Does that take us back to Willie Nelson’s philosophy?

How do people overcome a negative image of their math ability, especially when it has become instilled into their subconscious mind? They do it by using positive self-talk while they are working to improve their math skills by using some of the following techniques to help them learn math.



Math anxiety not confronted leads to frustration which may result in failure.

- Ask questions.
- Practice math (just remember that learning math is like learning a second language – it must be practiced).
- Seek understanding instead of relying on memorization.
- Study math according to your learning style.
- Get help when you do not understand something.
- Be relaxed and comfortable when practicing math.
- Talk about math with friends (but only those who believe you can do it).
- Take responsibility for future successes and failures (blaming others will be counterproductive).
- Look for uses of math in fun activities, such as gardening, home repair, hobbies, sports, and vacations.

You may have had negative math experiences that caused you to experience math anxiety. Previous schooling may have associated intelligence with quick recall of facts. Testing and classrooms may have created a cycle of failure. However, Chapter 3 has given you a way to change your attitude toward math after you understand why you feel that way. Use Chapter 2 and this chapter to understand why you lack confidence in your math abilities so you can deal with math anxiety.

As you study, look for real-life applications of the math you are learning; that will make math more meaningful and more interesting. Use the next two chapters to increase your confidence by developing better study and test-taking skills.



Chapter 5

Developing Study Skills

What is the Secret for Studying Math?

The best way to study math is every day. A lot of students don't see the value of daily math study and practice; many of those students fail. It is not how much you study that's important—it's how you study and how often. Students sometimes say, "I studied 10 hours just for the math test and I still didn't pass." That's not surprising, but it would be amazing if a student studied half an hour per day for 20 days and failed. Studying only a couple of hours over a three week period, then cramming during the two days before the test, will not build long-term memories (the kind you need so you can use math in real life and to learn more math). Doing that makes passing less likely and makes you go into the test scared, which can keep you from doing well. Cramming may allow many students to pass a lot of courses, but it is less likely to work in math. **Plan a study schedule. Take time each day to organize your notes and practice math.** This will make it easier to study and get the most from your study time.

Getting Organized

You can't study notes you don't have or notes you can't understand. Many valuable study hours are wasted because notes don't make sense. Note taking is one of the most valuable skills for studying math.

Start with a system. The student who just copies everything the instructor puts on the board, including mistakes, doesn't know what anything means or why it was on the board. Their plan to "work it out later" seldom happens. Those students waste a lot of time trying to interpret the notes (except for those who quit trying) and are not likely to interpret those notes correctly. It is important to start with a good system.

A good system requires a well-organized notebook. We recommend a three-ring binder with the following sections:

1. Overview materials (syllabus, calendar, assignments, etc.)
2. Class notes
3. Homework (corrected homework, practice problems, etc.)
4. Quizzes and tests

Update your notebook each day and remember to put a date on each item you include in your notebook in case questions arise about what was or will be covered on a particular quiz or test. Keeping this type of notebook can help you get to work quickly when you sit down to begin a study session, then you can accomplish what you need to do in much less time.

Taking Good Notes

It is almost impossible to take thorough notes without an appropriate system. Educators have proposed several note-taking systems. We believe the best system for most math courses is a 3-column system. Put topic notes and explanations in a wide center column (about 4 inches) with examples and problems in the 3rd column. The 1st column should be reserved for personal comments that will help you identify key points. The first column is also a good place to write possible test questions. The following page shows an example of notes taken using the 3-column system.

The 3-column system might not be suitable for most courses, but in math you should plan for things like explanations of steps in the middle of the problem. The instructor may also pause to describe common errors that students make; plan how you will record and label that kind of information. Without careful planning, your notes can be difficult to follow when they “get cold.” Consider making a practice test by forming your own questions from each day’s class and putting those questions in the first column of notes.

Your notes should include all of the steps in the solution of a problem, but it is more important that you follow the reasoning of the instructor. When you are having trouble doing both, ask questions so the instructor will know that you are not ready to move on. If that doesn’t work, make a note (in your personal comments column) and leave enough space to fill in additional steps or explanations later then focus on the new topic or problem.

Try to take complete notes. Too often students only write down the problem and the solution. It may have looked easy when the instructor did it, but it can still be hard to fill in the steps later. Review and edit your notes so you can catch things you did not write down correctly. If you do this shortly after class while the material is “fresh” in your mind, you are more likely to find errors and be able to fill in missing steps.

Don’t stop taking notes until class is over. You can lose important information trying to get out of the room the second the class ends. The information you miss is often summary information that brings everything together so that it makes sense. The instructor may hit a few high points to compensate when time is running short, so the last two minutes of class may

be very important. Getting the most out of each class is much more important than getting out of the classroom quickly.

