

Train Your Brain- Learn How to Learn

The Brain is Incredible!

ABSTRACT

Your brain is incredible! It can store unlimited information. It is the most valuable organ for understanding and learning. If you understand some of the basics– how the brain works, the memory is created and retrieved, you can learn more easily. This article introduces how to train brain, memory techniques, and others to use your brain effectively so that you can be benefitted from the boundless treasures of the brain!

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Shawwal 2, 1441

One: Introduction



1. Introduction:

This article will provide techniques, guidelines and others on how to train your brain effectively so that you can learn how to learn! You have to learn continuously throughout your life, known as Lifelong Learning, continue developing ideas, gaining knowledge, since every day is a new a day!



Either you use your brain or lose it!

You are a different person, before you go to sleep and after you wake up from sleep in terms of brain's memory–solidifying activity! Your brain recreates the patterns of memory when you sleep. Your brain is plastic known as neuroplasticity and always updating. It has the capacity to change at any age! It is made of approximately **100 billion nerve cells or neurons**. A neuron can transmit between 250 and 2500 impulses per second!

Ah! Now, you have to take control of your brain, which in fact controls all your affairs!

The first recorded use of the word "brain" belongs to the ancient **Egyptians**. The word for "brain" and other "neuro" words appear in the **Edwin Smith Surgical Papyrus** which was written by an unknown Egyptian surgeon around **1,700 BC**.

If you understand at least a little bit of how the brain works and how do we remember things, that will lead you to a superior brain utilization. You have unlimited hidden treasures in your brain that you should be aware of!

Our **memories** shape who we are!

Creating a memory: Our brain sends signals in a particular pattern associated with the event we're experiencing and creates connections between our neurons or nerve cells, called synapses. It's possible to have up to one quadrillion (1×10^{15}) synaptic (electro-chemical) connections in one brain! Isn't that incredible!

Consolidating the memory: Consolidation is the process of committing it to long-term memory so we can recall it later. A lot of this process happens while we're sleeping, as our brains recreate that same pattern of brain activity to strengthen the synapses we created earlier.

When trying to **memorize new material**, the occasional **break** time is great for consolidating. Do nothing during this break, relax. Just sit back, and enjoy 10–15 minutes of quiet contemplation, or take a shower and you'll find that it helps you better to remember what you have just learned.

Sleep more to consolidate your memories

Sleep has proven to be one of the most important elements in having a good memory. Since sleep is when most of our memory consolidation process occurs, it makes sense that without enough sleep we're going to struggle to remember the things we've learned. Even a short nap can improve your memory recall.

Avoid distraction before sleeping and right after wake up– such as looking into the electronic devices, etc.

Otherwise You become a tool of the electronic device/state. But the electronic device should be your tool not the other way.

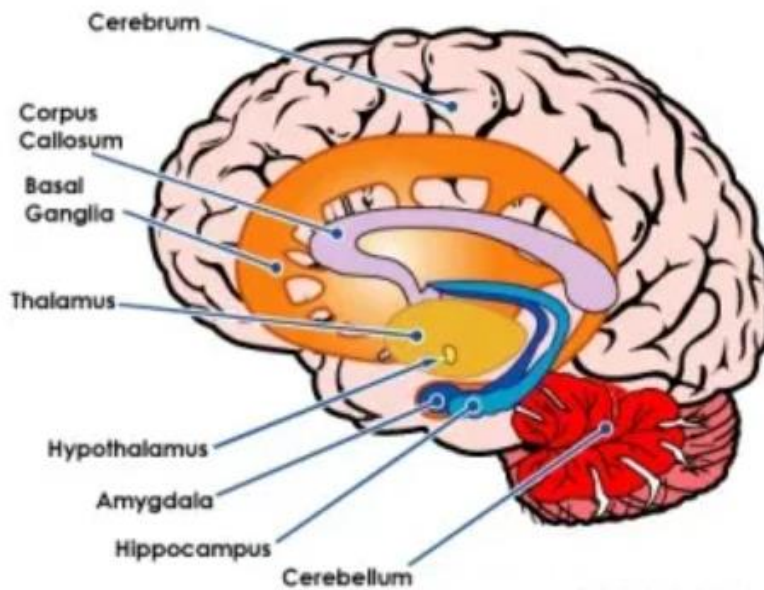
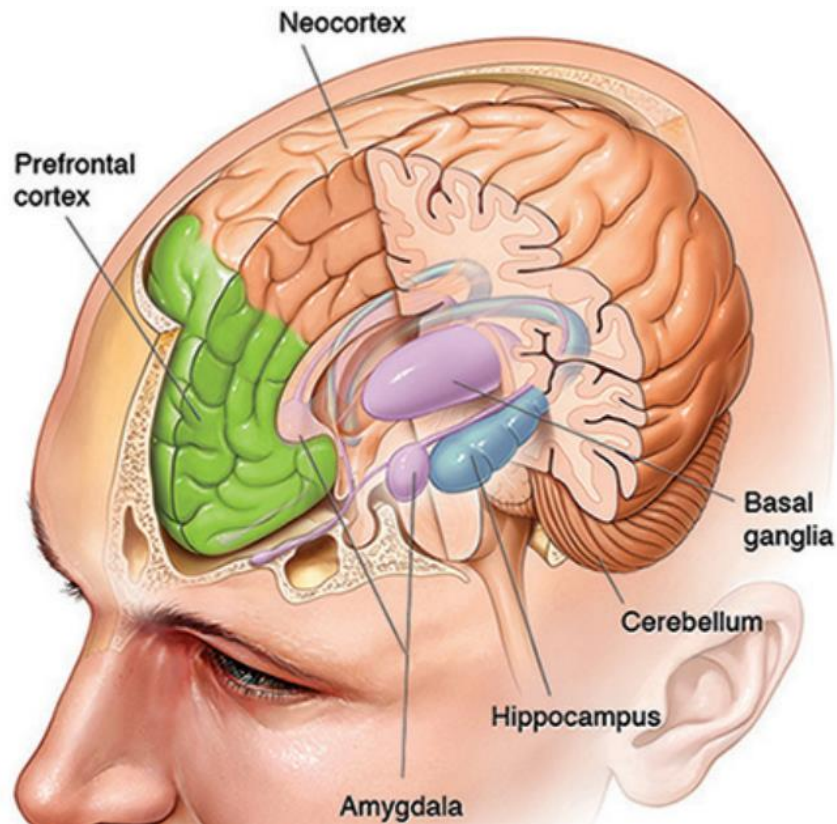
Emotion ties information.

