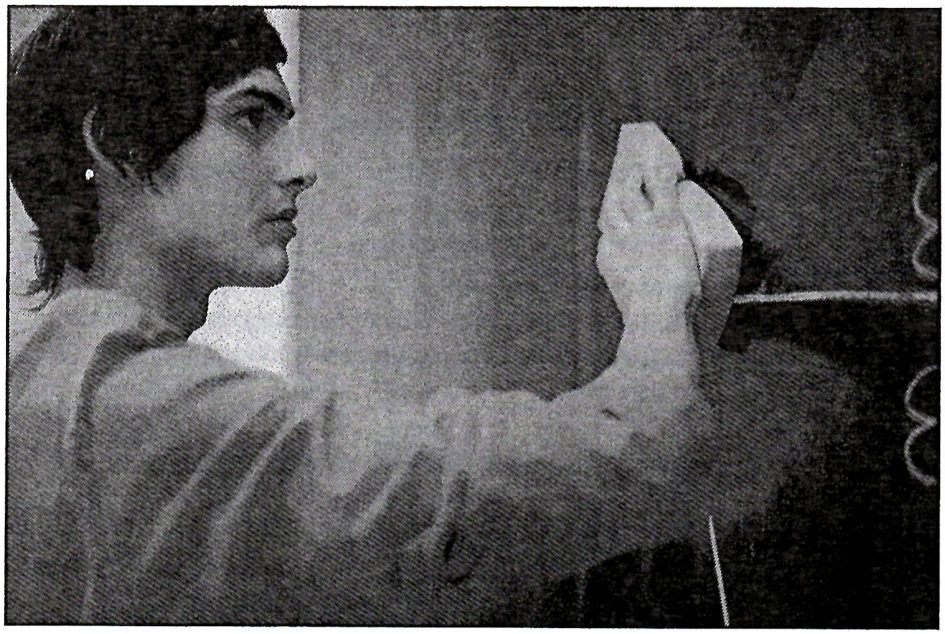


6

How to Remember What You Have Learned

WHAT YOU WILL LEARN IN CHAPTER 6

- ❑ How You Learn
- ❑ How to Use Learning Styles to Improve Memory
- ❑ How to Use Memory Techniques
- ❑ How to Develop Practice Tests
- ❑ How to Use Number Sense

To understand the learning process, you must understand how your memory works. You learn by conditioning and thinking. But memorization is different from learning. For memorization, your brain must perform several tasks, including receiving the information, storing the information, and recalling the information.

By understanding how your memory works, you will be better able to learn at which point your memory is failing you. Most students usually experience memory trouble between the time their brain receives the information and the time the information is stored.

There are many techniques for learning information that can help you receive and store information without losing it in the process. Some of these techniques may be more successful than others, depending on how you learn best.

How You Learn

Educators tell us that learning is the process of "achieving competency." More simply put, it is how you become good at something. The three ways of learning are by conditioning, by thinking, and by a combination of conditioning and thinking.

Learning by Conditioning and Thinking

Conditioning is learning things with a maximum of physical and emotional reaction and a minimum of thinking.

> **Examples:** Repeating the word *pi* to yourself and practicing finding its symbol on a calculator are two forms of conditioned learning. You are learning using by your voice and your eye-hand coordination (physical activities), and you are doing very little thinking.

Thinking is defined as learning with a maximum of thought and a minimum of emotional and physical reaction.

> **Example:** Learning about *pi* by thinking is different from learning about it by conditioning. To learn *pi* by thinking, you would have to do the calculations necessary to arrive at the numeric value that the word *pi* represents. You are learning *by using your mind* (thought activities), and you are using very little emotional or physical energy to learn *pi* in this way.

The most successful way to learn is to combine thinking and conditioning. The best learning combination is to learn by thinking first and by conditioning second.

Learning by thinking means that you learn by

- observing
- processing, and
- understanding the information.

How Your Memory Works

In order to remember information, we must receive and store it in a way that allows us to retrieve it. It is important to understand the process we must use to remember, because it can help us design more productive and time-efficient learning strategies. Briefly put, the memory process includes the following stages:

1. We receive information through our five senses: hearing, seeing, tasting, touching and smelling (**sensory input**).

2. Then, we briefly hold the image or sound of each sensory experience until it can be processed (**sensory register**).

3. After registering each sensory experience, we store the information that passes through the sensory register in **short-term memory.** We store small pieces of information in short-term memory for only a few seconds. Short-term memory is the ability to recall information immediately after it is given. If we do not do anything with it, such as put it in notes or learn it immediately, we lose this information. We can't put it into long-term memory.

4. Next, we use information we have stored in long-term memory along with new information that we have just processed to learn how to do math (**working memory**). Working memory is the ability to think about and use many pieces of information at the same time. It is like a mental chalkboard. It is also like the RAM in a computer, determining how many tasks can be done at the same time to produce an end product—understanding new math concepts. We also use reasoning skills to understand new concepts. **Reasoning** is thinking about these memories stored in long-term memory and comprehending what they mean. We also use reasoning and **long-term memory** to help us understand new concepts.

