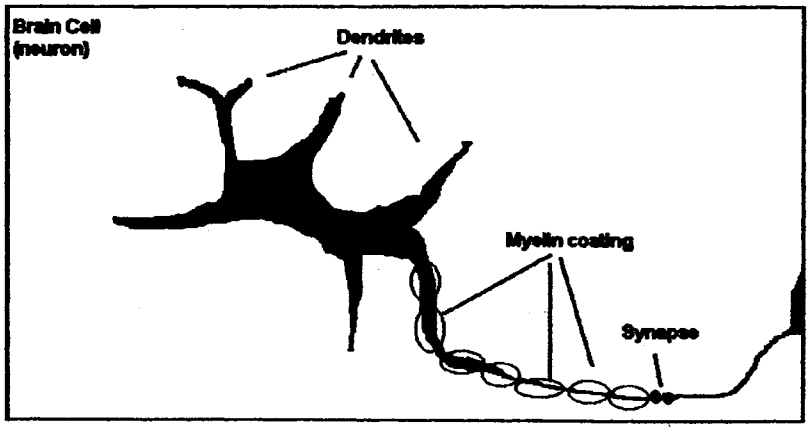
Your Brain-Friendly Guide to Success in Math

Your brain knows how to learn, just as your lungs know how to breathe. However, there are important things you can do to maximize your brain's ability to do its work. This short introduction will help you choose effective strategies to use while learning mathematics. This is a simplified explanation of a complex process; if you are interested in learning more about the brain, check page 37 for additional resources. Also, the Website www.mathnotes.com has links to related brain Websites.

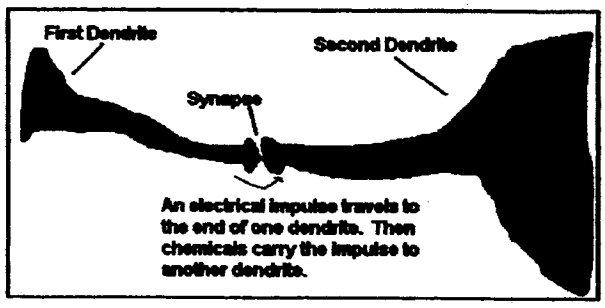
Your brain's outer layer is called the **neocortex**, which is where higher level thinking, language, reasoning, and purposeful behavior occur. The neocortex has about 100 billion (100,000,000,000) brain cells called **neurons**.

Learning Something New

- As you learn something new, threadlike branches grow out of each neuron. These branches are called **dendrites.**
- When the dendrite from one neuron grows close enough to the dendrite from another neuron, a connection is made. There is a small gap at the connection point called a **synapse.** One dendrite sends an electrical signal across the gap to another dendrite.
- ***Learning = growth and connecting of dendrites.***



The above drawing shows a neuron with several dendrites. One of the dendrites has developed a myelin coating through repeated practice.



This drawing shows a close up view of the connection point (synapse) between two dendrites.

Remembering New Skills

- When you practice a skill just once or twice, the connections between neurons are very weak. If you do not practice the skill again, the dendrites at the connection points wither and die back. You have forgotten the new skill!
- If you practice a new skill many times, the dendrites for that skill become coated with a fatty protein called **myelin.** Each time one dendrite sends a signal to another dendrite, the myelin coating becomes thicker and smoother, allowing the signals to move faster and with less interference. Thinking can now occur more quickly and easily, and ***you will remember the skill for a long time*** because the dendrite connections are very strong.

Other Important Points

- You grow dendrites specifically for the thing you are studying. If you practice adding fractions, you will grow specialized dendrites just for fractions. If you ***watch other people*** solve fraction problems, ***you will grow dendrites for watching, not for solving.*** So, be sure you are actively learning and practicing.
- If you practice something the ***wrong*** way, you will develop strong dendrite connections for doing it the wrong way! So, as you study, check frequently that you are getting correct answers.
- As you study a new topic that is related to things you already know, you will grow new dendrites, but your brain will also send signals throughout the network of dendrites for the related topics. In this way, you build a complex **neural network** that allows you to apply concepts, see differences and similarities between ideas, and understand relationships between concepts.