Solving Equations (x in the denominator) - p. 234		8/1/08
<p>○ STEPS:</p> <p>1) Notice x in denominator</p> <p>2) Multiply by LCD.</p> <p>3) Solve</p> <p>4) Check</p> <p>○</p> <p>BIG CONTRAST</p> <p>Solve—multiply by LCD</p> <p>○ Add—Rewrite each fraction with LCD</p>	<p>MUST use this method when x is in the denominator.</p> <p>1) Find LCD.</p> <p>2) Multiply both sides by LCD (denominator will cancel)</p> <p>3) Solve resulting equation</p> <p>4) MUST check! If any answer makes denominator = 0, then it can't be a solution.</p> <p>In $\frac{1}{x} - \frac{3}{4} = \frac{3}{x}$, $x = 0$ is only answer not permitted.</p> <p>Solve: $\frac{2x}{x+2} = \frac{1}{x^2-4} + 1$</p> <p>Add: $\frac{2x}{x+2} + \frac{1}{x^2-4} + 1$</p>	<p>$\frac{1}{x} - \frac{3}{4} = \frac{3}{x}$</p> <p>LCD: 4x</p> <p>$4x(\frac{1}{x} - \frac{3}{4}) = 4x(\frac{3}{x})$</p> <p>$4 - 3x = 12$ $-3x = 8$ $x = -\frac{8}{3}$</p> <p>Check:</p> <p>$\frac{1}{x} - \frac{3}{4} = \frac{3}{x}$</p> <p>$\frac{1}{-\frac{8}{3}} - \frac{3}{4} = \frac{3}{-\frac{8}{3}}$</p> <p>$-\frac{3}{8} - \frac{3}{4} = \frac{-9}{8}$</p> <p>$8(-\frac{3}{8}) - 8(\frac{3}{4}) = 8(\frac{-9}{8})$</p> <p>$-3 - 6 = -9$ $-9 = -9 \checkmark$</p> <p>This check optional but must check to see if answer makes denominator = 0</p>

Sample page of notes in 3-column system.

Getting the Most Out of your Math Class

Are you interested in three easy ways to do well in a math course? Here they are—go to every math class prepared and early enough to get organized before class begins. Do you see the three ways? One way is to **be prepared by doing your homework**. Another is to be ready to **start thinking and taking notes as soon as instruction begins**. The third, and perhaps most important, is to **attend every class**.

The notes of another math student cannot be expected to convey an understanding of how to solve most math problems. **Regular class attendance is vital** for practically every math student. We don't want you to go to class when you think you might have a contagious disease or when you are too sick to drive to class safely, and we understand that emergencies arise. But it is important to recognize the difference between avoidable emergencies and unavoidable emergencies and plan ahead to make sure you get to math class.

Many students miss a lot of instruction because they habitually come to class late. Other students miss just as much instruction because they wait until the instructor starts talking before looking for a pencil or finding the proper place in their text or notebook. **The first 5 to 10 minutes of class may be the most important—be ready to think and take notes at the beginning of class.** Often, those first few minutes are when new topics are introduced and their rationale or basic concepts are explained. Many students complain they don't know what is going on or why a particular topic is being studied, when the reason they are lost is that they miss the beginning of every class. When they have to try to catch up after class begins, most students try to copy everything the instructor has written on the board before it gets erased, so they are too busy copying to start listening and thinking until they have already missed a lot of explanations and reasoning.

<p>If you have come to class late, how many times? _____ Why were you late?</p> <p>_____</p> <p>_____</p>
<p>If you missed a class, how many have you missed? _____ Why did you miss?</p> <p>_____</p> <p>_____</p>
<p>How many times have you been in class on time, but not ready? _____ How can you avoid these problems in the future? _____</p> <p>_____</p> <p>_____</p>

Do you try to sit near the front of the room? If not, why don't you? Sitting near the front makes it easier to see the board and hear the instructor. It also does something you should not try to avoid—it invites attention from the instructor. That attention is more likely to help you than to hurt you.

Instructors can more easily work with students who sit near the front; and many instructors have come to expect that those sitting near the front are the more interested and better students. However, the biggest advantage of sitting near the front is that doing so can help you concentrate during class and improve your understanding of the material presented.

No matter how many times students are told otherwise, they continue to be reluctant to ask questions during class. **Instructors often depend on student questions to help them judge how well the material is being understood and whether to speed up or slow down.** If you have a question but don't ask it, the instructor may move on to something that builds on what you didn't understand. Then you are likely to waste many hours catching up. Don't worry about other students' reactions; usually they will be glad you asked something they did not know how to phrase.

How Do You Read a Math Book?