The goal of all the steps above is to get new information into long term memory. Long-term memory is a storehouse of information that is remembered for long periods of time.

5. The final goal for math students is to be able to show what they have learned—**memory output.** We recall what we have put into long-term memory and express this knowledge. It is the ability to go into the "storehouse of information," the long-term memory, and find what we need to complete a math problem.

Here is a story that describes the memory process.

On the second day of math class, Claudia, determined to start off strong, arrived at class early, enabling her to claim a desk where she could hear and make eye contact with the instructor. She wanted to make sure she caught everything he said. It worked. As the instructor began to discuss order of operations, she heard every word, and saw everything he wrote on the board (sensory input and sensory register). Since she was able to pick up easily on what he was saying and writing, she was able to remember all the information until she could record it in her notes (short-term memory). Also going for her was the fact that she had attended a review workshop before the semester started, which helped her review everything from the course she had taken the previous semester. Her long-term memory was strong as a result. So, she was able to use her working memory and reasoning in class to understand the math, not just record the information in her notes. At the end of class, the instructor gave the students a practice quiz to see what they had learned during the past hour. She aced the quiz using her memory output.

What did Claudia do to make sure she worked through each stage of the memory process? You should take the same steps to improve your memory! Try the following suggestions provided in the table.

Memory Process	Strategies
Sensory input and sensory register	Sit where you can easily hear the professor and see what the professor writes on the board.
Short-term memory	Make sure you have a good system of taking notes. Get plenty of sleep so that you are alert.
Working Memory	Make sure you complete all homework before going to class. Learn while you are doing your homework; do not just hurry through to get it done. Read the textbook before class to familiarize yourself with the vocabulary. You do not have to understand it all, but it will help your learning during class.
Long-term memory and reasoning	Whenever you are studying math, take time to memorize what you are learning and thinking. Use the study strategies mentioned later in this chapter to help you understand and memorize math concepts. Make mental cheat sheets to review constantly.
Memory Output	Practice, practice, practice. Ask your instructor for practice tests. Rehearse the "Ten Steps to Better Test Taking" in Chapter 7. Get with a group of students, and make up practice test questions.

The consequences of something interfering with any one of these stages are substantial. Here are some possible consequences.

If you do not input and register the information:	There is nothing to work with. The rest of the class is confusing, as is your homework.
If you do not hold information in short-term memory long enough to record it in your notes:	You end up reteaching yourself when working on homework. Sometimes, you have to take more time and go to a tutor.
If you do not spend quality time doing homework, which limits your working memory that helps you understand the math:	You will not remember what you spent time doing. The information will not remain in long-term memory. You won't get a good grasp on what is going on.
If you do not spend time memorizing what you are learning:	You will forget and have to relearn and rememorize the night before the test. You won't do as well on the math tests. Learning new material will always be harder for you.
If you freeze up when trying to answer math problems (memory output):	You can't show what you really know. You get a lower score than you think you deserve.

It is important to take a few moments to talk more about memory output. Many students struggle with this. They know the information going into the test, but they forget it once the test is on their desks. Memory output can be blocked by three things:

1. **Insufficient processing of information into long-term memory.** For most students, this is a result of not studying correctly throughout the math unit. It is easier to fix than other memory blocks.
2. **Poor test-taking skills.** Most students have not mastered a system for taking tests. That is why an entire chapter is devoted to test taking. Once again, this is not difficult to fix.
3. **Test anxiety.** Test anxiety is a learned behavior that blocks memory. Students with test anxiety usually need to learn some strategies to help them manage their anxiety, as well as learn good test-taking strategies.

Many students who have trouble taking tests wait too late to get help. If you have a pattern of test anxiety in your past, get assistance before the first test. Success on the first test will help you overcome anxiety. Failure on the first test will only feed it. Be proactive and set up a plan for taking your first test.

What is great about our memory is that we can learn strategies to improve it. The next section will describe ways in which you can improve the memory process by practicing learning strategies based on your learning modalities and learning styles.