Periodically, in your math text you will see an icon that looks like this: 

This desk light directs you to "brain friendly" activities in this workbook which are designed to help you grow and develop your own reliable neural networks for mathematics. Since you must grow your own dendrites (no one can grow them for you), these activities show you what you can do to

- develop new dendrites,
- strengthen existing ones, and
- encourage the myelin coating to become thicker so signals are sent with less effort.

When you incorporate the activities into your regular study routine, you will discover that you understand better, remember longer, and forget less.

Also remember that it does take <u>time</u> for dendrites to grow. Trying to cram several new concepts and skills in at the last minute is not possible. Your brain simply can't grow that quickly. You can't expect to develop huge muscles by lifting weights for just one evening before a body building competition! Practice the techniques ***throughout the course*** to facilitate good growth.

If you are under stress or feeling anxious, such as you might during a test, your body secretes **adrenaline** into your system. The presence of adrenaline in the brain blocks connections between neurons-in other words, you can't think! If you've ever experienced "blanking out" on a test, you've seen first hand what adrenaline does. You'll learn several solutions to that problem in the test taking activities.

HOW YOUR BRAIN DEVELOPS WHEN YOU LEARN MATH

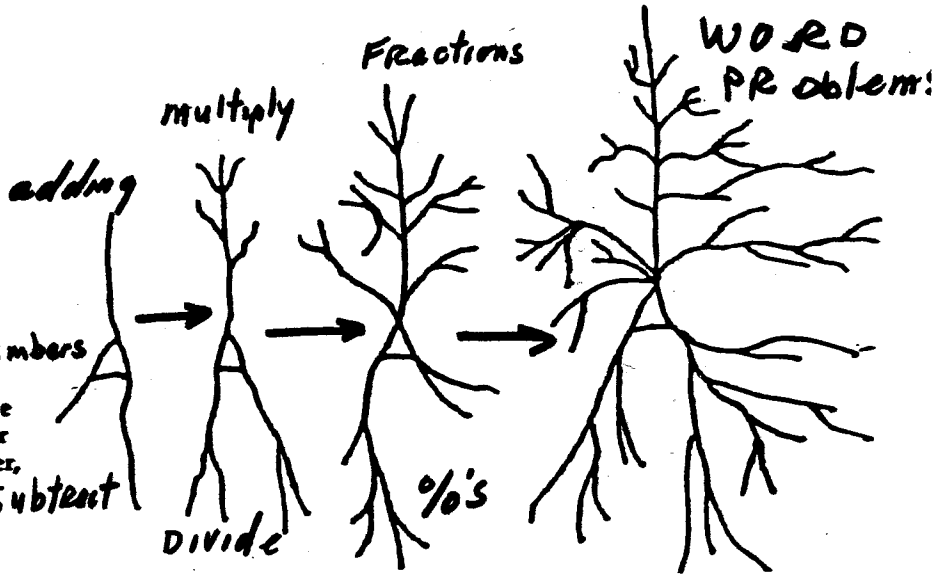


Figure 1

Dendrites grow on the neuron as learning occurs. The dendrites grow longer as well and connect with other dendrites at new synapses, forming new and/or richer, more complex neuronal networks.