Motivate yourself for learning something new. Since, Mental exercise is needed for mental health.

“Memories *aren’t stored in just one part of the brain. Different types are stored across different, interconnected brain regions.*

For explicit memories – which are about events that happened to you (episodic), as well as general facts and information (semantic) – there are three important areas of the brain: the hippocampus, the neocortex and the amygdala. Implicit memories, such as motor memories, rely on the basal ganglia and cerebellum. Short-term working memory relies most heavily on the prefrontal cortex.

Brain is the jelly-like material weighing around three pounds or 1.4 kilograms found within our skulls. Maybe it is the most complex living machine on Earth and in the whole universe.



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Types of memories

There are several different types of memories. Normally, when we talk about memory or remembering things, we are referring

to explicit memory, which is consciously recalled. Explicit memories can be episodic, meaning that they relate to experiences or 'episodes' in your life; or, they are semantic, relating to facts or general knowledge (e.g., the Sun rises in the East)."

When psychologists talk about improving memory, they most commonly focus on working memory because you have the most control over it and can actively improve it.

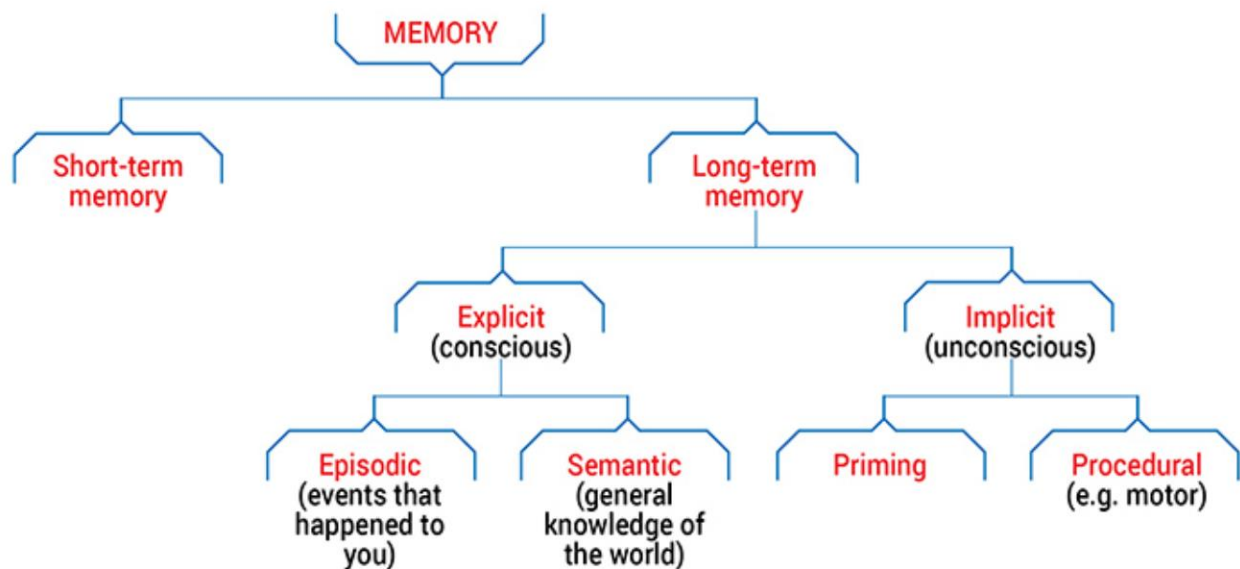
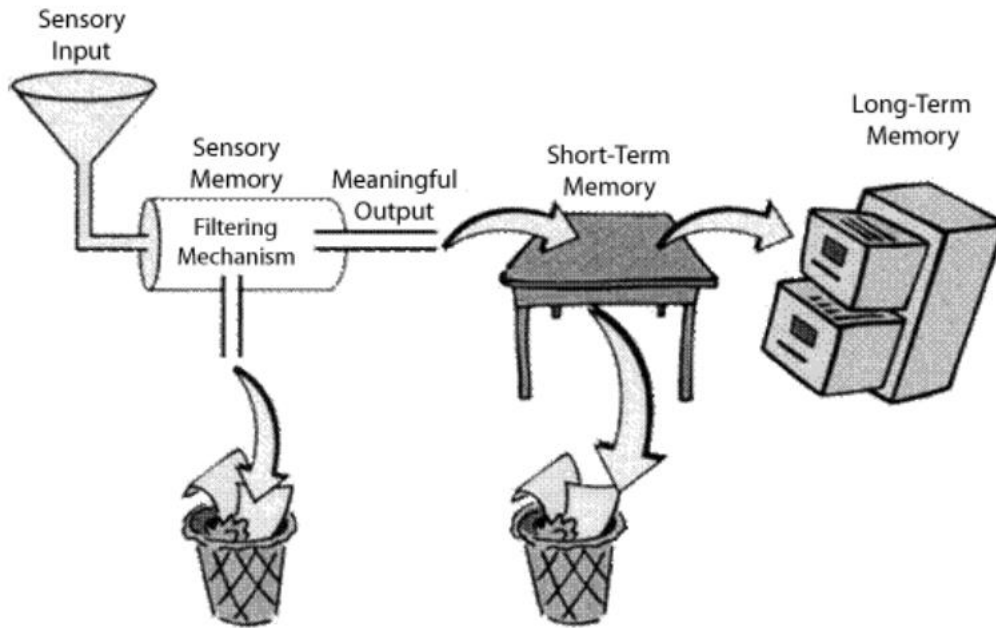


Image credit: Queensland Brain Institute

Memories occur when specific groups of neurons are reactivated. [Brian Becker](#), associate professor of neuropsychology at Lesley University, defines memory as “the process in which the mind interprets, stores, and retrieves information.”