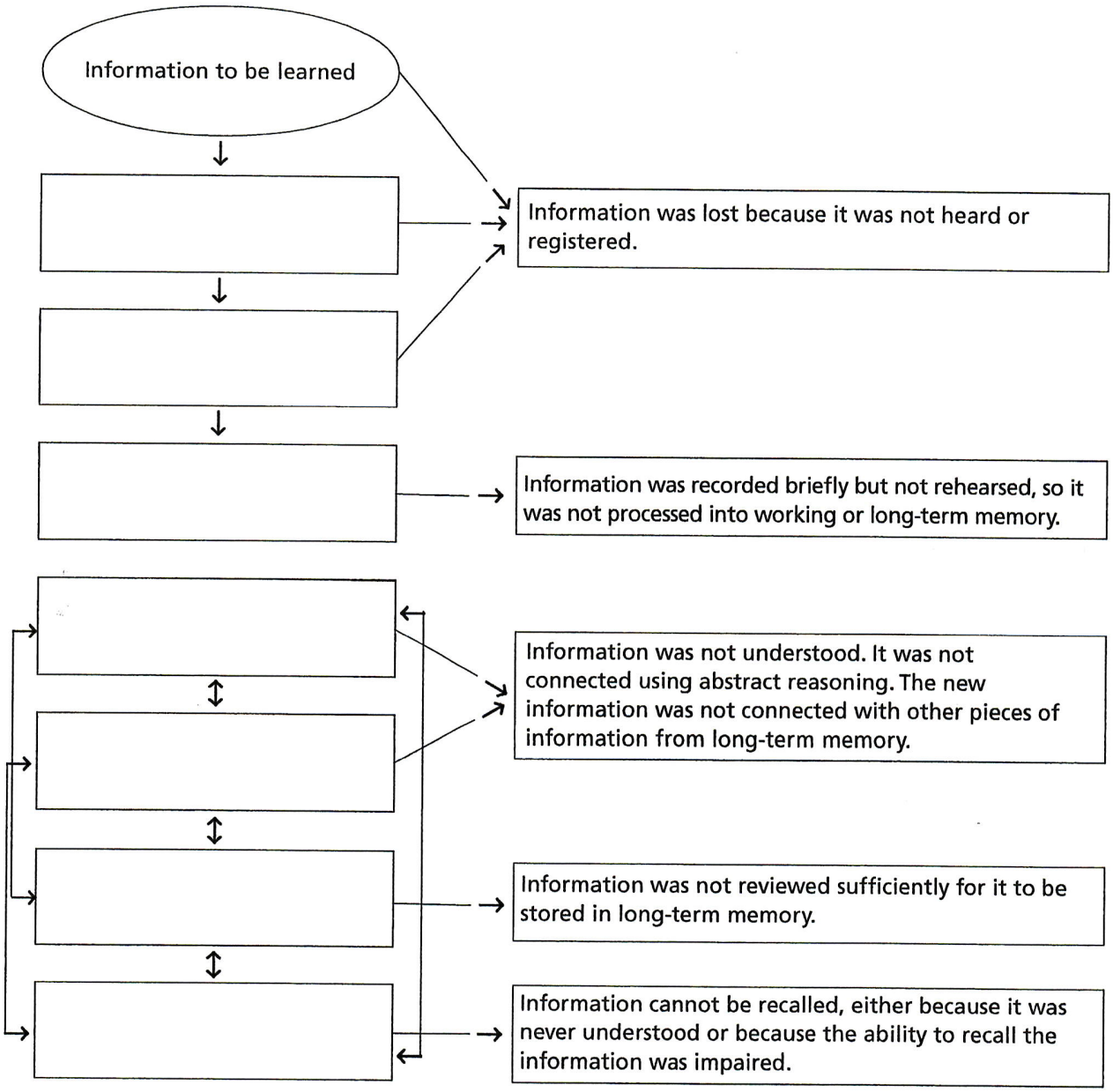
Remember

Locating where your memory breaks down and compensating for those weaknesses will improve your math learning.

Section Review

1. Label the boxes in Figure 10 with the stages of memory.

Figure 10 Stages of Memory



2. List, define, and give examples of each stage of memory.

   Stage One: _____

   Example: _____

   Stage Two: _____

   Example: _____

   Stage Three: _____

   Example: _____

   Stage Four: _____

   Example: _____

   Stage Five: _____

   Example: _____

   Stage Six: _____

   Example: _____

   Stage Seven: _____

   Example: _____

3. What are three conditions that can block your memory output?

   First Condition: _____

   Second Condition: _____

   Third Condition: _____

4. Review the stages of memory and list the stages at which *your* memory breaks down. For each stage of breakdown, state how you can prevent it.

   Stage: _____

   Prevention: _____

   _____

   Stage: _____

   Prevention: _____

   _____

   Stage: _____

   Prevention: _____

   _____

How to Use Learning Styles to Improve Memory

There are many different techniques that can help you store information in your long-term memory and reasoning. Using your learning sense or learning style and decreasing distractions while studying are very efficient ways to learn. Using your best *learning sense* (what educators call your "predominant learning modality") can improve how well you learn and enhance the transfer of knowledge into long-term memory/reasoning. Your learning senses are vision, hearing, touching, etc. Ask yourself if you learn best by watching (vision), listening (hearing), or touching (feeling).

Remember

Learning styles are neither good nor bad and are based on genetics and environment. Knowing your best learning styles and using them effectively can dramatically improve your math learning and grades.

Visual (Watching) Learner

Knowing that you are a *visual math learner* can help you select the memory technique that will work best for you. Repeatedly reading and writing down math materials being studied is the best way for a visual learner to study.

Based on the Learning Styles Inventory, students who learn math best by seeing it written are *visual numerical learners*. If you are a visual numerical learner you will learn best by following the ten suggestions in Figure 11. Try as many of these suggestions as possible and then select and practice those that are most helpful.