1) LEARNING NEW THINGS ADDS AND GROWS NEW DENDRITES

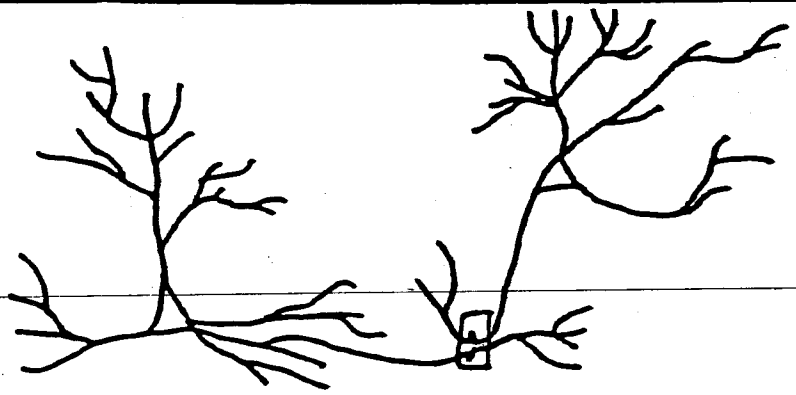
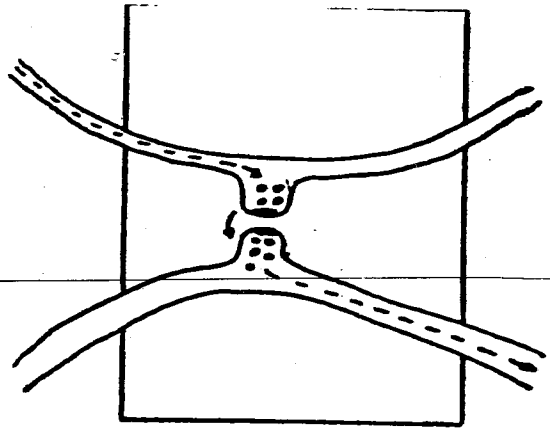
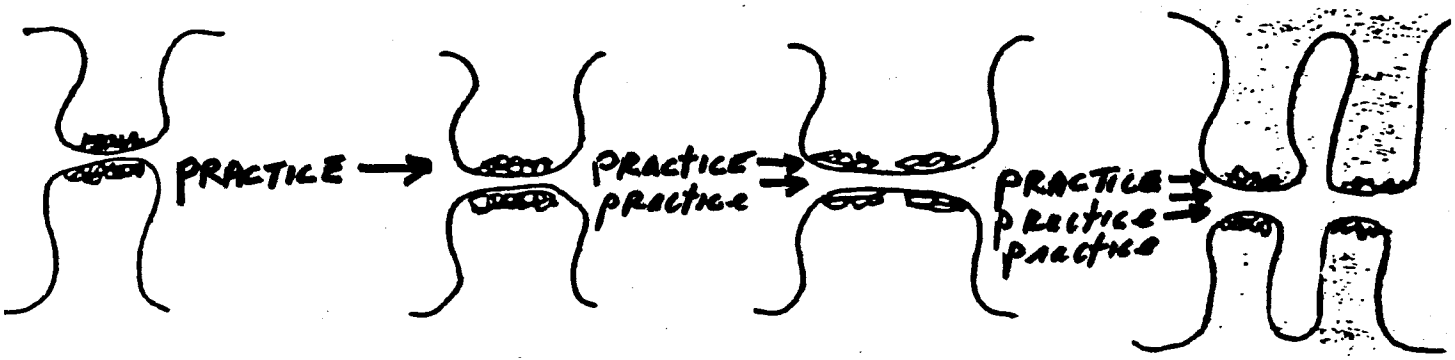


Figure 2: Two neurons at a contact point (synapse).



Enlarged area from Figure 2: A synapse. An electrical impulse travels into a spine of one dendrite. Chemicals in that spine are sent across the gap into the spine of another dendrite. An electrical impulse begins in the second dendrite and continues the process.

2) MEMORY INCREASES BY BUILDING SYNAPSES



Two spines at a synapse.

Through repeated non-rote practice the spines enlarge, forming a larger area for the communication between the spines.

After much non-rote practice, the original spine split into two spines, increasing the complexity and fluency of the communication and the neural network.

Emotions affect this brain activity: Positive emotions like confidence and interest produce hormones that facilitate synaptic communication. But negative ones like fear and self-doubt inhibit transmission between neurons, producing a "blank" mind, i.e., the inability to think, learn, and remember.

3) SYNAPSES BUILD THROUGH NON-ROTE PRACTICE

CONSEQUENCES OF MIND/LEARNING THEORY APPLIED TO ALGEBRA

1) What would the effect of missing class be, where new material is covered, on learning algebra?

2. What can you do to make up for the learning deficit created when you miss class?

3. If you are unable to practice algebra problems because of time limits caused by work, over scheduling, health of family problems, etc. what effect will this have on your brain?

4. According to the dendrite/synapse theory how can you best prepare for a mastery test?

5. What would the consequences be from missing several classes in a row during the semester on your ability to learn the new material that follows? (For example taking a vacation during the middle of the term)

name _____