Stages of Memory Creation

The brain has three types of memory processes: sensory register, short-term memory, and long-term memory.



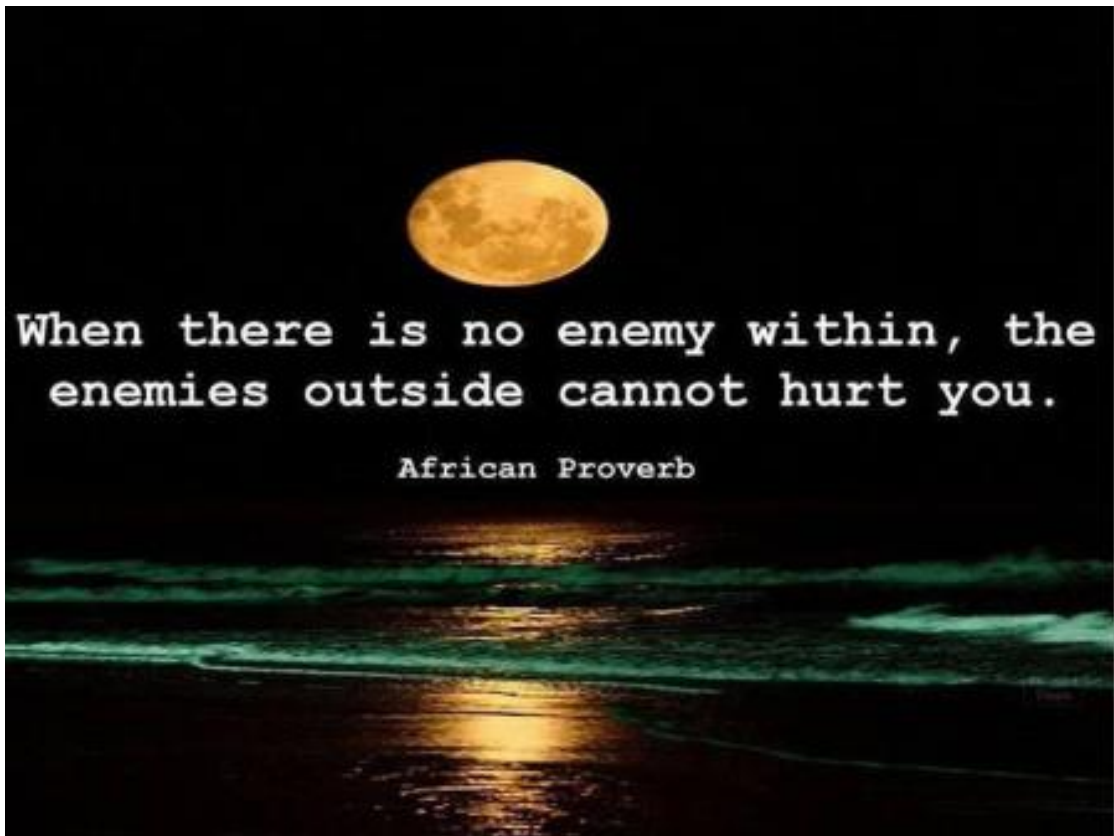
The creation of a memory begins with perception, occurs in the brief sensory stage that usually lasts only a fraction of a second. It's your **Sensory memory** that allows a perception (raw data).

The sensation is stored in short-term memory. It is considered to be outside of cognitive control and is instead an automatic response.

Short-term memory, working memory, has a fairly limited capacity; it can hold about seven items (7+/-2 items), in readily available state for no more than 20 or 30 seconds at a time.

Important information is gradually transferred from short-term memory into **Long-term memory through a bottleneck**. The more the information is repeated or used, the more likely it is to eventually end up in long-term memory which is thought to be **Unlimited**.

Two: Know Your Enemies



2. Know Your Enemies:

2.1 Distractions Make Learning Harder

“Even if you can learn while distracted, it changes how you learn to make it less efficient and useful,” said **Russell A. Poldrack**, a psychology professor at the University of California, Los Angeles.

Two major types of distractions:

Internal: Like hunger, fatigue, illness, stress, worries, other distracting thoughts –things you should be doing instead, things you’d rather be doing, etc.

External: External distractions can include things like general noise, other peoples' conversations, TV or movies, music, phone alerts, app alerts, and anything else that diverts your attention from the task at hand

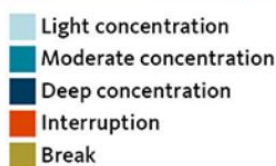
A. The Ideal Study Session: Good Concentration



B. A Common Study Session: Poor Concentration



C. Some Study Sessions: Poor Concentration



Informed by Fig 6.2. Blerkom, Dianna (2010) *Study Sessions and Levels of Concentration*, [image]. From *Orientation to College Learning* (pg. 143), by Dianna L. Van Blerkom, 2010, Boston: Wadsworth Cengage Learning.

So, you have to remove as many distractions as possible.

2.1.1 Remedy: Apply Pomodoro technique.



Developed by Italian Francesco Cirillo in the late 1980s. He named the system “Pomodoro” (Italian word, means Tomato) after the tomato-shaped timer. Steps:

- Set a timer for 20 to 30 minutes, and start to work.
- When the buzzer sounds, take a two to five minutes break.
- Repeat the session– start to work.
- After four sessions, take a longer break. (10–30 minutes.)

2.2 Anxiety, Worries -the Hidden Enemy

Stress, Anxiety causes the body to prepare itself for **fight or flight**. Anxiety and stress affect working memory — our ability to hold information in our minds for short periods, in order to do something with it.

Stress is one of the brain’s worst enemies. Over time, **chronic stress** destroys brain cells and damages the hippocampus, which is involved in the formation of new memories and the retrieval of old ones. Studies have also linked stress to memory loss.

Get rid of Anxiety.