A visual way to decrease distractions is by using the "my mind is full" concept. Imagine that your mind is completely filled with thoughts of learning math, and other distracting thoughts cannot enter. Your mind has one-way input and output, which responds only to thinking about math when you are doing homework or studying.

Figure 11 Visual Numerical Learners

1. Study a variety of written materials, such as additional handouts and math texts.
2. Play games with, and get involved in activities with, visible printed number problems.
3. Use visually orientated computer programs, CD-ROMs, and math websites.
4. Rework your notes using suggestions from this workbook.
5. Visualize numbers and formulas in detail.
6. Check out videocassette tapes from the math lab or learning resource center on campus.
7. Make 3" x 5" note (flash) cards, in color.
8. Use different colors of ink to emphasize different parts of each math formula.
9. Ask your tutor to ***show*** you how to do the problems instead of ***telling*** you how to do the problems.
10. Write down each problem step the tutor tells you to do. Highlight the important steps or concepts, that cause you difficulty.

Auditory (Hearing) Learner

If you are an *auditory learner* (one who learns best by hearing the information), then learning formulas is best accomplished by repeating them back to yourself, or recording them on a tape recorder and listening to them. Reading out loud is one of the best auditory ways to get important information into long-term memory. Stating facts and ideas out loud improves your ability to think and remember. If you cannot recite out loud, recite the material to yourself, emphasizing the key words.

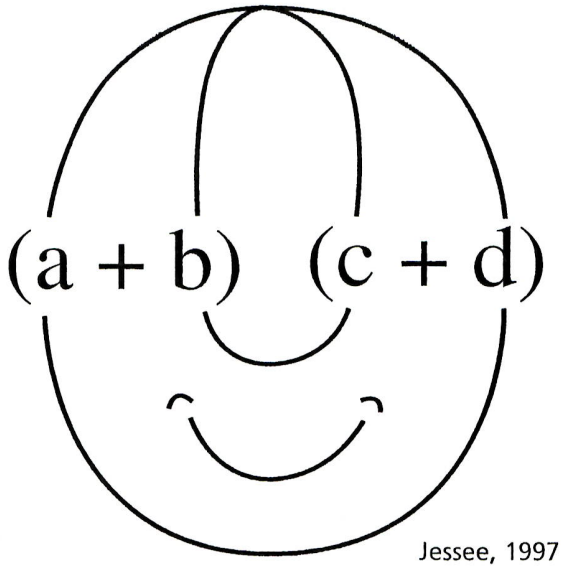
Based on the Learning Styles Inventory, students who learn math best by hearing it are *auditory numerical learners*. If you are an auditory numerical learner you may learn best by following the ten suggestions in Figure 12 on the next page. Try as many of these suggestions as possible and then select and practice those that are most helpful.

Figure 12 Auditory Numerical Learners

1. Say numbers to yourself or move your lips as you read problems.
2. Tape-record your class and play it back while reading your notes.
3. Read aloud any written explanations.
4. Explain to your tutor how to work math problems.
5. Make sure all important facts are spoken aloud with auditory repetition.
6. Remember important facts by auditory repetition.
7. Read math problems aloud and try solutions verbally and subverbally as you talk yourself through the problems.
8. Record directions to difficult math problems on audiotape and refer to them when solving those specific types of problems.
9. Have your tutor explain how to work problems instead of just showing you how to solve them.
10. Record math laws and rules in your own words, by chapters, and listen to them every other day (auditory highlighting).

Figure 13 The FOIL Method

F (a) (c)
O (a) (d)
I (b) (c)
L (b) (d)



Jessee, 1997

The FOIL Method is used to remember the procedure for multiplying two binomials. The letters in FOIL stand for First, Outside, Inside, and Last. To use the FOIL Method, multiply

- the First terms ((a) (c)),
- the Outside terms ((a) (d)),
- the Inside terms ((b) (c)),
- the Last terms ((b) (d)),
- and then combine the four products.

To learn the FOIL Method, trace your finger along the FOIL route.

An auditory way to improve your concentration is to become aware of your distractions and tell yourself to concentrate. If you are in a location where talking out loud will cause a disturbance, mouth the words "start concentrating" as you say them in your mind. Your concentration periods should increase.

Tactile/Concrete (Touching) Learner

A *tactile/concrete learner* needs to feel and touch the material to learn it. Tactile/concrete learners, who are also called *kinesthetic learners*, tend to learn best when they can concretely manipulate the information to be learned. Unfortunately, most math instructors do not use this learning sense. As a result, students who depend heavily on feeling and touching for learning will usually have the most difficulty developing effective math learning techniques. This learning style creates a problem with math learning because math is more abstract than concrete. Also, most math instructors are visual abstract learners and have difficulty teaching

math tactilely. Ask for the math instructors and tutors who give the most practical examples and who may even "act out" the math problems.