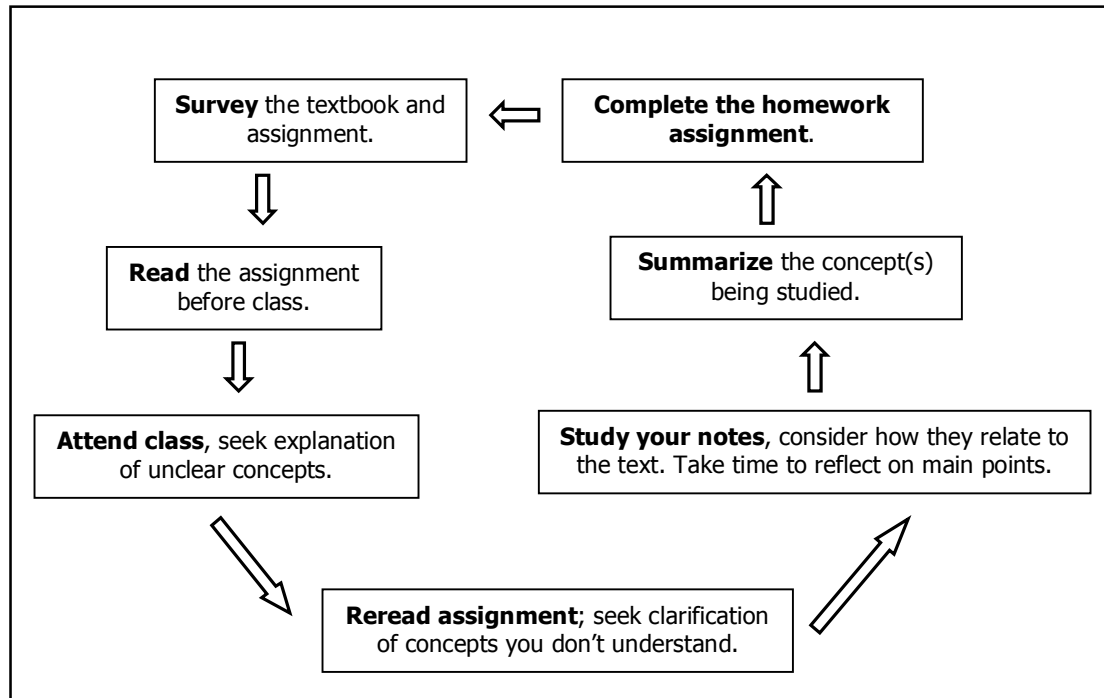
The answer is "**slowly, carefully and thoughtfully, with pencil and paper so you can take notes and work problems as you read.**" A highly respected math instructor once said, "Don't read a math book with your eyes because they will deceive you; read math with a pencil!"

Don't try to read math the same way you read a novel, and forget about speed-reading. Don't place any importance on how fast you can read the text assignment or how many pages you can read at a time. Expect to read only a few pages an hour. All that really matters is how much you learn from reading.

It is important to make an effort to complete the appropriate reading before a topic is covered in class, but don't get discouraged if some things aren't completely clear after the first reading. Instead, realize that you are doing this to find where you need help. Make notes on things (or put little question marks beside sentences) you don't understand; then watch for explanations in class, or ask about questions that don't get answered. Reread the assignment as soon after class as possible, and certainly before attempting the homework assignment. **Talk to your instructor if you are having trouble understanding your math textbook.**

The following page contains a flow chart of a recommended way to read your math textbook. In math (just as you should any course) begin your reading with a survey of the textbook. Then survey the chapter or chapters appropriate to your assignment. Surveying means looking at the table of contents or major headings to evaluate the organization of the book and the part you are preparing to read and become familiar with the location of related materials. Surveying also includes reading learning goals and

definition of new terms, as well as reading the introduction and summary of the section(s) to get an overview. Surveying helps you see how things fit in the “big picture” and where you are headed.



Flow Chart of the Recommended Procedure for Reading a Math Textbook

If you have trouble understanding a concept when reading your math textbook, make a note to ask someone, and then try the next section or problem. There is nothing wrong with moving on once you have made an effort; then you can read for clarification after the topic has been discussed in class.

Review and practice both alone and with others. When reading about a topic that has already been covered in class, it is important that you make every effort to understand what you are reading. If you have a question, is there someone you can call? Is there another student who might be willing to help? Can you get help at a tutoring center? If you must wait until later to get help, go ahead with your reading. Then start again at the same point after you get the help you need.

Use a lot of paper when you are reading math. Use scratch paper to work through the examples in the text and a notebook to record notes on procedures. When recording procedures, be sure to show all the steps, especially steps you had to fill in for your own understanding. Math books often skip steps to save space or to stimulate thought. Make thorough notes

now, including a personally written summary and practice test. Making a practice test now, while the ideas are fresh in your mind, will make it easier to review for the real test later.