2.3 Depression, Sadness -affects your ability to think

According to **James Cartreine**, PhD, “Depression can actually change your ability to think. It can impair your attention and memory, as well as your information processing and decision-making skills. It can also lower your cognitive flexibility (the ability to adapt your goals and strategies to changing situations) and executive functioning (the ability to take all the steps to get something done).”

Get rid of Depression.

2.4 Procrastination-

“Procrastination” is derived from the Latin verb “procrastinare”— to put off until tomorrow. But it’s more than just voluntarily delaying. Procrastination is also derived from the ancient Greek philosophers like **Socrates and Aristotle** who developed a Greek word to describe this type of behavior: *Akrasia*.

Akrasia is the state of acting against your better judgment—you do one thing even though you know you should do something else. This shows lack of self-control. When we procrastinate, we know that doing so is a bad idea. And yet, we do it!

The problem is not *doing* the work, it’s the *starting of the work!*
So, Start NOW!

Three: Memory Techniques



Photo Courtesy: [Joan Pendleton](#)

3. Memory Techniques: Make It Stick

Memory formation is like the foot way traffic path in the grass.

3.1. Prior Knowledge, Making Connection

We need prior knowledge and a system for organizing the information so we may assign meaning to it. Try to link what you want to learn with previous experience, prior knowledge. Did you have prior experience, similar knowledge before? Ask yourself, i.e., self-talk, if you can relate the new material to your earlier long-time memory.

3.2 Understand before You Memorize

Our previous experiences, knowledge, emotions, and understanding affect what and how we learn. If you can understand first, before memorizing, then, this will be stored easily in the Long-term memory.

3.3 Association- The Link, The Loci etc.

We remember things by association.

Do most of us have a bad memory?

Experts say, most of us **don't**. Most of us have a really good memory, but we just don't have the practice to use it.

Our memory works by association. If there is no association between things, it's very difficult to remember them.

Why association works? Because it attaches a string with something familiar, such as Mr. Hill with a hill to remember the name!

The Link Method– associations between the item to remember and an image.

The Loci Method– with the association of familiar locations.

The Journey Method– it will take landmarks and items like stop streets, circles and robot to associate your remember items.

The peg memory system creates a mental peg from an association, such as a rhyme, letter, or shape.

3.4 Chunking or clustering

The chunking technique involves grouping items, finding patterns in them etc. It is as an efficient approach for utilizing limited working (short time) memory. It breaks up long strings of information into **units or chunks**. Prior knowledge defines chunks, allows for more information to be retained in memory. **Chunking** is a tool for getting around the **bottleneck of short-term memory**.

Research suggests that on average the human brain can hold **4 to 7 different items in its working (short-term) memory**. Some say **7+/-2** chunks.

Exercise 1: Try to look at the number, **7194520207**, for 5 seconds and then recall.

Could you do it?

If you could chunk this number as 7 1945 2020 7, now it's easy!

Exercise 2:

Try to look at the number, **7458793107**, for 5 seconds and then recall.

Could you do it?

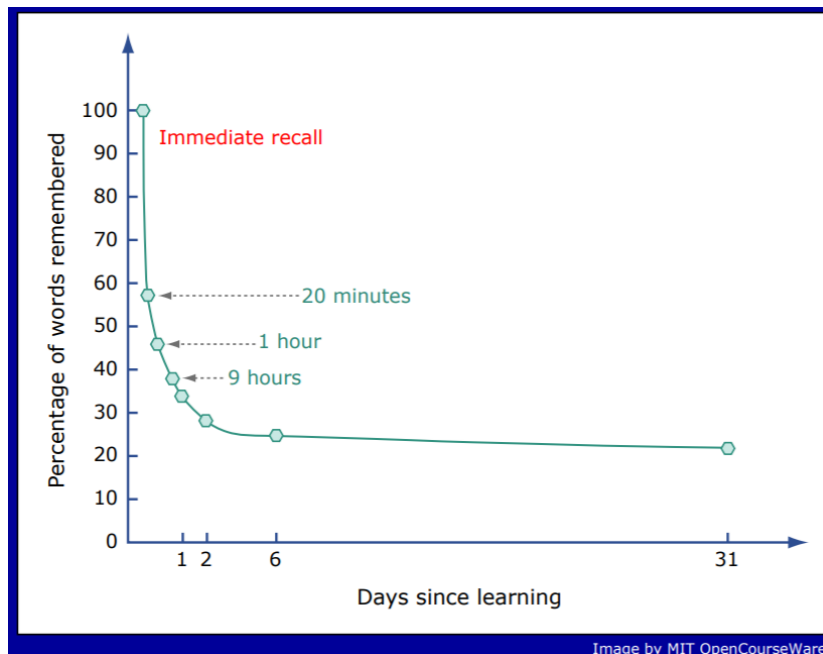
If you could chunk this number as 745 879 3107, now it's easy!