As mentioned before, a tactile/concrete learner will probably learn most efficiently by hands-on learning. For example, if you want to learn the FOIL Method, you would take your fingers and trace the "face" to remember the steps. See Figure 13 (The FOIL Method). Also, learning is most effective when physical involvement with manipulation is combined with sight and sound. For example, as you trace the face you also say the words out loud.

Based on the Learning Styles Inventory, tactile/concrete learners best learn math by manipulating the information that is to be taught. If you are a tactile/concrete learner, you may learn best by following the ten suggestions in Figure 14. Try as many of these suggestions as possible and then select and practice the ones that help the most. If you do not have these manipulatives or don't know how to use them, ask the math lab supervisor or instructor if they have any manipulative materials or models. If the math lab does not have any manipulative materials, you may have to ask for help to develop your own.

Tactile/concrete learners can also use graphing calculators to improve their learning. Entering the keystrokes makes it easier to remember how to solve the problems. This practice is also an excellent way to remember how to solve the problem when using a calculator while taking a test.

Another way tactile/concrete learners can learn is to trace graphs with their fingers when they appear on the calculator. They should read out loud and trace every equation to "feel" how the graph changes for different equations. For example, if you add 2 to one side of an equation, move your finger to where the graph changed and say out loud how much it moved.

A tactile/concrete way to improve your study concentration is by counting the number of distractions during each study session. Place a sheet of paper by your book when doing homework. When you catch yourself not concentrating, write the letter C on the sheet of paper. This will remind you to concentrate and get back to work. After each study period, count up the number of Cs and watch the number decrease over time.

Figure 14 Tactile/Concrete Learners

1. Cut up a paper plate to represent fractions of a whole.
2. Fold a piece of paper several times and cut along the fold marks to represent fractions of a whole.
3. In order to understand math concepts, ask to be shown how to use algebra tiles as manipulatives.
4. Try to use your hands and body to "act out" a solution. For example, you may "become" the car in a rate-and-distance word problem.
5. Obtain diagrams, objects, or manipulatives and incorporate activities such as drawing and writing into your study time. You may also enhance your learning by doing some type of physical activity such as walking.
6. Try to get involved with at least one other student, a tutor, or an instructor who uses manipulatives to help you learn math.
7. Ask to use the Hands-on Equations Learning System, which uses manipulatives, to learn basic algebra. You can go to their website (www.Borenson.com) to learn more about this system and other systems that can help you learn math.
8. Go to one of the "learning stores" in shopping malls to see if they have manipulatives.
9. Go to a K–12 learning resource store to see if they have manipulatives, such as magnetic boards with letters and numbers.
10. Talk to the coordinator of students with disabilities to see if they use manipulatives when tutoring their students.

Social Individual Learner

If you are a *social individual learner,* you may learn math best by learning it individually. You may learn best by yourself, working with computer programs and an individual tutor. In some cases, social individual learners may have to meet in groups to develop practice tests but leave socializing to a minimum. If you are a social individual learner

and a visual learner, the computer may be one of the best learning tools available. If you are a social individual learner, based on the Learning Styles Inventory, you may learn best by following the eight suggestions in Figure 15. Try as many of these suggestions as possible and then select those that are most helpful.

A problem that social individual learners may encounter is working too long on problems for which they could have received help. Social individual learners must understand that getting help is okay, especially if it saves study time and makes their studying more efficient.

Social Group Learners

If you are a *social group learner* (one who best learns in a group), then learning math may best be done in study groups and in math classes that offer collaborative learning (group learning). Social group learners may learn best by discussing information. They can usually develop their own study groups and discuss how to solve problems over the phone. If you are a social group learner and an auditory learner, then you definitely learn best by talking to people. If you are a social group learner, based on the Learning Styles Inventory, you may learn best by following the eight suggestions in Figure 16. Try as many of these suggestions as possible and then select and practice those that are most helpful.

A learning problem that a social group learner may have is talking too much about other subjects when in a study group. This is called being off task. You may want to have a group member serve as a discussion monitor and let the other students know when they need to get back on task. Also, social group learners need to know that they still must study math individually to be successful. During these individual study sessions, they should prepare questions for the group.

Multiple Senses

If you have difficulty learning material through one sense (learning style), you might want to try learning material through two or three senses. Involving two or more senses in learning improves your

Figure 15 Social Individual Learners

1. Study math, English, and your other subjects alone.
2. Utilize videocassette tapes or auditory tapes to learn by yourself.
3. Prepare individual questions for your tutor or instructor.
4. Obtain individual help from the math lab or hire your own tutor.
5. Set up a study schedule and a study area so that other people will not bother you.
6. Study in a library or in some other private, quiet place.
7. Use group study times only as a way to ask questions, obtain information, and take pretests on your subject material.
8. Use math websites to help you learn.