If you are still having trouble reading your math textbook after trying the above suggestions, try “reading up” instead of “reading down.” “Reading up” is looking at the example and then reading the preceding discussion to see what is being illustrated. Looking at an example may make it easier to follow the explanation. However, if you read the examples first, don’t forget to read the text that went with those examples. If that doesn’t set you on the right track, talk with your instructor because it is important that you are able to read, and learn from, your math textbook.

Getting the Most Out of Your Study Time

Make a study schedule and study math every day. Math is cumulative. This means you can’t understand tomorrow’s material unless you’ve learned (i.e. studied and practiced) today’s material. For many students the most important step in studying math is to make a study schedule. Take a careful look at the guidelines for budgeting your time.

Guidelines for Budgeting Your Time

1. Look for wasted hours, including daytime breaks.
2. Begin studying as soon after class as possible. Material “learned” during class goes into *short-term memory* and is forgotten within a few hours unless it is transferred to *long-term memory* by frequent review.
3. Be flexible, but put studying before play.
4. Plan some time to relax (be reasonable about how much).
5. Plan for exercise.

If your first try at a schedule fails, that does not mean a different schedule won’t work. In fact, plan to revise and improve your schedule after you have tried it. A daily schedule form is included at the end of this chapter. Fill it out in pencil so you can make changes. Copy and post it in different places so you won’t have any trouble remembering it.

The best schedule is an individual matter; what is best for one student might be totally wrong for another. However, few students do well without a schedule (and it almost always helps to see it written down). Most students who plan to study when they feel like it rarely study. Whatever form the schedule takes, most students do not do well without one.

Where studying math fits in your schedule is an individual matter. However, there are some important considerations for scheduling math study time. It will help if you **plan to study math at the same time every day**. This creates habits and attitudes that make it easier to get started each time.

Remember to schedule math study as soon after class as possible, so you forget less of what was covered in class. Also, most students benefit from scheduling their math study time as early in the day as possible. There are several reasons for studying math early; think about how each of the following reasons might relate to you:

1. Many students think math is their most challenging course. You should study “more challenging” courses first.
2. Studying math should involve more writing (copying problems and working out solutions on paper) and problem solving than most courses. For many students, that is less likely to happen late in the evening.
3. Many students need to spend more time on math than on some other courses. Early study may give you chances to retry problems you were unable to do on the first try later in the day.
4. Completing the planned math study is especially important due to the cumulative nature of math.
5. Many students find it easier to study math when they are “fresh.”

When do you study math? _____ Does this seem to be a good time for you? _____ When you can't study math at the time you planned, when is your alternate study time? _____ How could your study schedule be improved? _____ _____

Your schedule should have enough flexibility for you to be able to adjust for emergencies or rare opportunities. A good schedule will not keep you from having fun, but it will make it easier to keep a good balance between work and play.

In planning your weekend study schedule, avoid the extremes of never studying on weekends or scheduling all of your study time on weekends. Planning too heavily on a schedule that is based on regular weekend study time sets you up for major disruptions when there are opportunities for family or fun activities that would occupy the entire weekend or leave you too exhausted to study. Regardless of your weekend plans, it is usually better

to complete your work early in the weekend rather than putting it off until Sunday night.

Now that you know how to make a schedule, do it. Write it down; then post copies in notebooks, on your bulletin board, or wherever you will see it. As your math course progresses, reevaluate and make changes, but for now it is important to **get off to a good start**.

Do you still have doubts about your ability to maintain a study schedule? It is easier than you think. However, maintaining your study schedule may require that you learn to say “no” (both on the phone and in person).

One trick that might help make your study schedule lighter is making memory cards. They can be more convenient and beneficial than notes in a notebook when you are doing quick reviews prior to new topics, as well as when you are reviewing for quizzes and tests. **Carry these cards with you** so you can review them while you are waiting on friends or family, waiting on a ride, etc. A few minutes of break time may save you a bundle of time later.

Planning and Designing Your Study Environment

Choosing the proper study environment can make or break a study schedule. While some students can pick up where they left off before they were interrupted, no student can hope to work efficiently unless interruptions are minimized. Hence, **the most important consideration in choosing a study environment is reducing the number of interruptions and distractions**.

Plan ahead! Most students need an alternate study area for those occasions when neighbors, people working on the street, or some other unanticipated noise or distraction makes concentrating difficult. **Know in advance where you will go** when a problem arises.

Of course there are times when you will be able to study more effectively by getting comfortable and when you need to be where someone can find you. However, there are also times when getting comfortable and being where someone can find you are not good ideas. Many well-intentioned study sessions that begin with getting comfortable end very quickly. Be sure you can stay awake once you get comfortable.

