

How Your Brain Learns and Remembers

© 2007 Diana Hestwood and Linda Russell
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- **What happens inside your brain**
- **Brain-friendly ways to learn better**
- **How homework helps your brain**
- **How emotions affect learning and memory**

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Part One (1, 0+1, 3-2, I)

- **What happens inside your brain when you learn something new?**

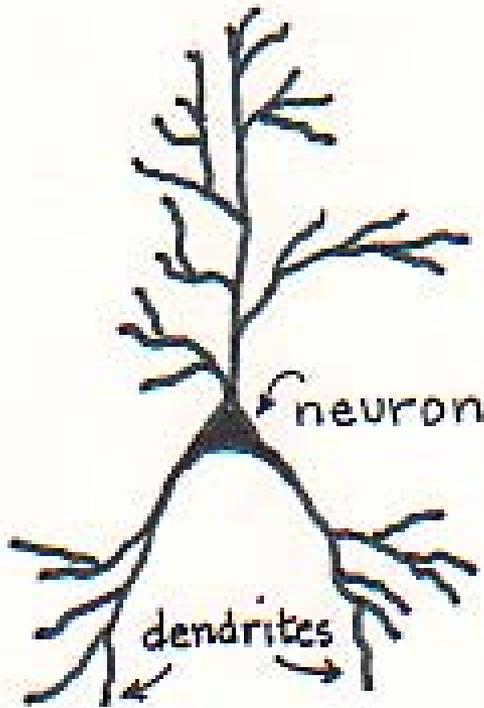


This is your brain...

- Brain cells are called **neurons**.
- You are born with at least 100 billion neurons.
- **Dendrites** (fibers) grow out of the neurons when you listen to/write about/talk about/ practice something.



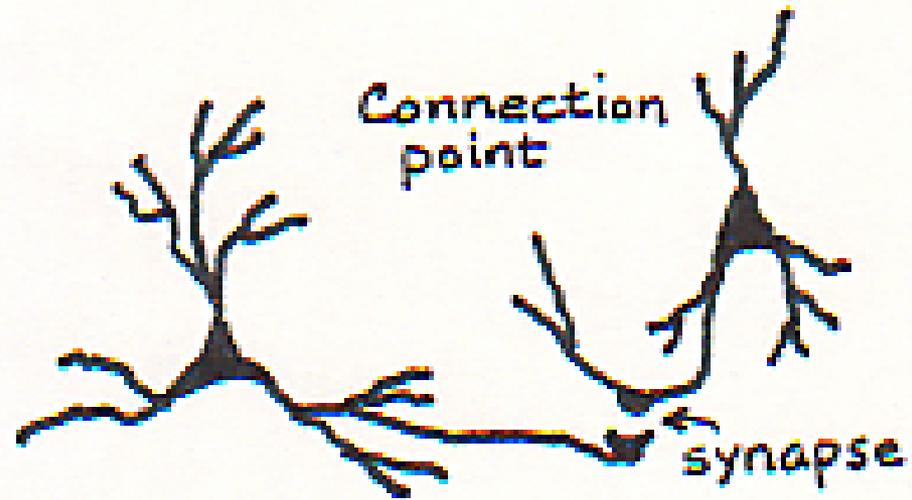
Learning is natural!



- Neurons know how to grow dendrites, just like a stomach knows how to digest food.
- **Learning = Growth of dendrites.**
- New dendrites take time to grow; it takes a lot of practice for them to grow.

