

Tips for Success in Math
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Introduction

These tips for success in math, written by Cynthia Arem, Ph.D., author of *Conquering Math Anxiety - A Self-Help Workbook*, present a comprehensive, multifaceted treatment approach to reduce math anxiety and help you succeed in math. This unique approach involves anxiety management and reduction, confidence building, “Success in Math Visualizations,” learning-style enhancement, problem-solving strategies, effective math study skills and winning strategies for overcoming math test anxiety.

- Do You Really Have Math Anxiety?
- The Math Anxiety Process
- Learning to Manage Anxiety
- Overcoming Internal Barriers
- Positive Thinking is a Plus Sign
- Winning with “Success in Math Visualizations”
- Enhancing Your Learning Style
- Effective Math Study Skills: The Fuel of Excellence
- Conquering Test Anxiety
- Be a Successful Problem Solver
- Math is the Future

Do You Really Have Math Anxiety?

Math anxiety may be defined as negative emotional, mental, and/or physical reactions to mathematical thought processes and problem solving, caused by unpleasant or unrewarding math experiences. As a college counselor, I've worked with many students who self-identified as math anxious. But, all too often, the anxieties, fears, or blocking behaviors they described were not caused by math.

For many students, math acts like a conduit, bringing to the surface academic deficiencies, such as poor study skills, knowledge gaps, insufficient comprehension or inadequate test-taking skills. In addition, there are others who believe they are math anxious, but are, in reality, victims of test anxiety.

There are still others who feel overwhelmed or anxious in math because they missed or didn't master important preparatory coursework in their previous math courses. For these students, proper math placement or remedial help for math deficiencies are key factors for achieving math success. I've worked with students who were very anxious in college algebra, only to discover they had sizable knowledge gaps in their math background, despite the fact they never skipped a semester of beginning or intermediate algebra.

Each math course builds upon the previous ones. Each step is an essential building block for the next. When constructing a large, impressive skyscraper, we must be sure the foundation is strong and sturdy. And, as we go higher and higher in math, it is like building a tall, elegant structure. If you have missed important knowledge along the way, you may have to go back, find those missing blocks, and reconstruct or reinforce your building. Once you do this and your building stands on a solid foundation, you'll find math can be both rewarding and fun.

If the knowledge you are missing is substantial, you should consider actually repeating or, if possible, auditing some of the math courses you have already taken in the past. Many community colleges offer developmental math courses, such as the fundamentals of math and beginning algebra. You may also be able to find courses that are modularized or separated into smaller units so that you can elect to take only the necessary unit(s) to fill in your background.

What are your goals for success in math? What do you want to achieve? If you're taking a math class now, what do you want to get out of it? Why are you taking the course? Why does your school think this course is important in your curriculum? What grade is acceptable to you? What does successful accomplishment in math mean to you? Your math success will happen by your design and not by chance. You *can* have the math success you want!

In the following exercise you are asked to identify a math achievement goal. For example, "I want to be able to solve quadratic equations," or "I want to learn how to work out the word problems in my math book," or "I want to successfully complete my Calculus 1 course this semester." It's important for you to be certain and not have doubts about your goal. Present it without alternatives. The less conflicted you are about achieving your goal, the greater the probability of accomplishing it. After identifying your goal for math success, you will be taken through a series of steps for developing a plan for math success.

Exercise: Your Plan for Math Success

Steps to Follow:

1. Write one realistic math success goal you wish to achieve. State it in specific, positive, measurable terms. Write out, in detail, exactly what you want.
2. Decide on a realistic target date for achieving this goal.
3. Describe the benefits and potential satisfactions, both tangible and intangible, for achieving this goal.
4. List the barriers or obstacles you may face and steps you'll take to overcome them.
5. Identify the positive forces and abilities you can use or strengthen to meet your math goal.
6. Identify the people who can help you achieve your goal.
7. Write down the *action steps* you need to take to meet your math goal along with the target dates for completing each step.
8. Describe how you will reward yourself for meeting your math goal.