Sometimes the only way you can study is to make sure that certain people can't find you, or that no one can find you. As long as you make a good plan for someone to contact you in case of an emergency, getting lost for at least part of your study time may be the only way for you to maintain a schedule.

Speaking of noise and distractions—many students insist they study best with music on, or even in front of the TV. If you have created a dependence on a certain “noise” background, break that dependence. There are times when you need to concentrate in a classroom environment or testing situation where there is no such noise. Also, don’t insist that you study better with the noise until you have seriously tried the same time and environment without that noise. Try it long enough to be sure it is not just the strangeness that is uncomfortable (or not just wishful thinking), and try it with math since you should study math differently from the way you study most subjects.

When you plan an environment for the study of math, **leave space to spread out**. You may want to consult several resources including your notes, quizzes, and exams as you study. **Keep scratch paper handy** and make sure you have room to practice math.

It is important to study math aggressively. Studying aggressively might mean reading the problem aloud or thinking aloud. Keep this in mind when choosing a place to study math. Studying aggressively also means that you **work at overcoming distractions**. Don’t use distractions as an excuse for not doing the math as planned.

Solving Problems

Your major objective when studying math is to learn how to solve problems. Developing a proper attitude toward math, planning the proper study environment, attending and actively listening during math class, and taking good notes puts you well on the way to becoming good at solving math problems. However, you still need to practice. **Practice is the key to solving math problems.**

Practice based on understanding is also the key to long-term memory. Cramming for rapid memorization does not create long-term memories; only understanding and practice can do that. Understanding a problem solution means knowing the solution steps and the reason for each step. Then it will be very important to practice using that strategy so you will be able to remember it later, especially under the pressure of taking tests.

If you just can’t seem to get started on a problem, try substituting words for symbols and think about the problem as a real-life situation. For example, if you are working with an interest problem and have the formula, “ $I = prt$ ” you may want to write down, “*interest earned = amount of money deposited \times rate of interest \times number of years.*” Sometimes it helps to visualize the problem by drawing a diagram, such as when the problem involves finding the area of a geometric figure.

When you encounter a problem that you just can't seem to solve, look back through your lecture notes, memory cards, and homework for an explanation. **Don't just mimic another problem;** look for understanding. Once you have made a real effort, it is better to skip the problem before you become badly frustrated. Often the solution to this problem will "click" after you have solved other problems. If not, sleep on it. If you can leave only one or two problems unsolved, the solution may come easily the next day.

Each time you solve a problem, pause to check your work. A good system for checking is to ask:

1. Did I read the problem correctly?
2. Did I follow logical steps?
3. Did I use the correct formula or equation?
4. Is my arithmetic correct?
5. Is the answer in proper form?
6. Does my answer make sense?

If these six items seem to check, stay with your solution instead of randomly making changes to get the answer. When solving equations, substitute the value you find for the unknown into the original equation to check the solution. When solving word problems, check the solution by rewriting the problems to include the solutions you found; this provides the best check of your work. Sometimes it is logical and correct to solve a problem more than one way; if so, **solving a problem two different ways is an excellent checking technique.**

If you have learned to use flow charts or some other form of decision chart in the military or another course, consider adapting them to math problem solving. Flow charts are normally made in diagrammatic form, with different branches of procedures based on your answers to simple questions. Another format is to list the steps or procedures used to solve each different type of problem; this is called a "strategy sheet" (see example on the following page). Regardless of which you use, the best time to prepare it is when you have just completed the homework on a particular problem type; then the procedures will be fresh in your mind. Using one of these techniques can save time and make solving difficult problems easier.

Rational Expressions

A. Reducing

$$\text{Use: } \frac{PK}{QK} = \frac{P}{Q}$$

1. Factor
2. Cancel like factors in numerators and denominators
3. Rewrite remaining factors

B. Multiplication and Division

1. Factor
2. Cancel like factors
3. Apply: $\frac{P}{Q} \cdot \frac{R}{S} = \frac{PR}{QS}$ → **Make sure it is reduced.**

C. Addition and Subtraction

1. Find the lowest common denominator (LCD) by
 - a. Factoring all the denominators and
 - b. Take each factor the most number of times it appears in each denominator
2. Write each fraction with the LCD and find numerators by raising each rational expression to higher terms--> Use: $\frac{P}{Q} \cdot \frac{K}{K} = \frac{PK}{QK}$ (opposite of reducing)
3. Add numerators (avoid tendency to cancel)
4. Keep denominators
5. Factor numerator (to reduce)
6. Reduce, if possible

D. Equations

1. Multiply both sides of the equation by the LCD (all denominators should cancel)
2. Solve the resulting equation (the equations will be linear or quadratic)
3. Check answer(s) → if answer(s) makes the denominator "0" it is not a solution.