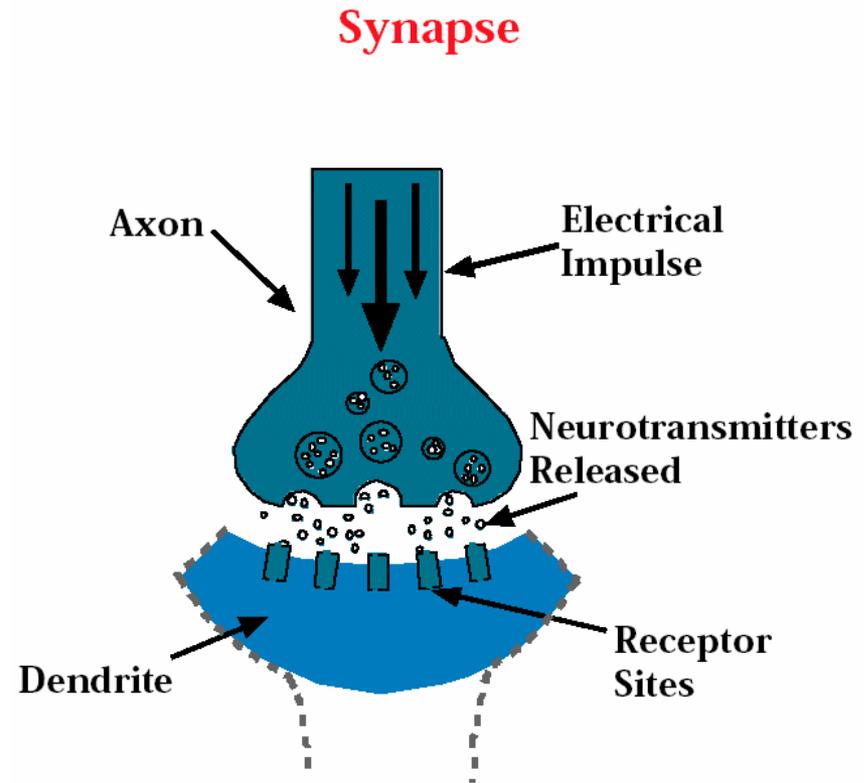
Connections form between neurons.

- When two dendrites grow close together, a contact point is formed. A small gap at the contact point is called the **synapse**.
- Messages are sent from one neuron to another as electrical signals travel across the synapse.



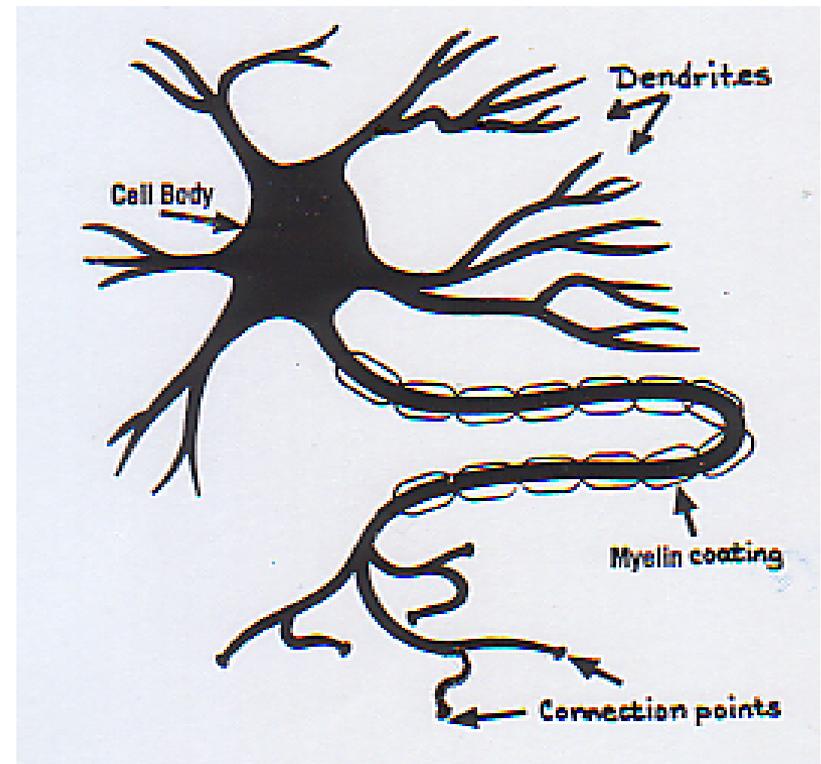
Practice builds strong connections!

- Special chemicals called **neurotransmitters** carry the electrical signals across the synapse.
- When you practice something, it gets easier for the signals to cross the synapse. That's because the contact area becomes wider and more neurotransmitters are stored there.