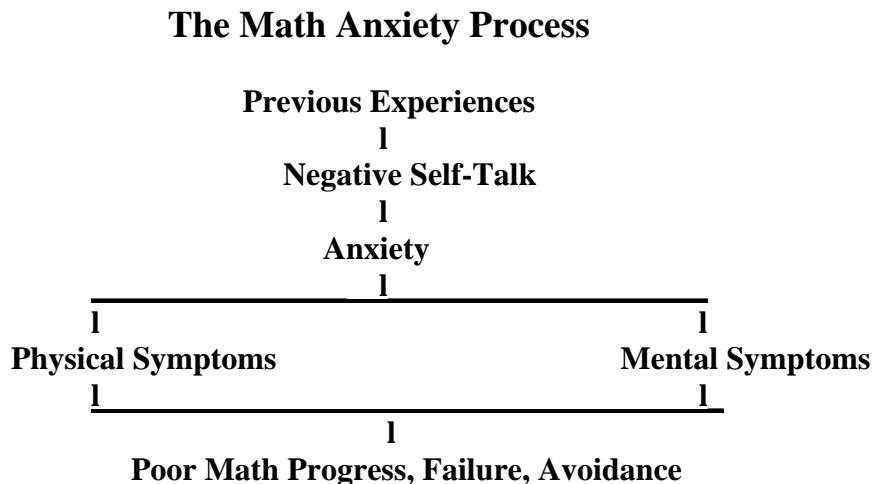
The Math Anxiety Process

When we investigate the roots of students' math anxiety we see many have encountered poor teaching methods, embarrassments, poor curriculum, negative life experiences, social pressures and expectations, desires to be perfect, negative math games, math myths, gender stereotyping, and socialization. There are students who had the misfortune to encounter unkind people who did not help foster and often squelched their positive math feelings. Perhaps you, too, were victimized by such people. They were unkind to your blossoming math skills. They did not act in your best interest. They perpetuated a negative and untrue belief about your ability to learn math.

My strong message to you is: *Your past negative math experiences needn't continue to burden you.* I encourage you to throw off the shackles of the past. Say to yourself, "I can and will succeed in math."

Unpleasant encounters with math in formative years can be ruinous to subsequent learning. Students who were made to feel bad about math, in their early years, become wary and prejudiced against it, mistrusting their own abilities. New experiences in math, seen in light of the old, are tarnished by the troubled past, which only accentuates and reinforces long-entrenched negativity. Bad feelings persist, impairing prospects for learning new material and generating anxiety and self-doubt.

Math-anxious people often say things to themselves such as "I'm stupid," "I'll never be able to do math," "I'll fail," and "Why do I need to know math anyway?" Soon a continuous flood of negative talk about math ensues; before long, anxiety, overwhelming fears of failing or looking stupid, and panic set in. Physically, these people may experience nausea, perspire profusely, develop a headache or tight muscles, or exhibit a number of other physical symptoms. Mentally, they become confused or disorganized, make lots of careless errors, forget formulas they knew or blank out. The end result: poor progress, avoidance of math, and feelings of failure. I have diagrammed this process in the figure below.



When doing math, pay scrupulous attention to what you really think and feel. Negative self-talk is usually the culprit keeping alive past negative experiences. It also tends to cause high anxiety. Writing a journal is an effective means of becoming aware of all your inner mind chatter surrounding math. By keeping a math journal of your current math experiences you will gain important insights into how your thoughts and feelings affect your math success. I encourage you to heighten your awareness of what you are saying to yourself when doing math. What are the situations and ensuing self-statements that trigger your anxiety?

Exercise: My Math Journal

Whether you're taking a math course or not, there are many daily life situations in which math is needed. Starting *today*, keep a journal about your everyday experiences using math. Make at least two entries per week answering four major questions:

1. **“What situation required me to use math today?”**

2. **“What I said to myself and how I felt during and after the situation.”**

Listen carefully to your inner voice and note all your mind talk. Record all feelings and sensations.

3. **“What I've learned about myself.”** It is here that you start to find ways to overcome your specific anxieties in math. Here you must objectively look at what you learned from this current math lesson. Write down everything you learn from observing your current math experiences.

4. **“What I'm going to do about it.”** Having identified what you've learned from this experience, you're now asked to make a commitment and take some positive actions. Ask yourself: What can I do to feel better about math? How can I increase my chances of math success? What can I say to myself to feel better about my math abilities?” Describe all the steps you are willing to take.

As you continue to keep this journal in the next few months, more ideas will come to you regarding the most relevant steps you need to take to succeed in math. Jot them down; capture all your ideas on paper.

Learning to Manage Anxiety

Anxiety can be your friend or your foe. With too little anxiety, you can feel lazy or unmotivated. On the other hand, when you experience too much anxiety, you may feel confused, inadequate, or panicky. Images of doom and disaster loom over you.

With just the right amount of anxiety you can think clearly. Your memory is sharp, perceptions accurate, judgments good. Maintaining the proper amount of anxiety helps you perform at your best. The goal of anxiety management is not to alleviate all your anxiety but to help you learn how to manage and fine tune the anxiety you have.

Let's look at what physical changes occur when you experience an anxiety reaction. Your body reacts as if it was in danger and prepares for possible fight or flight. For example, the muscles of your arms and legs tense, anticipating the need for action; the pupils of your eyes dilate, letting in more light to sharpen your eyesight; your heart rate increases to circulate blood more rapidly to the brain and vital organs; and respiration increases to provide more oxygen to the tissues. All of these reactions are perfectly suited for survival when dealing with real-life emergencies.

Working out a math problem is obviously not a life-threatening event, but you may be approaching it as if it were. You may be focusing more and more on fearful, negative self-talk and on these bodily sensations. This only serves to increase the anxiety and tension in your body. In a later chapter, we will deal with ways to change the negative self-talk and negative attitudes toward math that feed into this anxiety process and continuously threaten to make it overpowering.