Figure 16 Social Group Learners

1. Study math, English, and your other subjects in a study group.
2. Sign up for math course sections that offer cooperative learning (learning in small groups).
3. Review your notes with a small group.
4. Obtain help in the math lab or other labs where you can work in group situations.
5. Watch math videocassette tapes with a group and discuss the subject matter.
6. Listen to audiocassette tapes on the lecture and discuss them with the group.
7. Obtain several "study buddies" so you can discuss with them the steps to solving math problems.
8. Form a study group. Each member should bring ten test questions with explanations on the back. The group should complete all the test questions.

learning and remembering. Review the figures in this section on learning styles and whenever possible combine two or more learning styles.

If your primary sense is visual and your secondary sense is auditory, you may want to write down equations while saying them out loud to yourself. Writing and reciting the material at the same time combines visual, auditory, and (to some extent) tactile/concrete styles of learning.

Studying with a pen or highlighter is a visual as well as a tactile/concrete way to improve your concentration. Placing the pen or highlighter in your hand and using it will force you to concentrate more on what you are reading. After you write and recite the material back to yourself, do it five or ten more times to overlearn it.

Section Review

1. List five ways visual learners can improve their memory.

   First Way: _____

   Second Way: _____

   Third Way: _____

   Fourth Way: _____

   Fifth Way: _____

2. List five ways auditory learners can improve their memory.

   First Way: _____

   Second Way: _____

   Third Way: _____

   Fourth Way: _____

   Fifth Way: _____

3. List five ways tactile/concrete learners can improve their memory.

   First Way: _____

   Second Way: _____

   Third Way: _____

   Fourth Way: _____

   Fifth Way: _____

4. List three ways social individual learners can improve their memory.

   First Way: _____

   Second Way: _____

   Third Way: _____

5. List three ways social group learners can improve their memory.

   First Way: _____

   Second Way: _____

   Third Way: _____

6. What is your best modality learning style for math? Visual, auditory, or tactile/concrete?

   _____

   _____

7. What is your second-best modality learning style for math?

   _____

8. Are you more of an individual or a group learner? Why?

   _____

   _____

   _____

9. How can you use multiple senses to improve your memory?

   _____

   _____

   _____

10. What is your best combination of learning styles to learn math? _____

    _____

    _____

    Give an example of how you can combine your learning styles to learn a math concept. (If you cannot think of a concept, ask your instructor for one.)

    _____

    _____

    _____

How to Use Memory Techniques

There are many different techniques that can help you store information in your long-term memory: a positive attitude about studying, selective learning, organization, visual imagery, mnemonic devices, and acronyms.

A Good Study/Math Attitude

A positive attitude about studying will help you concentrate and improve your retention of information. This means that you should have at least a neutral math attitude (you neither like nor dislike it) and should reserve the right to learn to like math. If you still don't like math, just pretend that you do while studying it. View studying as an opportunity to learn rather than an unpleasant task. Tell yourself that you can learn the material, and it will help you pass the course and graduate.

Be a Selective Learner

Being selective in your math learning will improve your memory. Prioritize the materials you are studying; decide which facts you need to know and which ones you can ignore. Narrow down information into laws and principles that can be generalized. Learn the laws and principles 100 percent.

> **Example:** If you have been given a list of math principles and laws to learn for a test, put each one on an index card. As you go through them, create two piles: an "I already know this" pile and an "I don't know this" pile. Then study *only* the cards in the "I don't know this" pile. Study the principles on these cards until you have memorized them and understand them completely.

Become an Organizer

Organizing your math material into idea/fact clusters or groups will help you learn and memorize it. Grouping similar material in a problem log or calculator log is an example of categorizing information. Do not learn isolated facts; always try to connect them with other similar material.

Use Visual Imagery

Using mental pictures or diagrams to help you learn the material is especially helpful for visual learners and for students who are right-hemisphere dominant (who tend to learn best by visual and spatial methods). Mental pictures and actual diagrams involve 100 percent of your brain power. Picturing solution steps can help you solve difficult math problems in your mind.

> **Example:** Use the FOIL Method (see Figure 13 on page 94) to learn visually how to multiply binomials. Memorize the face until you can sketch it from memory. If you need to use it during a test, you can sketch the face on your scratch paper and refer to it.

Make Associations

Association learning can help you remember better. Find a link between new facts and some well-established old facts and study them together. The recalling of old facts will help you remember the new facts and strengthen a mental connection between the two. Make up your own associations to remember math properties and laws.

Remember

The more ridiculous the association, the more likely you are to remember it.

> **Examples:** When learning the *Commutative Property,* remember that the word *commutative* sounds like the word *community.* A community is made up of different types of people who could be divided into an *a* group and a *b* group. However, in a community of a people and b people, it does not matter if we count the a people first or the b people first; we still have the

same total number of people in the community. Thus, $a + b = b + a$.

When learning the *Distributive Law of Multiplication Over Addition,* such as $a(b + c)$, remember that "distributive" sounds like "distributor," which is associated with giving out a product. The distributor a is giving its products to b and c.