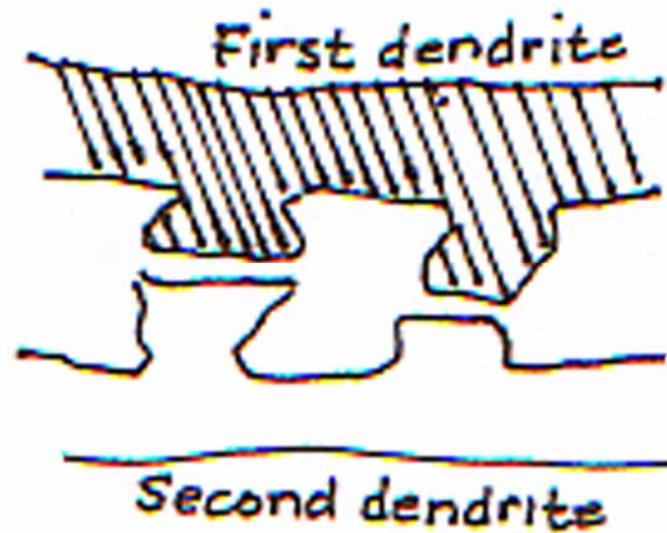
Practice builds faster connections.

- When you practice something, the dendrites grow thicker with a fatty coating of **myelin**.
- The thicker the dendrites, the faster the signals travel. The myelin coating also reduces interference.



Practice builds double connections.

- With enough practice, the dendrites build a *double* connection.
- Faster, stronger, double connections last a very long time. You remember what you learned!



Short-term memory is VERY short!

- If you learn something new and do it only once or twice, the dendrite connection is very fragile and can disappear within hours.
 - Within 20 minutes, you remember **only 60%**.
 - Within 24 hours, you remember **only 30%**.

But if you practice within 24 hours, and then practice again later, you **remember 80%**.

Make the most of practice time...

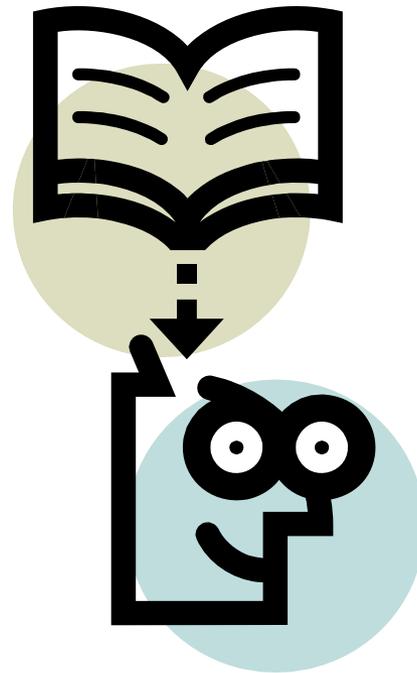
- You grow dendrites for **exactly** the same thing you are practicing.
- If **you listen or watch** while math problems are solved, **you grow dendrites for listening or for watching**.
- If **you actually solve** the problems yourself, **you grow dendrites for solving**.

The dendrites this toddler is growing are for what skill or concept?



Part Two (2, II, 1+1, 3-1)

- **What are the most important points for me to remember?**



Major Points to Remember, #1

- **You are naturally smart, because ...**





You are naturally smart, because ...

- Your brain knows how to grow dendrites just like your stomach knows how to digest food.
- Think about a baby who learns to speak in its native language without any special classes or training!

Major Points, #2

- You must do something active (explain, solve, draw, write, etc.) in order to learn, because...



You must do something active to learn, because...

- Dendrites grow ONLY when you are actively doing something.
- No one else can grow dendrites for you!

Major Points, #3

- **Dendrites cannot grow in a void. They can only grow ...**

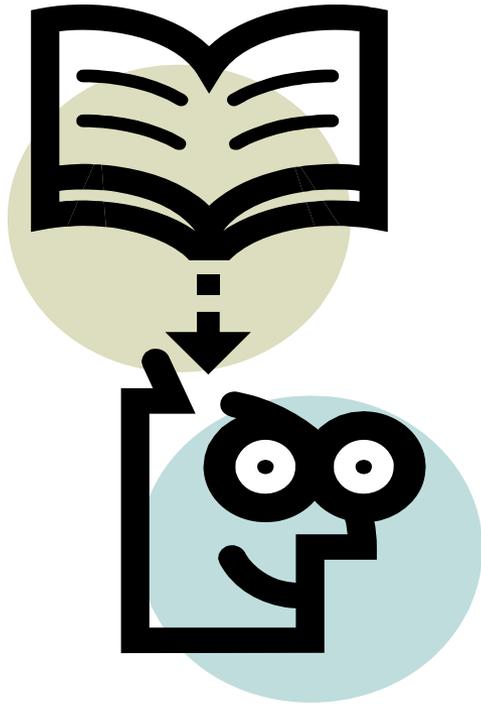




Dendrites cannot grow in a void.