As your anxiety reaction intensifies, the changes in the rate and pattern of breathing tend to be more pronounced. Instead of breathing from the lower lungs, you begin to breathe much more rapidly and shallowly from your upper lungs. You may not even be aware of this more accelerated breathing. As you breathe more quickly, you expel carbon dioxide too rapidly. This produces hyperventilation, a condition resulting in the uncomfortable bodily sensations math-anxious students experience. Some symptoms include confusion, inability to concentrate, shaking, fatigue, muscle spasms or pain, difficulty swallowing, tightness in the throat, choking sensations, shortness of breath, dizziness, irregular heart rate, numbness of the extremities or lightheadedness.

This process, if not stopped in its tracks, can lead to a total panic reaction in which you may avoid doing math, freeze up, or actually get sick when approaching math. The following is the most important principle you need to know for managing anxiety: ***By changing the rate and pattern of your breathing (during anxiety-producing situations) to a deep, slow breathing pattern utilizing your lower lungs, you can bring a sense of calm and ease to your body and mind.***

By regularly practicing relaxation exercises you can master your anxiety. You will be able to quiet your mind and body and restore homeostasis, your body's internal equilibrium. The Calming Breath exercise described below teaches you how to calm yourself physiologically and prevent panic from setting in. Instead of automatically breathing rapidly and shallowly with your upper lungs, you learn to breathe gently, slowly, and fully from your lower lungs. This technique is particularly beneficial when used before entering a math situation in which you are very anxious. By practicing it daily, you will learn how to relax yourself quickly and readily.

Exercise: The Calming Breath

Practice this exercise once or twice each day for 5, 10, or 20 minutes each time. You can also listen to this exercise on the CD accompanying this book.

Sit in a comfortable position with your eyes closed. Slowly and gently inhale, concentrating on filling your lower lungs completely and expanding your abdomen. Then, very slowly and easily, exhale . . . saying, “relax” as you do so.

Continue breathing in this gentle, slow manner, always filling your lower lungs and then, very slowly, exhaling, saying, “relax.” Feel yourself becoming more and more relaxed with every breath you take. Continue for approximately 10 more minutes.

Overcoming Internal Barriers

How do you handle life's problems when they emerge? A psychology professor once said to me, "I've noticed that how my students deal with math is how they deal with life's problems." I soon recognized the wisdom in this statement. For example, as a counselor I found that students who avoided math were often also avoiding other situations or personal problems in their lives. I've seen students who become so frustrated with their slow math progress that they give up too easily. They stop trying. They don't study or seek help. They eventually have no other alternative than to drop their math course. Invariably, these same students repeat this "give up too easily" pattern in other courses or life situations, as soon as "the going gets rough."

On the positive side, there are students who face their math difficulties as well as life's obstacles as challenges that can be successfully mastered. They work to build their confidence in math, to establish a good math foundation, to chip away at problems as they arise. As in life, they are determined and persistent in tackling problems.

An important step in overcoming life's problems is for you to be introspective and observe your own behavior and thought processes. As with life's problems, overcoming math anxiety starts with self-awareness. Ask yourself: Is it possible that I may be doing something to stop myself from succeeding in math? Am I creating internal barriers or obstacles that impede my academic progress? Through reflection and self-awareness, you can discover whether you are sabotaging your own progress. Armed with this knowledge, you can then take decisive action to change and prevent these obstacles from ever again standing in your way. Once you realize what you do to handicap your own progress, you can make a conscious decision to take corrective action.

Students can do many things that sabotage their own math success. Ask yourself: Do you really want to overcome your problems with math anxiety? Are you willing to put in the time and effort needed to be successful in math? Are you determined and persistent? Are you willing to deal with your obstacles *now*? Once you are aware of how you stop yourself from succeeding, you can consciously decide to change this situation. Here are just a few ways you may be undermining your own math progress:

- You tell yourself negative things about math.
- You avoid seeking adequate math help when you run into difficulties.
- You tell yourself and others you just can't do math.
- You avoid studying for math tests until the last minute.
- You give math your bare minimum.
- You give up on math too easily.

Remember, these are your own barriers to your future success. You can decide, right here and now, to do things differently, to overcome your own internal obstacles.

The following exercise is a variation of the journal writing exercise described in the previous exercise. It can help you confront word problems, a nemesis for many. As you are doing these problems, carefully observe your thoughts and feelings and see if they impede you in any way.

Exercise: Word Problem Log

Many people fear word problems. Faced with one, internal barriers go up and walls seem to appear from nowhere. As you read the following word problems and begin to work them out, pay attention to how you feel, what you say to yourself, and how this inner dialogue inhibits your progress. Don't worry if you're not sure how to approach these problems—it's not the solutions but how you feel about being asked to solve them that is important. You may be quite surprised at what you learn about yourself. You will find the answers to these two problems at the end of the next exercise.

Sample Word Problems

1. A business executive left her car in an all-night parking garage for three and a half days. The garage charges either an hourly rate of \$1.25 or a daily rate of \$24 for whole or partial days. Is she better off paying the hourly or the daily rate?

2. Eileen is 4 years older than Monika, who is 2 years younger than Philip. Philip's twin brother, Mark, is best friends with Joe, who is 4 years older than he. Joe baby-sits for Tom and his newborn baby sister, Julie. Julie is 14 years younger than Joe. How old is Eileen?

