**Studying and Learning Math**

Much of the information in this reading will be helpful to you in all subjects, but there are some things about studying math that are different from other areas. Some of these are:

1. It is widely recognized that math is a foreign language. The language barrier adds a layer of complexity on top of the actual concepts. So learning math can be a little bit like an English-speaker trying to learn a new subject that is being taught in French. Many students don’t understand this. Because they associate math with numbers, they often think that the words aren’t really important so they try to get by without really learning the vocabulary, syntax and notation that makes up the language of Math. And many people don’t try to read the textbook.

* **What to do about it…**Make an effort to understand the language of math, and, especially, make an effort to use it correctly in your notes, assignments and in class. When making your own study plan, have at least one strategy that relates to language (reading the text, vocabulary, notation). Read your textbook! Suggestions of strategies for reading math are given below.

1. Math builds upon itself to a greater extent than any other subject. If a student has gaps in their mathematical skills and concepts, that makes learning new material far more difficult.
   * **What to do about it…**Make review of previous material a part of your study routine. Don’t try to just “learn it for the test” and think you will never use it again. Make sure you fully understand the concepts using the strategies for self-assessment that are included in this reading. Most importantly, when you recognize you have a gap, get help immediately. Don’t be embarrassed that you don’t know something. You are not alone!
2. Math may be different from other subjects to the individual student. American students identify math as their most challenging subject more than any other. Many people in our society have negative attitudes towards math and believe that only a select few are “math people”. While this is not the time and place to fully discuss the causes of these beliefs, it is important to note that it is a cultural phenomenon. All evidence shows that aside from those with severe cognitive disabilities, all people are capable of learning and understanding math. There are cultures where people grow up believing they can learn math, and they do. Unfortunately, if a person has negative experiences, their natural reaction is to avoid it in the future. In learning, this may mean that a person actually spends less time with the subject and is more hesitant to ask for help. This leads to more failure which reinforces the desire to avoid it even more.
   * **What to do about it…**Break yourself out of the cycle of avoidance and failure. It is well-documented that verbalizing a goal to someone else makes it more likely that you will follow through with it. So talk to your instructor or Algebra Alcove staff about your goal and your plan. They can help you develop strategies. If you suffer from severe anxiety related to math, your instructor can give information and resources that will help you reduce your anxiety.

The following information is based on what scientists and educators know about how the brain learns. Later in this course, you will learn more about what this process yourself.

**Being Strategic about Studying**

As instructors, we sometimes see students who work very hard and devote a huge amount of time to their math class with very little result. These students are intelligent and capable. It’s not that they can’t learn the material, it’s that they don’t use their time well and often their efforts are actually counter-productive.

***Something to Think About***

*The German psychologist Hermann Ebbinghaus was the first person to do research on the rate of forgetting. He did his research with meaningless material know as nonsense syllables. He found that, after 20 minutes, nearly half of what has been learned was forgotten, and after 1 day, nearly two-thirds were lost…This means that, after a month, you remember only 22% of the material you learned.*

*A classic study by H. F. Spitzer on the retention of meaningful material found results similar to Ebbinghaus’s study. Even with meaningful material, most forgetting takes place immediate after learning occurs. However, Spitzer showed that students who* ***review the material immediately after learning*** *and* ***then did periodic reviews*** *were able to retain almost 80% of the material after 2 months!*

--*Conquering Math Anxiety*, Cynthia Arem, 2003, p. 120

As you develop your own study plan, think about using three types of studying. The type of work you do for each type is different, and it can be a good idea to use different strategies.

* **Understanding and Practicing New Concepts and Skills:** Much of this work is accomplished through doing your daily homework. This makes it easier for you because your instructor selects the work for you and gives you a deadline. However, just completing the assignment isn’t enough. You should also review notes and material in the textbook and you may want to prepare materials such as flashcards, problem list, vocabulary list or concept maps that you will use in future reviews. In this stage, you are moving information from working (short-term) to long-term memory. Therefore, at least some work should be done on the same day as class or you will have forgotten much of what you did in class.
* **Review Previous Material:** This is work that you should be doing on your own. Connections in your brain are built through repetition and multiple types of experiences. This stage helps solidify learning in your long-term memory. It is a good time to use multiple strategies, especially using different senses. You should also be working to become more “fluent”. This means that you can do problems or access information quickly and correctly. You need to develop some system for reviewing information because you can’t review everything every day. Perhaps you might keep a problem list with two examples from each homework assignment. Then each week you go back and do five problems from the list. Or you can review vocabulary using flash cards. Find a system that breaks the review into small pieces so that you review regularly and also cover all the material over time.
* **Summary Review to Deepen Understanding:** Math is often taught in pieces that connect together. For example, In *Intermediate Algebra*, you will spend several days working on polynomials. Then you will move on to another topic. The work with polynomials will relate to future work, but you can also think of that topic as a “unit”. In this course, your instructor will alert you to the completion of these units, but you also need to learn to recognize it on your own. The completion of a unit is a good time to do a summary review which focuses on a deeper understanding of concepts rather than just skills. Work to understand how concepts relate to each other, identify the general rules that are used in the skills, make connections to other work you have done and personalize the information if possible.

**Specific Strategies**

Here are some suggestions for strategies but you also probably have your own ideas. Keep in mind that it can be a good idea to at least try different things. Don’t assume that what you have always done is the best approach.