Sample Strategy Sheet

Solving Word Problems

Who told you that word problems are hard? There are much more constructive ways to think of word problems (remember the quote from Winston Churchill?). First, and foremost, word problems should be considered realistic. Few people make a career of solving equations or numerical problems; in real life, problems almost always have to be interpreted from words. Admittedly, real-life problems are more difficult than the problems in your math course because in real life a lot more information is available and you must sort out what is useful and discard what is not. Still, solving word problems is good preparation for the future.

Word problems can be both challenging and fun. Have you been taught how to approach word problems? If you are one of those students who really dreads word problems, it will help you to complete the questions

below and think about the reasons for your fear or dislike so you can start believing that, with practice, you can do word problems.

How do you feel about word problems? _____ _____
How much practice have you had solving word problems? _____ _____
Have your experiences with word problems been good? _____
If you are scared of word problems, explain why. _____ _____

Word problems are one of the most interesting parts of math because they call for a balance of left-brain and right-brain skills. Used alone, the right-brain techniques of estimating, juggling numbers in your head, and using intuitive skills will often produce a quick but unreliable answer. The person who uses only left-brain procedures may have trouble deciphering the problem, and may get unrealistic answers such as “34.3 people attended.”

A helpful right-brain technique is to guess the answer before trying to solve the problem. This helps because it requires you to understand the question to be answered. When the answer will be in some identifiable unit, such as pounds, miles, people or dollars, guessing helps you to focus on the terms of the question and enables you to consider realistic answers. Record your guess for later comparison; large differences can alert you to serious errors. Estimating sometimes alerts students to ridiculous solutions such as, “an automobile is traveling at the speed of 6275 miles per hour.” However after guessing, you must **follow the appropriate step-by-step process to get the correct solution.**

Solving word problems is basically a matter of identifying and sorting information. Sometimes all that is required is a literal translation into an equation. However, other word problems require interpretation. When you are having trouble interpreting word problems, read the problem once to get some idea of what is given, then read the problem again to search for the specific question being asked. After you understand the question, identify and record given values. This procedure provides you with a list of what is given and what you need to find.

Below is a list of steps that may be used when solving word problems. These steps are categorized as “left brain” or “right brain” to help you see which is natural for you, and which steps you would tend to skip. **If you are naturally a right-brain thinker, be sure to do the left-brain solution steps.** Write down all these steps when solving a word problem so it will be easier to retrace your work at a later time. Recording steps gives you a pattern to follow and helps you develop a habit of following a strategy.

Word problems provide your best opportunity to learn to enjoy math and see the value of math in your future. Since solving word problems requires breaking down a complex problem into more simple parts, it teaches a skill which is a valuable preparation for life.

Steps for Solving Word Problems	
Left-brain Techniques	Right-brain Techniques
1. Read and reread the problem	
	2. If you don't understand the problem, restate it in your own words
	3. Estimate the answer
4. Write a “let statement” → in the form: Let $x = \underline{\hspace{2cm}}$ (it is extremely important to identify what the unknown (x) is)	
	5. If possible, make a diagram (sketch or chart); label parts of the diagram with given values
6. Write an equation	
7. Solve the equation → the appropriate strategy should be deduced from the form of the equation	
8. Substitute values into the equation to check your answer(s)	Compare your answer to the estimate made in step 3
9. Write your answer	
Note: Steps 4, 6, and 7 are in bold type because they are the essential steps; their omission is the major reason right-brain thinkers have trouble with word problems.	

Skills used in solving word problems

What Else Can You Do?

We would like to add a few general suggestions that you might find useful when entering a math course. Also, several points made earlier are worth repeating. The following list includes both general suggestions and points repeated for emphasis.

1. Keep yourself in good health.
2. Always plan time for study and practice.
3. Think positively. Think, "I can do it!" Back up that thought with more positive self-talk and by working diligently on math.
4. Over learn! It builds proficiency, speed, and confidence. Over learning does not mean memorizing or cramming. Study for understanding.
5. Take time to learn math symbols and their meanings.
6. Get to know your instructor. Then you will feel more comfortable asking for help or discussing a complication.
7. Ask questions when you need help. Remember that nothing in math is obvious, so don't worry about asking dumb questions and don't let the instructor pass over points that aren't clear. Let the instructor know when you don't understand.
8. Don't let yourself fall behind.
9. Use scratch paper and take time to work problems as you study.
10. Reward yourself for doing a good job. Self-rewards can be used often to reinforce good work habits. They encourage effort and achievement if you choose them carefully.

Think about your priorities. What is your first priority? What priority is math? Giving math a high priority does not have to mean planning to spend more time on math than any other course. However, it might mean planning your math work for a better time slot and practicing math regularly.