My Thoughts and Feelings

Positive Thinking Is a Plus Sign

What do you say to yourself when you're having trouble figuring out a problem? Do you say things like: "I'll never be able to do math; I'm overwhelmed." "Who needs math anyway?" Why bother?" Do you feel no matter how hard you try, you'll never be able to succeed? Have you ever thought, perhaps your negative attitude toward math diminished your ability to succeed in it?

Educators have known for centuries, a student's academic success depends on more than innate ability, competence, or the desire to learn. The key ingredient that must be present is a positive attitude toward learning. If you have a negative math attitude, the time has come change to it to a positive, growth enhancing one.

One thing is certain: If you maintain a positive attitude toward math and your ability to do math, you have discovered the supercharger that will propel you toward your math success goal. Tell yourself: "I can and will succeed in math. I am a winner and I can do math." Believe you will succeed in reaching your math goal and you will!

To feel better about math, why not put some enthusiasm into your work? Enthusiasm can make everything you do easier. It gives you the "oomph," the energy, and forward momentum to achieve anything on which you set your sights. When you become enthusiastic about a subject, your motivation increases and learning improves.

To become more enthusiastic about math, it helps to explore and view it from different angles. Start asking more questions, let your curiosity fly. Search out different math books to further explain a difficult topic and to give you a deeper understanding of it. In addition to increasing your enthusiasm, it is a great study-skills strategy.

Begin to pay attention to the usefulness of math in your everyday activities. Look on the Internet for math games and math puzzles. Seek out interesting math facts or curiosities. See how math affects every aspect of our lives. Math is amazingly pervasive.

A positive attitude and enthusiasm affects everything you do. Adding it to your work with math will make you feel better. And even if, at first, you don't feel like being enthusiastic—*fake it!* If you start to act enthusiastic and motivated, guess what? Your mind starts to believe it, and before you know it, you are feeling better. So go enthusiastically to math class. Really want to be in class and to be learning the material. Listen and become intrigued, take lots of notes, ask questions with interest and motivation. Do your homework with gusto. Put vitality into your studying. *Don't* grumble to yourself, "I have to take math." Instead, tell yourself, "I choose to study math—it's a great opportunity." It's okay to fake it - pretty soon, it will all be true!

Never underestimate the power of thought. It is your thought power that directs you in your pursuit of life. If you think you're stupid, if you think you can't do math, if you think you'll never succeed in math—you're *right*. You are what you think you are.

So, beginning today, think positive thoughts about yourself and about math. Let an optimistic, radiant glow gradually build inside you, a feeling based on the thought, "I can do it!" You must vaccinate yourself against thinking failure! Use positive statements whenever talking about math, and say them as if you mean it. Say and think: "Math is great; I'm liking math more each day; Solving math problems gives me a great sense of

accomplishment; I really love challenging my mind with math problems; I'm winning at math and I love it!"

Exercise: Challenging Negative Self-Talk

Every time negative statements about your abilities or about math come to mind, take note of them and then immediately change or challenge them. Ask yourself these questions:

1. Is this self-talk actually hurting or helping me with math?
2. Does this self-talk affect how I feel about math and my ability to do math?
3. Is this statement distorting reality? If so, what is the objective reality?
4. Is this statement 100% true? Is there room for doubt?
5. What evidence do I have to prove it is true?
6. Even if it is true, does it make me, or math, bad?
7. What is a more reasonable statement I can say to feel better about math?

Exercise: Positive Affirmations

Here are some positive affirmations to help you succeed in math. Check the ones you believe would be most helpful on your path to math success. Add your own. Repeat these statements often to yourself. Remember to substitute these or similar positive affirmations any time negative thoughts about math enter your mind.

- _____ 1. I'm becoming a good math student.
 - _____ 2. I'm learning more math each day.
 - _____ 3. I'm capable of learning math.
 - _____ 4. I have good abilities in math.
 - _____ 5. I allow myself to relax while I study math.
 - _____ 6. I remember more math each day.
 - _____ 7. I am relaxed, calm, alert, and confident in math.
 - _____ 8. My math improves every day.
 - _____ 9. I can understand math if I give myself a chance.
 - _____ 10. I enjoy math more each day.
- (Add your own positive affirmations)

Answers to the sample word problems in the "Overcoming Internal Barriers" Word Log Exercise:

1. The daily rate is \$24 times 4 days, totaling \$96. This is better than the hourly rate of \$1.25 times 84 hours, totaling \$105.
2. Eileen is 12 years old.

Winning with “Success in Math Visualizations”

We all have the ability to visualize or see images in our minds. You can use your visualization skills to construct an environment conducive to achieving math success. You can learn to harness your creative energies to realize your fullest math potential.