General Tips

* Don’t study for more than 45 minutes at a time. If you want to devote a large block of time to studying, break up the time with 5-15 minute breaks.
* Recognize when it is time to stop for a while. This may be due to frustration, exhaustion, a need to eat, etc. There are many factors that affect how well you can tackle difficult information at a given time. But remember, “stopping” isn’t the same as “quitting”. Come back to the work while it is still fresh in your mind.
* Plan study time strategically. Most students schedule a block of time to do their homework and then consider themselves “done” until the next class. It is more effective to schedule some time as soon as possible after class to review notes and perhaps rework a few problems from class, then have a time to actually do the assignment and then do a quick review right before class. The overall amount of time spent may be the same, but it will lead to better retention and preparation for class.

***Something to Think About***

*Ed and Nick, two brothers studying electronics, came for study-skills help. They said they had studied electronics math for 5 hours together, and at the end of that time, they felt they knew less than they knew at the beginning of the session. I asked them to make only one change in their study habits. I still wanted them to study for 5 hours but to spread their studying into five 1-hour study periods distributed over 2 days and to interrupt their 1-hour study periods with a 5- or 10-minute break every half-hour. A few weeks later they reported that this made all the difference. Now they were learning and retaining everything they studied.*

--*Conquering Math Anxiety*, Cynthia Arem, 2003, p. 120

Use Your Whole Brain

Different parts of your brain are used for different types of activities. You are most likely to learn and remember when you use several parts of your brain. So try to use strategies from different categories below.

**Verbal/Auditory**

* Read the text or your notes aloud.
* Tape class and listen to it.
* Discuss work and concepts with other students
* Explain a concept to another person or even out loud to yourself
* Use YouTube videos that have verbal explanations
* Create mnemonics, rhymes or sayings to help remember rules or vocabulary

**Visual**

* Read the text, especially focus on graphics
* Review notes
* Make a concept map (see example at the end of this reading)
* Flashcards
* Highlight important terms in the text or your notes
* Use websites or YouTube videos that use graphics
* Create visual memory aids to help remember rule or vocabulary

**Kinesthetic**

* Combine review with physical activity – use flashcards while walking, solve a problem mentally while exercising, try to “replay” class in your head while exercising
* Written work – summarize notes, do problems
* Highlight important terms in the text or your notes
* Use a “beat” as you study – drum your fingers, read to a beat, create “raps” to help remember rules or vocabulary

Strategies to Read and Use a Math Textbook

* Get to know your book – math texts usually have a certain structure and features to help students. Being familiar with these features can help save you time and work. Often the features are described at the beginning of the book.
* Read instructions carefully even if you are sure you know what to do. First, you may find the instructions are different than what you expected. Second, this will reinforce vocabulary for you.
* After you have read a short section, try to summarize what you read without looking at the book
* Don’t “read over” words you don’t know
* Pay careful attention to notation – make sure you understand it
* Be prepared to read the text several times
* Carefully read graphics – look for titles, subtitles, labels on graphs, ask yourself questions about graphs and tables
* Try to do examples on your own and then compare your work to the text; if you can’t get started, review the example and then do another similar problem. Note that your text for *Intermediate Algebra* gives a sample problem next to each example, and you can check your answers in the back of the book.
* Check your work when possible!
* Connect the reading to your notes from class – add page numbers to your notes for references to the text, add to definitions, explanations or graphics if you didn’t have time to complete them in class
* Keep a list of questions to ask your instructor, study partners or tutor.

Making the Most of Help

* Whether you are working in the Algebra Alcove, visiting your instructor or have a regular tutor, you should always prepare before you ask for help by reviewing the material and attempting the work. This should give you specific items to ask about.
* Remember that there is a social and emotional side to learning. If you work in the Algebra Alcove, learn the names of the tutors and staff. Help yourself get comfortable with your instructor or tutor with social conversation or getting to know him or her a little. Share your frustrations and successes about math. You will feel more comfortable, and they will understand you better.
* Don’t wait to get help.
* Don’t expect someone to “just show me how to do it.” This doesn’t help you learn, and if someone is doing this for you, you need to go elsewhere for help. A good tutor will talk you through a problem so you develop your own understanding and do the problem yourself. It may be frustrating, but some level of frustration is part of learning.
* Ask about concepts and not just about the steps in a particular problem.
* Write the steps of a problem clearly but also add notes to help you remember what you did.
* After getting help, try to do a similar problem on your own.
* Be honest if you don’t understand an explanation but also be patient.

Finding Resources on the Internet

The internet offers great resources for learning math. The huge variety of sites accommodates many different learning styles with visual examples, interactive sites, explanations that can be read or listened to. We will sometimes recommend specific sites, especially for the *Thinking Ahead* assignments. In addition to explanations, the internet can be a good source of problems for extra practice. However, you also need to be aware that as with all information on the internet, some math sites are misleading and even incorrect. You should always verify information you get from the internet. We have reviewed all the sites we recommend in assignments. If you are looking up sites on your own, always use at least two sites and make sure the information is consistent. If it isn’t, verify through another source. Note: We often recommend videos from the Khan Academy, [www.khanacademy.org](file:///\\faculty\freshmanmath\82%20Class%20Documents\10%20Winter\Study%20Skills\www.khanacademy.org). This site has tutorials on a wide range of topics in science and math (go to Video Library to see a list of topics). We have not reviewed every tutorial, but all those we have seen are very good, and this would be a good place to start if you are looking for a resource.