Study Schedule							
6-7 am							
7-8 am							
8-9 am							
9-10 am							
10-11 am							
11-12 Noon							
12-1 pm							
1-2 pm							
2-3 pm							
3-4 pm							
4-5 pm							
5-6 pm							
6-7 pm							
7-8 pm							
8-9 pm							
9-10 pm							
10-11 pm							
11-12 midnight							



Chapter 6

Developing Test-taking Skills

Preparing for Tests

Much more important than how to take tests is how to prepare for them. Let's begin by talking about how to prepare.

Start today! Never put off studying until the night before the test!

The best way to prepare for tests is to review daily. Begin each math study session with a quick review; material you keep reviewing will become part of your long-term memory. Many students depend on short-term memory (which is where things almost always go when you "cram"). Short-term memory is not good enough in math because math is cumulative.

Review daily by working a few easy problems in each section; this does not need to take much time and often saves time by providing for quick recall of basics needed for solving a new kind of problem.

However, this kind of review won't help unless you understand the concepts. Don't let yourself get lost. Get help as soon as you realize you need it by asking questions in class and/or by talking to the instructor outside of class. If you think you need more help, use whatever tutoring services are available at your school or consider getting a private tutor. If you decide to use a tutor, go to each tutoring session with a prepared list of questions; doing that will help you get the most from the time or money invested in each session.

At the end of each study session, decide what must be memorized. It is easier and more effective to do this now than to wait until the night before the test. **Make memory cards**, or at least a list of things you need to remember. That will make final preparation for the test much easier and less frustrating.

Keep all work (tests, quizzes, and practice problems) for review. In chapter 5 we suggested using a 3-ring binder with a designated section for these items so you can find them quickly. Of course, reviewing them will not be very effective unless you know how to answer the questions and work the problems. As soon as you find mistakes, **correct the mistakes, and then practice working more problems like the ones you missed.**

Techniques for Test Preparation

1. Keep up! Don't fall behind.
2. Seek explanations and understanding of all concepts.
3. Continually test yourself over the material being covered.
4. Use corrected quizzes, tests, and practice problems to help you continue learning.

Making your own practice test can make test preparation a lot easier. Choose or make one or two questions each day using problems from lecture, class practice or homework assignments. You will benefit from taking your own practice test, and you could find someone else who is making practice tests and trade. Often your math textbook will have practice tests at the end of chapters or in the case of the GED test; there are official practice tests.

Work a complete practice test before you take the real test. Practice tests serve the same purpose as dress rehearsals; they help you anticipate some of those unexpected complications. They also help with psychological preparation, which is especially important if you tend to “go blank” on tests. Psychological preparation may include the following:

1. Know what to say when you talk to yourself. Use positive self-talk to bolster your confidence.
2. Remember the importance of feeling prepared. Prepare and then let yourself feel comfortable that you have done your best. Try to enjoy the challenge.
3. Develop and use relaxation techniques while waiting for the test.
4. After you get the test, look through it for problems you expected. Finding and working them will give you a feeling of confidence and get you off to a good start.

Physical preparation is also important. Physical preparation includes eating properly and getting enough sleep, especially the day before the exam. Proper diet is important every day because it helps you to avoid illness. It also helps you think clearly, and problem solving requires clear thinking.

Try to relax during the 30 minutes before the test. Trying to cram a few more things into your brain at the last minute usually does more harm than good because it creates a sense of panic. Rushing to the test or arriving late can also lead to a feeling of panic.

A little bit of test anxiety might be good because it tends to get the adrenaline flowing and sharpens your thinking. However, too much test anxiety, or panicking, can be devastating in math. Many students form a habit of panicking at tests, a habit that is aggravated by always cramming during the 24 hours before the test. Panicking and cramming can cause you to go

blank during the test. **The best ways to avoid test anxiety are to be prepared, feel prepared, and arrive on time.**

For any test, but especially a math test, it is important to arrive early enough to catch your breath and get organized. However, some people will develop more anxiety if they arrive too early. If test anxiety is a frequent problem for you, time your arrival carefully or bring along a newspaper to read until the test begins.

If you still feel yourself panicking, you might try more self-talk, or it might help to think about something else for a few minutes. If you experience extreme test anxiety, and nothing else seems to help, consider getting some relaxation training. Don't let test anxiety become a convenient excuse; using this excuse can become habit forming. **The major causes of test anxiety are (1) not understanding the concepts and (2) inadequate preparation.**

Depending upon how bad your test anxiety is you may want to arrive early enough to get a seat at the front of the room. People at the front usually get their tests first, and those extra seconds may help. You will also be in a better position to catch corrections or comments the instructor might make. It is easier to see corrections written on the board if no one is between you and the board.