“Programmed Positive Visualization” (PPV) is a technique to help you visualize very clearly whatever changes you want to make in your life and to see your life, as you want it to be. It is the deliberate use of the power of your imagination to create your own positive reality. You might rehearse an upcoming math exam, imagine yourself calm and clear in math class, mentally practice asking your teacher for help outside of class, or perhaps see yourself solving difficult problems with ease. You *can* program yourself to succeed in math! Here are guidelines to set up your own programmed visualization:

1. State clearly to yourself the math success goal you would like to accomplish.
2. Truly want what you imagine. The fewer doubts you have, the better.
3. Practice the Calming Breath technique you learned in Part III, Learning to Manage Anxiety.
4. Once deeply relaxed, picture yourself achieving your math success goal.
5. Build a sequence of positive steps in your mind portraying the fulfillment of your goal. Each step should clearly take you in the direction you want to go.
6. Your visualization will be more effective if you are aware of all your senses.
7. Say to yourself positive self-statements to help you feel good and reinforce your progressive movement toward achieving math success. Say them to yourself over and over again during your visualization.
8. Believe you can and will attain the success you work toward and visualize in your life. Push away all negative thoughts.
9. Once you have designed your visualization, decide on a specific time each day to relax and go through this imagery. After relaxing, repeat your positive affirmations to yourself several times. Then, visualize a gradual progression through the steps leading to your goal, ending with the image of your goal successfully achieved.
10. Each day, no matter where you are—on your way to class, exercising, falling off to sleep—visualize your goal and create positive images of achievement in your mind. Always picture the goal as exciting and stimulating. See yourself as successful *now!*
11. Continue this process of relaxation and visualization each day until your math success goal becomes a reality for you. You may then want to repeat this process with a new goal and visualization.

Most students who are successful and confident in math have learned the one important thing that sustains them: *focus on the positive*. These students have a storehouse of positive images in their memory to readily recall whenever the going gets rough. Past positive experiences are the foundation for future successful ones. If you recall only positive, pleasant experiences related to math, you can boost your confidence whenever you need to. Is your memory bank a powerhouse of positive images? Here is an exercise to help you deposit only positive images in your memory bank.

Exercise: A Memory Bank of Positive Images

Successful students build their confidence on all the little accomplishments accumulated and stored in their memories. Each night before going to sleep, think of positive, enjoyable math experiences. Evoke only good, pleasurable images. Recall even the smallest accomplishments. Deposit only good math images in your memory. This process will boost your confidence and improve your self-esteem about doing math. Allow the challenge of math to confront all the strength and power of your memory. Whenever necessary, simply draw on this powerhouse of good math memories. There are no penalties for early withdrawal—only lots and lots of interest!

Exercise: Rehearsing a Forthcoming Math Situation

Do you get nervous before math class? Does it upset you to ask your math instructor a question? To help you deal with these or other difficult situations, I suggest you practice this simple technique. Take about 10 minutes to relax and calm yourself using the Calming Breath technique described in Part III, Learning to Manage Anxiety. Once you are relaxed, imagine the difficult situation and then visualize yourself calmly and peacefully handling it with competence, self-assuredness, and adeptness. See the situation going well for you, and you remain calm and composed throughout. This visualization should be practiced several times in the days before the actual event occurs. It is particularly important to practice it in the half-hour preceding the event.

Enhancing Your Learning Style

Would you like to improve your understanding and retention of new or difficult math concepts? Would you like to discover ways to increase your concentration? By understanding and working with your unique learning style, you can greatly enhance your math achievement. You'll study better, feel more excited about learning math, and your test scores will be higher.

Your learning style has been forged from a unique mixture of perceptual preferences, personal attributes, individual background, childhood experiences, and environmental cues. By knowing how these factors influence you, you'll be able to intentionally choose the most effective learning environment and strategies to meet your individual needs.

One significant aspect of your learning style is your perceptual preference. Three major perceptual learning channels have been identified: visual, auditory, and kinesthetic/tactile. People who are visual learners learn best by *seeing* or visualizing words and numbers written out. Auditory learners learn best through *hearing* math explained to them or saying math to themselves. Kinesthetic/tactile learners need to be involved in the learning process through *touch* or *whole-body movement*. You may find one channel is dominant for you and a second one further strengthens your learning. Research shows that, when students are introduced to new material through their preferred perceptual channel, they remember significantly more than when they are taught through their least preferred channel.

Are you a visual learner? Must you see math problems before you can comprehend them? Here are a few strategies to enhance your math achievement if you consider yourself more of a visual learner:

1. Always take written notes when someone explains math to you.
2. Make your own drawings or diagrams when figuring out word problems.
3. Use flashcards to review all important concepts and key terms.
4. Use two or more math books when studying math.
5. Always write in your textbook. Underline or mark key words & concepts.

Perhaps you are an auditory learner. Do you prefer to have someone explain math to you rather than read about it or see it on paper? If so, these strategies may help:

1. Tape record your math lectures and listen to them over and over again.
2. Ask lots of questions in class, after class, and in help sessions.
3. Ask your math teacher to repeat important concepts and key terms.
4. Read your class notes and textbook notes aloud.

Maybe you feel more like a kinesthetic/tactile learner. Do you prefer real-life experiences with math, manipulating it, and experimenting with it? Do you like to move around when you study, pace the floor, or shift positions often? If so, try these strategies:

1. Work out lots of math problems. Do, do, do. Practice, practice, practice.
2. Convert what you are learning in math to real-life concrete experiences.
3. You may have to move, rock or shift positions often during the learning.
4. Use math software programs or workbooks.
5. While engaging in physical activities, mentally review math concepts.