3.5 Practice makes permanent.

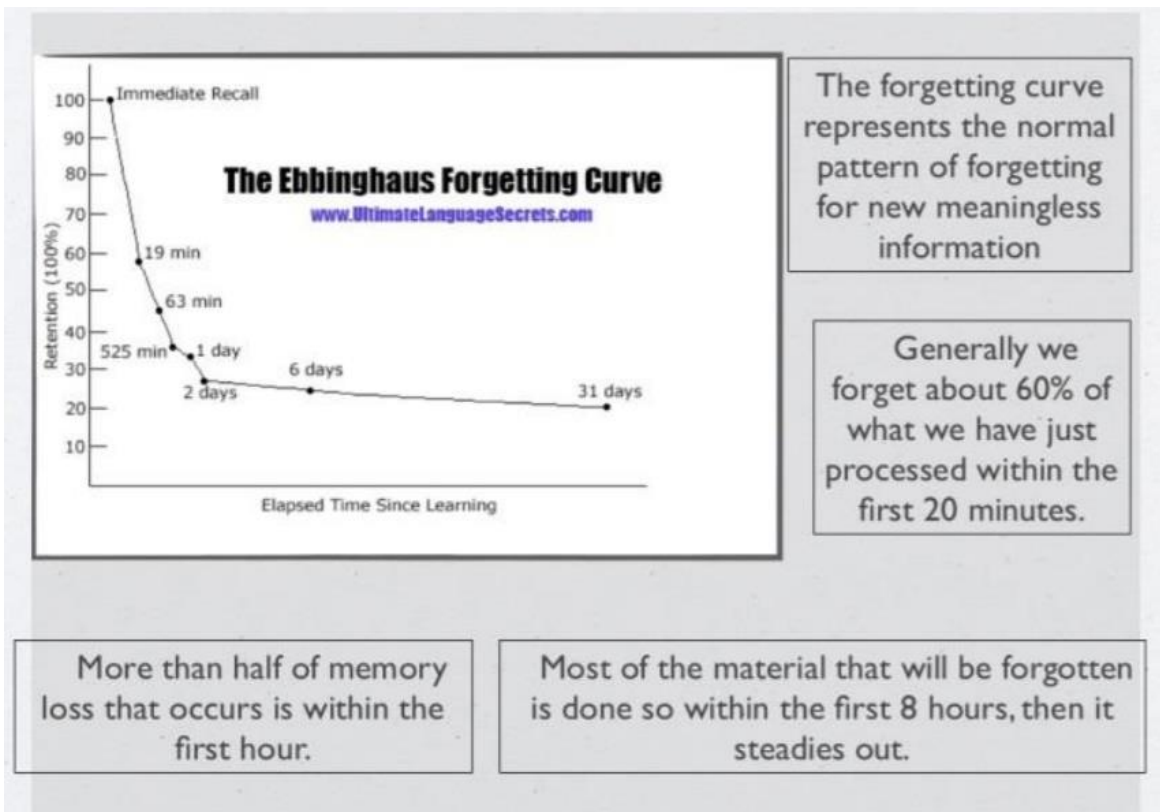
Repeated retrieval during learning is the key to long-term retention. There is a wise saying, “If you listen, you forget; if you see, you remember, if you do, you understand”

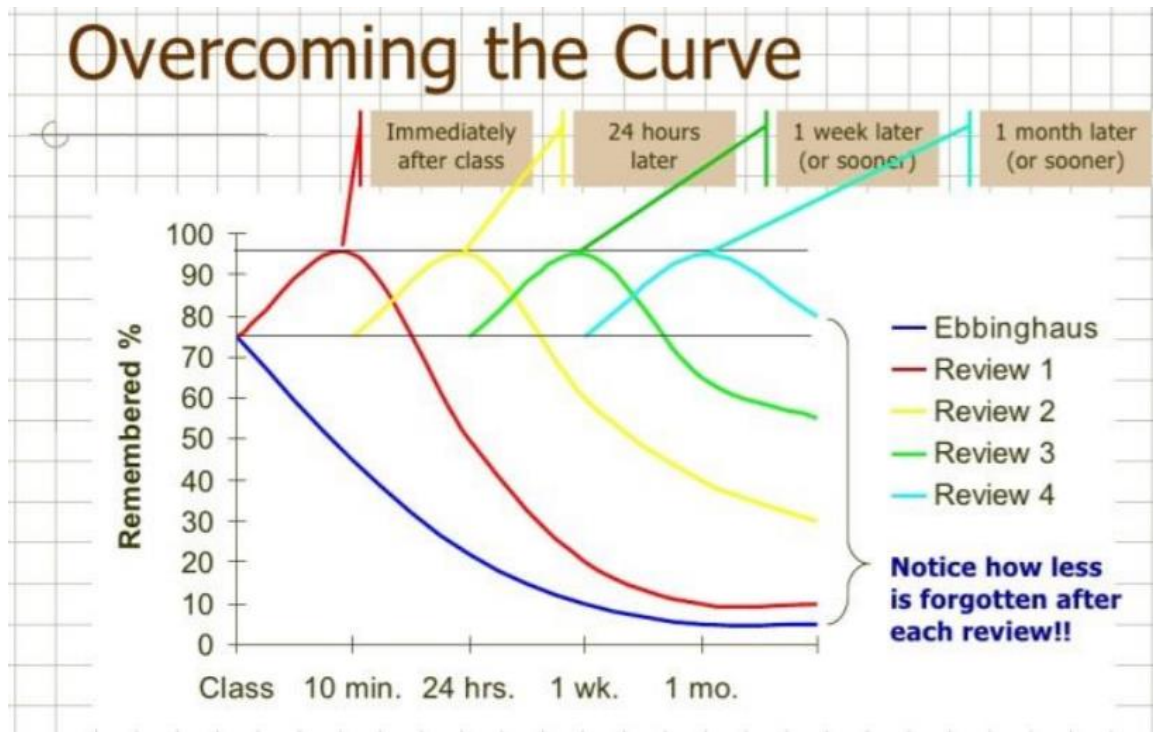
- When you review or practice something you’ve learned, dendrites actually grow between nerve cells in the network that holds that memory.
- Each time you review that knowledge, this mental manipulation increases activity along the connections between nerve cells.
- Repeated stimulation—for example, studying the times tables many times—makes the network stronger, just like muscles become stronger when you exercise them. And that makes the memory stay in your brain. Practice makes permanent.
- Recalling the memory is easier if it’s been strengthened over time, and each time we do so, we run through that same pattern of brain activity again, making it a little stronger. To retrieve a memory, your brain “replays” or revisits the old nerve pathways created when the memory was originally formed. Repeatedly recalling information strengthen those connections and therefore your memories. That’s why techniques like reviewing your notes or using flashcards help you retain information.