Students who are not prepared usually run out of time and do not complete the test. Be prepared, then budget your time in a way that won't cause or increase anxiety. Don't rush! There is a big difference between rushing and pacing yourself by budgeting your time. It is a good idea to attempt each question, but trying to work too quickly usually results in so many errors that you lose more than you gain.

Suggestions for Taking Tests

1. Be on time.
2. Begin by writing down formulas you expect to use.
3. **Read the directions carefully.**
4. Survey the entire test before you begin answering questions.
5. Budget your time, but don't rush.
6. Do the easier problems first so you don't lose easy points. This builds self-confidence and may allow adjustment of your time budget.
7. Don't panic if you can't remember something—come back to it later.
8. **Show your work.** Then you can check or complete a problem later.
9. Do your own work.
10. **Use the entire test period.** Use any extra time to rework or check problems. Don't pay any attention to those leaving the exam early.

Read the directions carefully. Do not increase your work by doing more than you were asked to do. In particular, **do not rush through the directions.** Take time to be sure you understand what to do. Trying to solve an equation when there is no equation and the directions read, “Simplify the following expressions,” can really mess up your time and attitude. Watch for, and underline, words such as solve, simplify, expression, and equation in the directions, and then reread to be sure you know what you should do.

Budgeting test time does not mean you spend the same amount of time on each question. Occasionally check on your time, but don’t let time limits cause you to get frustrated and lose concentration. Also, don’t set a limit that is too short for working most problems. Time budgeting works best if you do the easier problems first, then you can reallocate the remaining time.

Why leave a test early? Check all work and then re-check if you have time. **Look for mistakes**—you may catch a major error.

If you use the techniques described in this section, you can expect to succeed in math. Remember, **preparation is the key to combating test anxiety.**

The suggestions made in this chapter provide an adequate framework for most students. If, however, you still have trouble after giving these ideas a fair trial, don’t give up. Talk with your instructor or someone who can help you analyze your study techniques and test-taking skills.

Taking the GED Math Test

Preparing for taking the GED Math test requires more than just learning how to work problems. Practice answering open-ended math questions. Be sure you understand the concepts. Consider practicing with another student so you can discuss your thinking processes in arriving at answers. Always judge the “reasonableness” of your answers. Be sure you are familiar with the GED test format. Be sure you know how to use the bubble sheet, i.e., how to bubble in answers and write in answers for alternate format questions. Below are a few more ideas for taking the GED Math test.

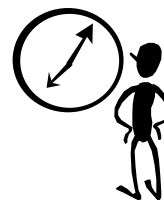
Arrive early: Be sure to arrive at the testing center early enough to get settled and relaxed before the test begins. To alleviate test anxiety and relax, take deep breaths (or use the breathing technique described in chapter 4) and visualize doing well.

Use the formula sheet: A page of formulas is provided with the test. Be sure you understand and know how to use every formula on the *Formula Sheet* prior to registering for the test.



Use the calculator: A Casio fx-260 scientific calculator is provided for use on Part I of the GED 2002 Mathematics Test. Be sure you know how to use the calculator and are comfortable using it prior to registering for the test.

Budget your time: You are allotted a total of 90 minutes to complete 50 math questions. However, the time and questions are evenly split between two parts. This means you have 45 minutes to answer 25 questions on Part I and 45 minutes to answer 25 questions on Part II.



The questions on each part of the test are arranged from less difficult to more difficult. One strategy is to answer all the questions that are "easy," then return to the harder questions. Since more time may be needed for the harder questions, do not spend too much time on the questions that are easy. Another important strategy is to answer every question. Be sure to bubble in a "guess" for all questions before time is up. Adequate preparation should keep guessing to a minimum; none of the questions should be surprising or too difficult.

Read and Understand: Read every question carefully. This may require reading it over two or three times. Understand what is being asked before beginning to find the solution. Look for key words. Words such as "not" or "estimate" can change the question entirely.

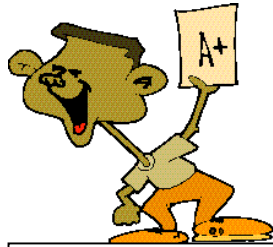
Multiple-Choice: Approximately 40 questions on the test are multiple-choice. Each multiple-choice question has 5 possible answers. Only one choice is correct. If you must guess, try to eliminate all choices that you "know" are incorrect. Do not leave any questions blank. Choose an answer for every question. There is no penalty for guessing.



Alternate Format: Alternate format questions are really just open-ended questions. Below is a list of strategies to help with these questions:

- Work the problem and find the answer
- Transfer answer to the answer book
- If answer does not fit, check your work
- No mixed number answers
- No negative number answers
- Print your answer in the answer boxes
- Fill in the corresponding bubbles
- Make sure bubbles match answer

Check Answers: If you finish early, use the extra time to check your answers.



Do Your Best!

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