Some other factors influencing learning style include: time of day we study, lighting conditions, sound level, temperature, room design, your food intake, clothing you wear, and whether you prefer studying alone or with others. The following exercise will help you become aware of how these factors influence your learning.

Exercise: Factors Influencing Your Learning

For this exercise observe your own behavior patterns so you can determine when your energy is highest, you concentrate the best and what sounds, lighting conditions, temperatures, foods, and other conditions increase or decrease your ability to learn math.

1. When is your energy at its highest? What time of day do you concentrate best?
2. Which sound conditions work best for you when you study math? Do you like to study in a very quiet place, free from all distractions, or must you hear music or activity around you?
3. How does lighting affect your ability to study and learn? For example, do you prefer natural lighting or do you prefer curling up under a soft incandescent lamp?
4. What temperature conditions work best for you when you study math?
5. In what type of environment do you learn and concentrate best? Do you like to study in a big, soft, comfortable chair or couch? Or maybe you study best at a desk, seated in a nicely cushioned straight-backed chair.
6. Do you think better if you snack when you study? How do your meals affect your ability to concentrate? After you eat a meal, how long does it take for you to reach your best level of concentration?
7. Are you a loner when you study or would you prefer studying with others?
8. What are your favorite clothes for studying? What clothes make you feel successful and sure of yourself when taking tests?

After answering all these questions, make an action plan that brings together all the conditions under which you learn or study best.

Effective Math Study Skills: The Fuel of Excellence

Math isn't the same as other subjects. Strategies to help you study and learn Psychology, History, or English won't necessarily help you with math. There are studying techniques that work best for math; master them, and master good habits that breed success. These strategies are highlighted below.

1. **Correct placement in math is key.** If you take a math course too advanced for your level of understanding, your anxiety level is sure to increase. Take your school's math placement exam, if there is one, because it can help place you properly.
2. **Never skip a semester while taking math if you can help it.** One study showed that after skipping one year, students had lost approximately two-thirds of their elementary algebraic knowledge.
3. **Learn math in small chunks.** Choose a math class that meets as many times a week as possible. For most three-credit college courses, this usually means meeting three times a week during the regular semester. Remember, the more days per week, the better.
4. **Scheduling is important.** If you're a night owl, don't take an early morning math class. Also, avoid scheduling anything immediately after your math class. Use this time to review and reinforce the concepts you just learned.
5. **Choose a good math teacher.** Choose a teacher who explains concepts well; teaches according to your learning style; welcomes questions before, during, and after class; has office hours for outside help; has a positive attitude toward students; and gives fair tests.
6. **Learning math takes time.** Math requires persistence, concentration, patience and lots and lots of practice. Successful students usually study math for at least two hours daily.
7. **Stay current in math.** Don't fall behind or the entire course will become a struggle.
8. **Don't cut math class.** Successful students are more likely to attend all classes.
9. **Take full class notes.** Your class notes and your text notes are like your bible in math.
10. **Be an active listener in class.** Pose questions to keep up your interest and further your understanding. Always remember, you have the right to ask questions of your teacher before, during, and after class. There is *no such thing as a stupid question!*
11. **Always review math immediately after learning and then again 8 hours later..** Make a commitment to yourself to review regularly throughout the semester.
12. **Practice, Practice, Practice.** Make problem solving a part of every study session. As a rule of thumb, work out at least ten problems per study session and review five problems from previous study sessions.
13. **Constantly test and retest yourself.** When you study, test yourself repeatedly on each new principle you learn. This will lock the concept into your mind.
14. **Study no longer than 20-40 minutes and then take a five minute break.** Studies show short study sessions are much more effective than sitting for hours without breaks.
15. **Reward yourself for good studying.** Rewards increase your motivation for studying math and discourage procrastination. A principle we learn from behavior modification is that if a behavior is rewarded *after* it is performed, it is more likely to be continued.

16. **Read the chapter before and after class.** Make it a practice to familiarize yourself with your assigned chapter *before* attending math class. After class, read it in greater depth, and do practice problems.
17. **Read your math book slowly, every word is important.** Math books are usually written succinctly and to the point. Each word is carefully chosen to explain a concept.
18. **Use additional resource materials.** Use your textbook's student study guide. It will provide you with lots of problems for practice. Also use two or more math textbooks when studying. They, too, provide additional problems to work out.
19. **Get help fast.** Seek help immediately when you have difficulty with a new concept.
20. **Find a good "study buddy."** A study partner can help you learn new material, reinforce difficult concepts and test your knowledge. *Caution:* Always avoid studying with someone who puts you down or makes you feel dumb or stupid.

Exercise: My Commitment for Improvement

List the five most important study skills you've learned in "Effective Math Study Skills" and that you're willing to act upon within the next month.

- 1.
- 2.
- 3.
- 4.
- 5.

Conquering Test Anxiety

Have you ever experienced test anxiety on math exams? Test anxiety may result from poor test preparation and test-taking skills, psychological pressures, or poor health habits. Here, we explore how to deal with each of these troublemakers.