Ebbinghaus Curve of Forgetting



The Ebbinghaus Forgetting Curve is a theory about how our memory works, proposed in 1885 by a German psychologist named Hermann Ebbinghaus

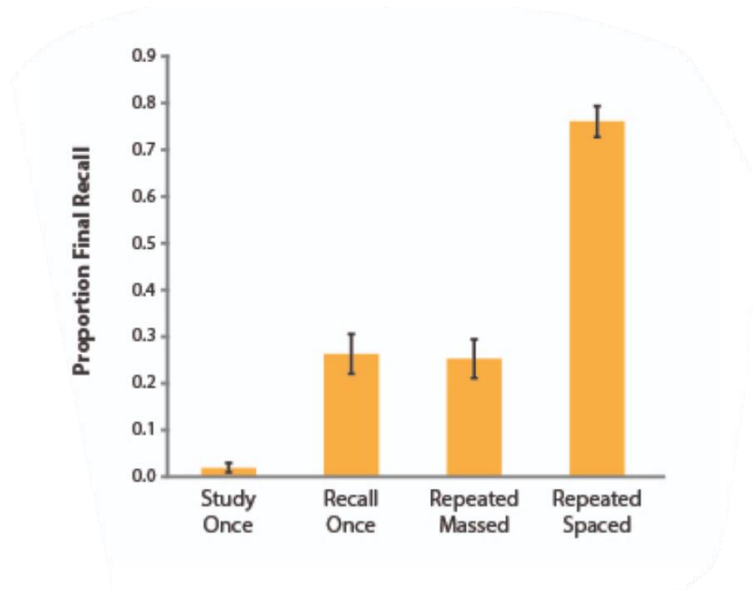




But, your own awareness of the current situation gets mixed in with the memory. As [The Human Memory explains](#):

Memories are not frozen in time, and new information and suggestions may become incorporated into old memories over time. Thus, remembering can be thought of as an act of creative reimagination.

That's also why people can have false memories and their memories of events might change over time.



Data from Karpicke & Bauernschmidt (2011).

3.6 Recall is better than Rereading the Text

- The practice of remembering things without rereading the text can improve brain function.

Active recall involves retrieving information from memory. It's a Close book exercise!

In the Learning Scientists' book *Understanding How We Learn: A Visual Guide*, writers Dr. Megan Sumeracki and Dr. Yana Weinstein delve into the basics of how memory works.

Memories, rather than being fixed objects, are malleable. They're not read-only records stored in archives. Neurons, or brain cells, reach out to other neurons through connectors called synapses to form memories. **When neurons fire off together, a pattern (sometimes called an "engram") is formed. Recall of the memory will light up the pattern again.**

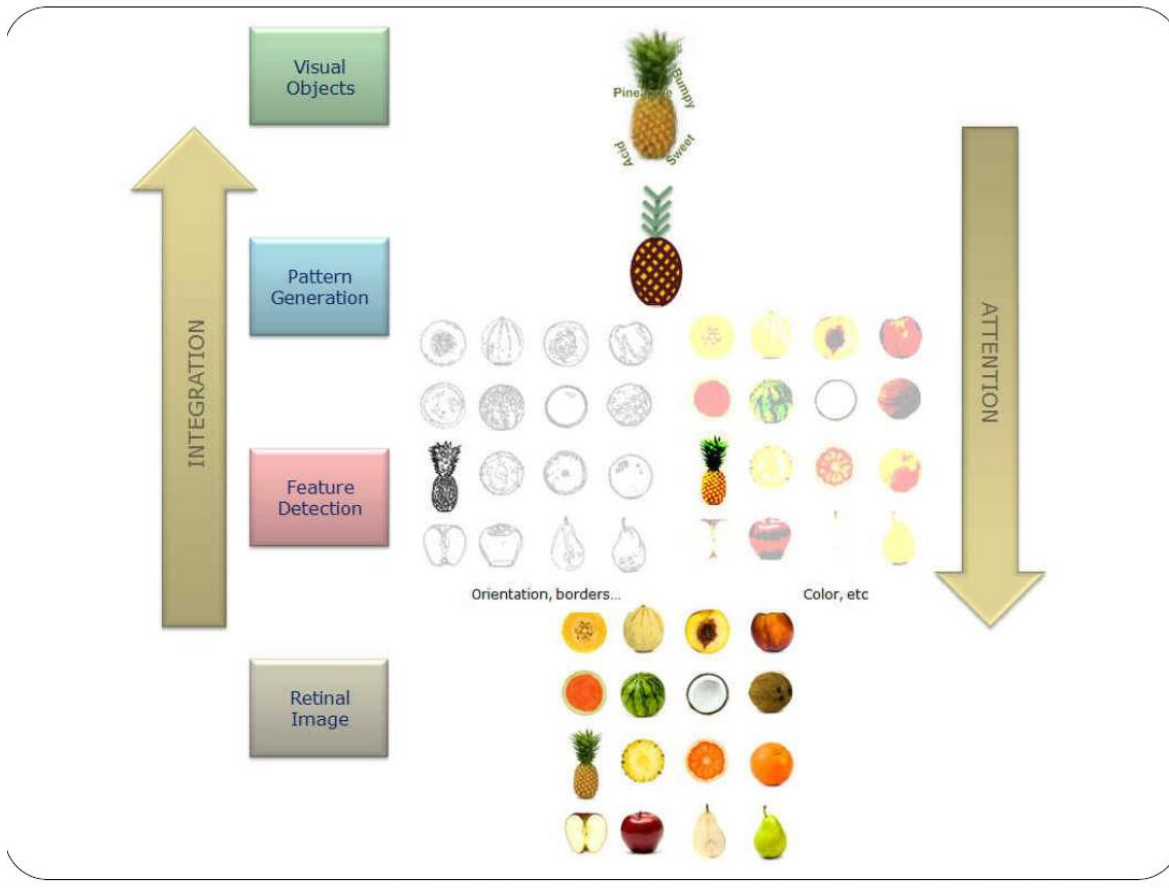
3.7 Feeling Good Helps Learning!

Dopamine: An important neurotransmitter (messenger) in the brain. It is a neurotransmitter that plays a role in pleasure, motivation, and learning. Dopamine carries electrical messages across the gap from one neuron to another. This transmission is crucial to your brain's capacity to process new information.

Your brain releases extra dopamine when an experience is enjoyable. As positive emotions cause dopamine to travel to more parts of your brain, additional neurons are activated. Thus, a boost in dopamine not only increases your own sense of pleasure, but also increases other neurotransmitters, such as acetylcholine, that enhance alertness, memory, and executive functions in the prefrontal cortex.