- New dendrites can only grow off of what is already there. New skills must connect to, and grow off of, previously learned skills.
- If you do **not** have the necessary dendrites in place, new material will seem to go “right over your head”.
- So, start with a math course that matches your skill level.

Major Points, #4



- Dendrites take time to grow, because...



Dendrites take time to grow, because...

- It takes a lot of practice for dendrites to grow.
- This is why you do homework.
- This is why trying to cram everything into your brain the night before a test doesn't work.

Major Points, #5

- ❑ **Mistakes, with feedback, are essential and good, because...**





Mistakes are essential, because...

- ❑ Making mistakes, and getting feedback so you can correct them, allows you to check the accuracy of the connections in your brain.
- ❑ Be sure to get feedback quickly so you don't practice the wrong thing and build a strong, but wrong, connection!

Major Points, #6



- **Emotions affect learning and memory! Let's see how it works...**

What can emotions do to you?



- ❑ Anxiety floods your body with **adrenaline** (“fight or flight”).
- ❑ Adrenaline makes it hard for the neurotransmitters to carry messages across the synapses in your brain.
- ❑ That causes “blanking out” on a test.

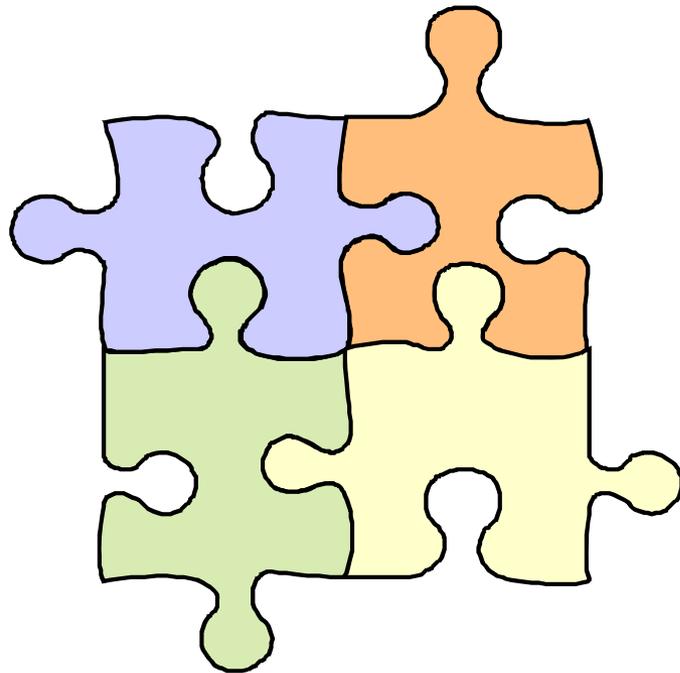
How can emotions help you?

- ❑ **Endorphins** make you feel calm.
- ❑ Your body produces endorphins when you relax, exercise, laugh, or learn new things.
- ❑ If you practice producing calming hormones, it will help when you are under stress.



Part Three (3, III, 1+1+1)

□ So what does all this mean for me?



Use dendrite theory to answer these questions...

- I understand what's going on in the lecture just fine. But when I get home and start on the homework assignment, why am I lost?
- I attend class and do all the homework and feel like I understand everything. Then why do I just “blank out” on the test and can't do anything?

Can you answer these?

- Why should I do all this homework? It's just the same thing over and over.
- I work full time. Can I do homework only on weekends and still pass the course?

More questions...

- I've been absent for a week but there's a test tomorrow. Can I cram it all in tonight?
- Why can't I take this math course even if I haven't passed the prerequisite course (or gotten a high enough score on the placement test)?



So what should you do?

- ❑ Start with the right math course; the skills build from one course to the next. Take the rest of your math courses one at a time, in order.
- ❑ Do some of the homework as soon as possible after class, before you forget.
- ❑ Try to practice math every day.
- ❑ To manage anxiety, learn simple relaxation techniques such as slow, deep breathing.



More things you can do...

- Make sure you are actively **DOING** something when you study.
 - Make study cards.
 - Draw pictures or diagrams.
 - Solve lots of problems; check your answers.
 - Check your understanding by explaining how to do a problem to another student.
 - Create a practice test for yourself. Work it in the same amount of time you'll be given in class.



New Vocabulary

- neuron**
- dendrite**
- synapse**
- neurotransmitters**
- myelin**
- adrenaline**
- endorphins**

Enjoy using your brain! The end.