Practice Effective Test Preparation and Test-Taking Strategies

1. When a test is announced, check in advance the format and the concepts to be covered.
2. Review each concept and solve lots of difficult problems illustrating these concepts.
3. After completing your review, design your own sample practice exams covering each topic. Choose questions from your text, other math texts, study guides or math software.
4. If your exam is timed, take several timed practice exams. Practice, practice, practice.
5. Learn to recognize problems out of the context of your textbook or class notes. Note the types of questions causing you too much difficulty. If needed, get help fast.
6. Use your practice exams to analyze what typical errors you are making.
7. To avoid others' preexam jitters, arrive at the exam just on time and speak with no one.
8. As soon as you receive your math exam paper, on the top corner write *all* the formulas, rules, and key information you'll need. This becomes a handy reference guide.
9. Note the time limit and the point values for each question, particularly those that carry more value. Give yourself more time for questions having higher point values.
10. Read the test slowly and carefully, then circle or underline significant words.
11. Start the math test with the easiest problems first. You need not go in order.
12. When working on a difficult problem, write down whatever you know. This often helps in solving the problem. The answer might come to you as you work on it.
13. After finishing the test, verify your solutions. Does the answer make sense? Next, proofread your test. Look for omissions. Check to see if you've made any of your typical errors. After you leave the test, reward yourself for a job well done!

Dealing with Psychological Pressures

Research shows that anxiety influences performance. Some anxiety is good; it helps you perform at your best. But with high anxiety, you may make careless errors, freeze up, go blank or even panic. The key to optimal performance on exams is to learn how to manage your anxiety. You may do this by using the following three-pronged approach:

- (a) Reverse Negative Self-Talk.** Challenge all negative thoughts and reverse them to positive, self-enhancing statements. Keep your inner dialogue positive and reinforcing.
- (b) Use Calming Techniques Before and Throughout the Exam.** Breathe slowly from your lower lungs during the exam, while continuing to say positive self-statements. Push away all distracting or disturbing thoughts. Focus on staying positive and calm.
- (c) Practice Visualization in the Days Before the Exam.** While in a deep state of relaxation, visualize yourself feeling confident, capable and successful while taking your math exam.

Performance Health Tips

1. Make it a rule to get 7 to 8 hours of sleep regularly, especially before tests.
2. Allow time each day to meditate or relax.
3. Exercise 20-30 minutes several days a week. Don't stop exercising around test time.

4. Two hours before an exam, eat small, low-fat meals with 3 or 4 ounces of protein.
5. To induce sleep the night before the exam, eat a dinner high in carbohydrates.
6. Don't eat foods with high fat content before the exam. They will make you lethargic.
7. Avoid excessive use of caffeinated beverages, such as coffee or soda.

Exercise: Math Test Anxiety Reduction Checklist

- _____ I've reviewed and worked out lots of problems.
- _____ I know the format and content of my upcoming math exam.
- _____ I know how many questions will be on my exam and its duration.
- _____ I've given myself several practice exams.
- _____ On practice exams, I've noted areas of difficulty so I can strengthen them.
- _____ I've analyzed my past pattern of typical errors so I can be alert to them.
- _____ I've gotten 7 to 8 hours of sleep in the days prior to the exam.
- _____ I've kept up a regular program of moderate exercise.
- _____ I've practiced relaxation exercises along with positive visualization in the days and the half-hour before the exam.
- _____ I've eaten a small meal of low-fat protein 1 to 2 hours before the exam and avoided too much caffeine.
- _____ I'll arrive at the exam on time and avoid talking with others.
- _____ Throughout the exam, I'll remain relaxed and positive, checking my breathing.
- _____ I'll say positive self-statements to myself and push away all disturbing thoughts.
- _____ I'll write key formulas and concepts on the exam sheet before beginning the test.
- _____ I'll quickly read through the exam, note point values, and schedule my time.
- _____ I'll proceed comfortably throughout the exam, working first on the problems that come most easily to me.
- _____ I'll carefully read the directions to all problems and circle significant words.
- _____ After finishing the exam, I'll check my answers, proofread for omissions, and check for my typical errors. Then, I'll leave and reward myself for a job well done!

Be a Successful Problem Solver

How do mathematicians think? Mathematicians train their minds to think logically. In this type of thinking, when given a problem, the person proceeds step by step, using specific rules, to draw a conclusion or derive a solution. This is not to say problems can't be solved in other ways, for they often are.

Some students intuitively solve equations or problems. They are certain they know the answer but cannot explain how they got it. Others use their own personal approaches to problem solving and have been successful. There are still others who look at how similar problems are solved, and through comparison and association, they figure out the current solution. These are all fine ways to solve problems, though none is a fail-safe method for consistent success. By learning a mathematician's disciplined, logical thinking approach, you will have more resources to successfully tackle and solve more and more math problems.

In mathematician George Polya's famous book, *How to Solve It* (Princeton University Press, 1971), he published his classic problem-solving model, along with a host of suggestions, advice, rules of thumb, and strategies for solving problems. His problem-solving model has four steps: 1. Understanding the problem. 2. Devising a plan, 3. Carrying out the plan. 4. Looking back. This model will help you follow a logical thinking approach, starting with some given information and proceeding step by step until you reach a reasonable conclusion.