3.8 Pay Attention: Attention and Memory are related

- Attention and memory operate with each other. attention helps to improve memory encoding
- **Attention** is the cognitive process of selectively concentrating on one aspect of the environment while ignoring other things. Attention has also been referred to as the allocation of processing resources
- **Top-down processing**, also known as goal driven, endogenous attention, attentional control or executive attention. This aspect of our attentional orienting is **under the control of the person who is attending**. It is mediated primarily by the frontal cortex and basal ganglia as one of the executive functions.
- **Bottom-up processing**, also known as stimulus driven attention or exogenous attention. These describe attentional processing which is driven by the properties of the objects themselves. Some processes, such as motion or a sudden loud noise, can attract our attention in a preconscious, or non-volitional way. **We attend to them whether we want or not**.
- Memory has a limited capacity, and thus **attention determines what will be encoded**.
- Memory **from past experience** guides what should be attended.
- Brain areas that are important for memory, such as the **hippocampus** and **medial temporal lobe** structures, are recruited in attention tasks.



3.9 Sleep Well: It will Clean Your Brain

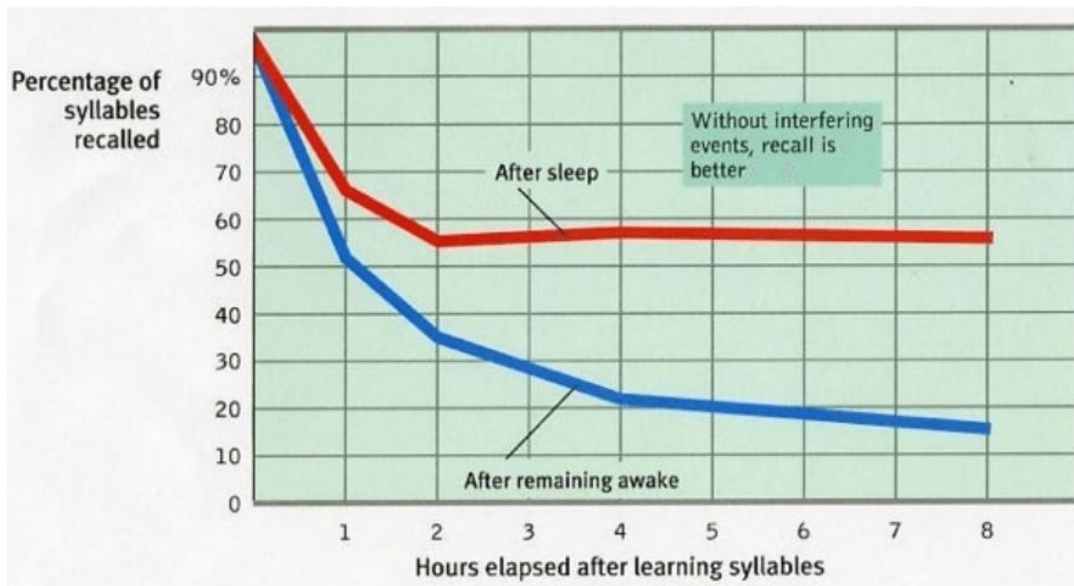
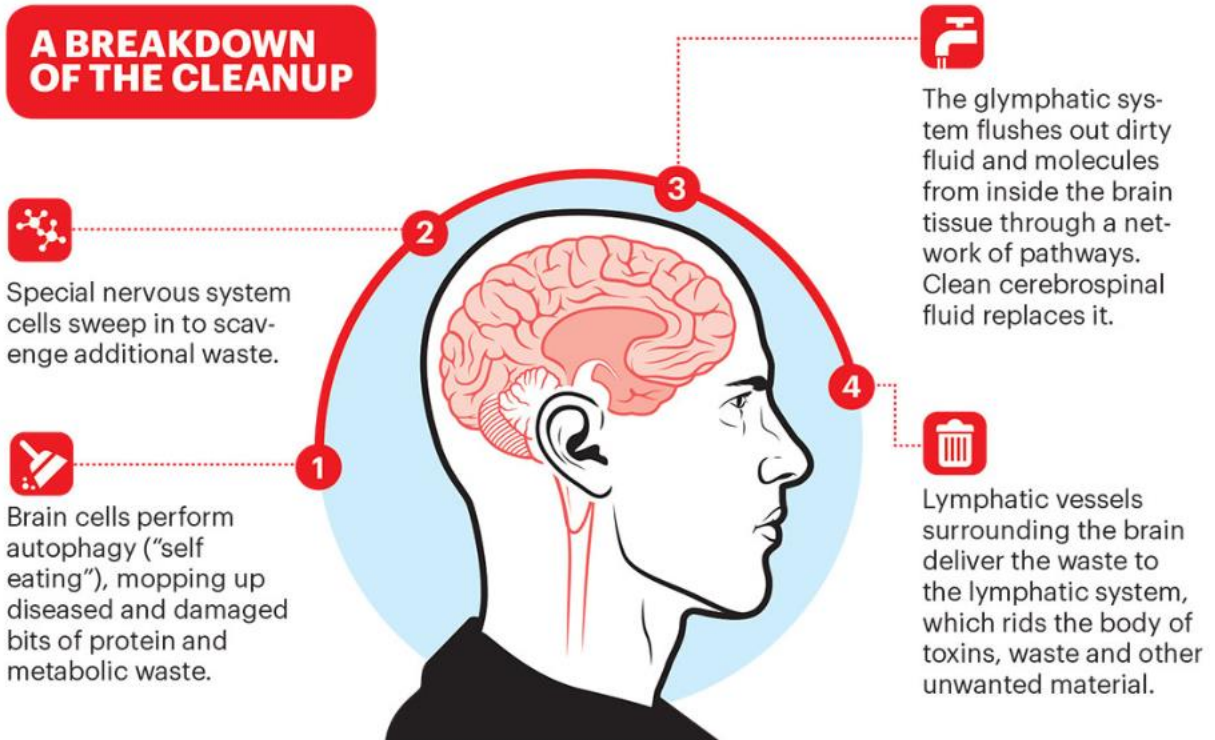
Sleep is absolutely essential to brain health. Your brain flushes out **toxins** that have accumulated during the day. It is also important for consolidating short-term memories into long-term memories. A Clean Mind Is Good for Your Health.