Use Mnemonic Devices

The use of mnemonic devices is another way to help you remember. Mnemonic devices are easily remembered words, phrases, or rhymes associated with difficult-to-remember principles or facts.

Example: Many students become confused by the order of operations. These students mix up the order of the steps in solving a problem, such as dividing before adding the numbers in parentheses. A mnemonic device that can help you remember the order of operations is "Please Excuse My Dear Aunt Sally." The first letter in each of these words represents the math function to be completed from the first to the last. Thus, the order of operations is Parentheses (***P****lease*), Exponents (***E****xcuse*), Multiplication (***M****y*), Division (***D****ear*), Addition (***A****unt*), and Subtraction (***S****ally*). Remember to multiply and/or divide whatever comes first, from left to right. Also, add or subtract whatever comes first, from left to right.

Use Acronyms

Acronyms are another memory device that can help you learn math. Acronyms are word forms created from the first letters of a series of words.

Example: FOIL is one of the most common math acronyms. FOIL is used to remember the procedure for multiplying two binomials. Each letter in the word *FOIL* represents a math operation. **FOIL** stands for **F**irst, **O**utside, **I**nside, and **L**ast, as it applies to multiplication of two binomials such as $(2x + 3)(x + 7)$. The **F**irst quantities are $2x$ (in the first expression) and x (in the second expression). The **O**utside quantities are $2x$ (in the first expression) and 7 (in the second expression). The **I**nside quantities are 3 (in the first expression) and x (in the second expression). The **L**ast quantities are 3 (in the first expression) and 7 (in the second expression). This results in

F $(2x)(x)$ + **O** $(2x)(7)$ + **I** $(3)(x)$ + **L** $(3)(7)$.

Do the multiplication to get $2x^2 + 14x + 3x + 21$, which adds up to $2x^2 + 17x + 21$. See Figure 13 (the FOIL Method).

Section Review

1. How can a good math attitude help you learn?

   _____

   _____

2. Give an example of being a selective learner in your math class.

   _____

   _____

3. From your current math lessons, make up and explain one association remembering device that is not in this workbook.

   _____

   _____

4. For your next major math test, make up and explain one mnemonic device that is not in this workbook.

_____

_____

5. For your next major math test, make up and explain one acronym that is not in this workbook.

_____

_____

How to Develop Practice Tests

Developing a practice test is one of the best ways to evaluate your memory and math skills before taking a real test. You want to find out what you do not know *before* the real test instead of *during* the test. Practice tests should be as real as possible and should include time constraints.

You can create a practice test by reworking all the problems that you have recorded in your problem log since your last test. Another practice test can be developed using every other problem in the textbook chapter tests. Further, you can use the solutions manual to generate other problems with which to test yourself. You can also use old exams from the previous semester. Check to see if your math lab/LRC or library has tests on file from previous semesters, or ask your instructor for other tests. For some students, a better way to prepare for a test is the group method.

> **Example:** Hold a group study session several days before the test. Have each student prepare a test with ten questions. On the back of the test, have the answers listed, worked out step by step. Have each member of the study group exchange his or her test with another member of the group. Once all the tests have been completed, have the author of each test discuss with the group the procedures used to solve the problems in his or her test.

If group work improves your learning, you may want to hold a group study session at least once a week. Make sure the individual or group test is completed at least three days before the real test.

Completing practice math tests will help you increase your testing skills. It will also reveal your test problem weaknesses in enough time for you to learn how to solve the problems before the real test. If you have difficulty with any of the problems during class or after taking the practice test, be sure to see your tutor or instructor.

After taking the practice test(s), you should know what types of problems you do not understand (and need to study) and what is likely to be on the actual test. Put this valuable information on one sheet of paper. This information needs to be understood and memorized. It may include formulas, rules, or steps in solving problems.

Use the learning strategies discussed in this chapter to remember this information. A good example of how this information should look is what students might call a mental "cheat sheet." Obviously, you cannot use the written form of this sheet during the real test.

If you cannot take a practice test, put down on your mental cheat sheet the valuable information you will need for the test. Work to understand and memorize your mental cheat sheet. Chapter 7, "How to Improve Your Math Test-Taking Skills," will discuss how to use the information on the mental cheat sheet—*without cheating.*

Section Review

1. List three different ways you can make up a practice test.

   First Way: _____

   Second Way: _____

   Third Way: _____

2. List ten different problems you would put on your practice test for the next exam.

   First Problem: _____

   Second Problem: _____

   Third Problem: _____

   Fourth Problem: _____

   Fifth Problem: _____

   Sixth Problem: _____

   Seventh Problem: _____

   Eighth Problem: _____

   Ninth Problem: _____

   Tenth Problem: _____

3. Give these ten problems to your study buddy and get ten problems from him or her. Compare your answers with those of your study buddy. How many did you get right? _____ How can you correct the wrong answers?