In the first step, ask yourself to restate the problem in your own words. What is this problem really asking you to do? What are the unknowns involved? What information does the problem give you and what is missing?

In step two, you look for patterns. Ask yourself: Is this problem related to previous problems I've solved, preferably simpler ones? Can the same technique used on previous problems be used here? If I can't find a similar related problem, is it possible to restate the present problem? Can I draw a chart, table, diagram, or model to illustrate what is being sought? Can I work backward? Can I "guess and test?"

If you still can't figure out how to solve the problem, can you divide it into small parts and identify subgoals to solve? This is "divide and conquer." No matter what, don't get discouraged, because even Polya says, in addition to formerly acquired knowledge, good mental habits, and concentration on purpose, you may need "good luck."

In Polya's third step, you are to carry out a plan. You perform the necessary computations. You do all the geometric or algebraic operations you identified in step two. Check each step of your plan as you proceed, either using a formal proof or your own "intuitive" approach. What's neat about Polya's guidelines is his integration of intuition with logic.

In the final step, you check the result of your problem and interpret the solution in terms of the original problem. Ask yourself: Is there another, more direct solution?

After your solution is found, Polya urges you not to shut your book or look for something else to do. Try to determine other related or more general problems for which your results or methods would work. He says, "By looking back at the completed solution, by reconsidering and reexamining the result and the path that led to it," you can

consolidate as well as acquire well-ordered, ready-to-use knowledge and further develop your ability to solve problems. Polya's problem-solving approach is certainly very straightforward and makes good sense.

Exercise: Practice Logical Sequential Thinking

Logical sequencing skills help mathematicians in solving problems. This exercise uses a top-down programming approach to develop these skills.

- Level 1. Describe a difficult situation you would like to solve.
- Level 2. List three or four possible ways to approach the problem.
- Level 3. For each of the approaches listed, identify at least two steps you'll need to take to implement the approach.
- Level 4. For each step listed in Level 3, identify what further steps need to be taken. Continue this process, listing the smaller and smaller steps needed.

Math Is the Future

If you've come this far, you've proven your mettle. You've demonstrated toughness, a willingness to explore new directions, and a refusal to give up. Perseverance and steadfastness do pay off. The rewards abound. Math is the link.

Math opens the doors to your future. To be an active, concerned member of this world, you must use the power of math. To be successful in school; to have a rewarding, stimulating career; to get the jobs you want; to be an involved citizen; to have a knowledge of personal finances, the nation's economy, and the technological advances of modern-day society—all these require you have an understanding of math.

Math is far more than the ability to calculate, memorize formulas, or solve equations. Math trains your mind to think logically and succinctly. It requires you to perceive patterns, observe relationships, clarify and critically analyze problems, deduce consequences, formulate alternatives, test conjectures, estimate results, and enhance your problem-solving abilities. By sharpening your reasoning and thinking skills, you can become more productive in every facet of your life.

Math provides you with the resources to comprehend the barrage of information communicated to you each day. It gives you the ability to be a critical reader of anything you read, from newspaper reports and research articles to insurance policies and loan documents. Math logic, reasoning, and thinking ability help you to ascertain possible risks or fallacies, to unearth biases, and to come up with suggestions and alternatives.

It's no wonder so many careers require math skills. Employers want to hire individuals who can solve problems, who can think clearly on the job, and who can deal with new ideas, ambiguity, and change. We are constantly being flooded with technological advances, new scientific discoveries and new knowledge. Are you prepared for this challenge?

Math-anxious students frequently ask, "Why do I have to take math?" This question came up so often I decided to interview students who enjoyed studying math to see how they would answer them. Here are some of their responses:

"Name a good-paying job that doesn't require math."

"Math affects everything I do: balancing my checkbook, checking over my bills, paying my credit cards, following my investments, shopping for bargains, buying a car, figuring out my taxes."

"Math is one of the first courses where I was taught how to think and to reason. It's helped me think in a methodical way, step by step until I can draw a conclusion."

"Math describes what is going on around us. It answers why things do what they do."

The National Research Council (NRC) reports 75% of all jobs require proficiency in basic algebra or geometry as a prerequisite for licensure or training. In addition, more than three-quarters of the nation's university degree programs require more advanced math such as calculus, discrete math, statistics, or comparable mathematics.

The National Council of Teachers of Mathematics (NCTM) finds students who progress through mathematics are more likely to succeed in their education than those who avoid it. High school students already know the important role of math for the Standard Achievement Test (SAT). But did you know training in mathematics also ensures you greater success on the Graduate Record Exam (GRE), an exam required by

most universities for entrance into graduate programs? Bachelor's degrees in engineering and computer science require several semesters of advanced mathematics beyond college algebra.

Well, we've come to the end. You've made a commitment to succeed. It was a great decision! Math will open the door to your future. Congratulations!

Exercise: Jump in and Take Action Now

In the following spaces list five action steps you are willing to take in the next 6 months as a result of completing this workbook. Make sure to write down your target date for each step taken.

Action Steps Target Date

- 1.
- 2.
- 3.
- 4.
- 5.