   _____

   _____

   _____

   _____

How to Use Number Sense

When taking your practice tests, you should use "number sense," or estimations, to make sure your answers are reasonable. Number sense is common sense applied to math. Number sense is the ability to see if your answer makes sense without using algorithms. (Algorithms are the sequential math steps used to solve problems.) The following examples demonstrate solving a math problem (from a national math test given to high school students) using algorithms and number sense.

Example: Solve 3.04 x 5.3. Students used algorithms to solve this problem by multiplying the number 3.04 by 5.3, in sequence. Seventy-two percent of the students answered the problem correctly using algorithms.

Example: Estimate the product 3.04 x 5.3, and choose from the following answers.

(A) 1.6 (C) 160
(B) 16 (D) 1600

Only 15 percent of the students chose B, which is the correct answer. Twenty-eight percent of the students chose A. Using *estimation* to solve the answer, a whopping 85 percent of the students got the problem wrong.

These students were incorrectly using their "mental chalkboard" instead of using number sense. In using number sense, you would multiply the numbers to the left of the decimal point in each number to estimate the answer. To estimate the answer, then, you would multiply 3 (the number to the left of the decimal in 3.04) by 5 (the number to the left of the decimal in 5.3) and expect the answer to be a little larger than 15.

It appears that the students' procedural processing (the use of algorithms) was good, but when asked to solve a nonroutine problem using estimation (which is easier than using algorithms), the results were disappointing.

Another example of using number sense, or estimation, is "rounding off."

Taking the time to estimate the answer to a math problem is a good way to check your answer. Another way to check your answer is to see if it is reasonable. Many students forget this important step and get the answer wrong. This is especially true of word or story problems.

Example: Solve 48 + 48 by rounding off. Rounding off means mentally changing the number (up or down) to make it more manageable to you, without using algorithms. By rounding off, 48 becomes 50 (which is easier to work with). 50 + 50 = 100. If the choices for answers were 104, 100, 98, and 96, you would then subtract 4 from 100 (since each number was rounded up by 2) and you would get 96.

Also, when dealing with an equation, make sure to substitute the answer back into the equation to see if one side of the equation equals the other. If the two sides are not equal, you have the wrong answer. If you have extra time after you have completed a test, you should check answers using this method.

Examples: When solving a rate-and-distance problem, use your common sense to realize that a car cannot go 500 miles per hour to catch another car. However, the car can go 50 miles per hour.

The same common sense rule applies to age problems, where the age of a person cannot be 150 years, but it can be 15 years.

Furthermore, in solving equations that are not word problems, x is *usually* a number that is less than 20. When you solve a problem for x and get 50, then this isn't reasonable, and you should recheck your calculations.

Example: In solving the equation $x + 3 = 9$, you calculated that $x = 5$. To check your answer, substitute 5 for x and see if the problem works out correctly. 5 + 3 does not equal 9, so you know you have made a mistake and need to recalculate the problem. The correct answer, of course, is $x = 6$.

Remember

Number sense is a way to get more math problems correct by estimating your answer to determine if it is reasonable.

Section Review

1. Give an explanation of number sense.

   _____

   _____

2. How does number sense compare with common sense?

   _____

   _____

3. Give an example of a recent math problem you failed to solve correctly as a result of number sense.

   _____

   _____

4. List two ways you can improve your number sense.

   First Way: _____

   Second Way: _____

Dan's Take

Have you ever known someone who could learn something right away and then remember it perfectly forever? I had a friend like this in college. He could sit in on a lecture and remember the speech two years later without missing a beat.

Needless to say, most of us aren't like this. Most of our brains aren't strong enough to keep up with it all, so we hold onto the information we care about and filter the rest out of our minds.

This process makes learning math, a sequential learning subject, more demanding than most other subjects. It's important when learning a step in a math problem to remember it for the rest of your college career.

So how do you remember math? I had this problem throughout high school and college. I eventually realized that the answer to this problem was simple: to remember math, you simply need to do math every day. I noticed that by breaking up my math homework and doing a little bit of it every day, I was able to keep the information fresh in my head.

For the majority of us, remembering something takes effort. For me, remembering how to do math took a little bit of daily effort, and in the end it paid off.

Name: _____ Date: _____

Chapter 6 Review

1. The way you receive information is through your five senses, which are _____, _____, _____, _____, and _____.
2. The main problem most students have is converting learned material into _____ _____ and _____ it.
3. Repeatedly reading and writing math material is one of the best ways for a _____ learner to study.
4. Reading _____ _____ is one of the best auditory ways to learn material.
5. A _____/ _____ learner needs to feel and touch material to learn it.
6. Being a selective learner means _____ the material to study and learning the laws and principles _____ percent.
7. Mnemonic devices are easy-to-remember _____, _____, or _____ associated with difficult-to-remember principles or facts.
8. _____ are word forms created from the first letters of a series of words.
9. The reason to develop a practice test is to find out what you do not know _____ the test instead of _____ the test.
10. Social group learners benefit from forming _____ _____.

What is the most important information you learned from this chapter?

_____

_____

_____

How can you immediately use it?

_____

_____

_____

Lecture Notes