Deep Sleep Gives Your Brain a Deep Clean.

Naps improve your brain's day to day performance.

Research indicates that when a memory is first recorded in the brain—in the **hippocampus**, to be specific—it's still “fragile” and easily forgotten, especially if the brain is asked to memorize more things. **Napping**, it seems, pushes memories to the neocortex, the

brain's "more permanent storage," preventing them from being "overwritten."



Better learning: Taking a nap also helps to clear information out of your brain's temporary storage areas, getting it ready for new information to be absorbed.

3.10 Stop multi-tasking.

While you may feel like you are accomplishing more by multi-tasking, you are actually more likely to make mistakes and get frustrated when things go wrong. By not multi-tasking, you can train your brain to focus your attention on one activity at a time and do better work. Break up tasks into smaller blocks of time so that you can dedicate that time solely to what you need to accomplish.

3.11 Draw Pictures: A Picture Worth a Thousand Words

Drawing pictures of information is a strong and reliable strategy to enhance memory.

Comparisons of people's memories for words with their memories for pictures of the same objects show a superiority effect for pictures.

The superiority effect of pictures is also true if words and pictures are combined during learning.

Hear a piece of information, and three days later you'll remember 10 percent of it. Add a picture and you'll remember 65 percent.

Pictures beat **text** as well, in part because reading is so inefficient for us. Our brain sees **words** as lots of **tiny pictures**, and we have to identify certain features in the letters to be able to read them.

Sensation is the stimulation of a sensory receptor which produces neural impulses that the brain interprets as a sound, visual image, odor, taste, pain, etc. Sensation occurs when sensory organs absorb

energy from a physical stimulus in the environment. Sensory receptors then convert this energy into neural impulses and send them to the brain.

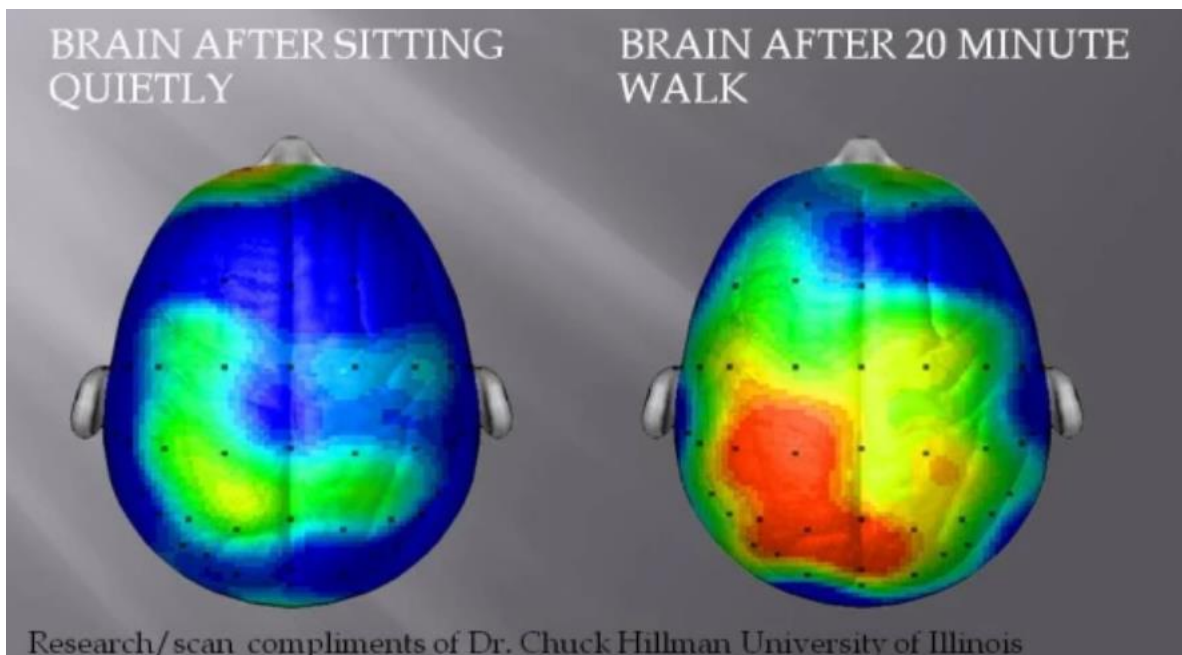
Perception (from the Latin **perceptio, percipio**) is the organization, identification and interpretation of sensory information in order to represent and understand the environment.

3.12 Read every day.

Reading a book of your interest can actually enhance your cognitive function. Reading also helps to develop language skills and increase attention spans.

3.13 Exercise daily.

Exercising as little as 20 minutes a day can increase your brain function. Exercise helps you learn faster and retain information better.



3.14 Eat a Healthy Diet: Fruits and Vegetable

What a person puts into their body directly affects how they think and feel, and certain foods can help improve memory. Omega-3 fatty acids, vitamins, unsaturated fats, and fiber are particularly important for your brain.

Drink lots of water as well to stay hydrated.

[Harvard Health Publishing](#) suggests that maintaining a healthy diet that includes green, leafy vegetables (e.g., kale, spinach and broccoli) and fatty fish (e.g., salmon and light tuna), as well as berries, walnuts, tea and coffee, can help to improve memory. [Healthline](#) also recommends pumpkin seeds, dark chocolate, oranges and eggs as foods that can improve and maintain memory.

3.15 Meditate to improve Your Memory

Working memory, which is like the brain's notepad for holding new information temporarily. If they're not useful anymore, your brain let go of them entirely. If they are, your brain commits them to long-term memory where they can be strengthened and recalled later. Meditation strengthen Working memory. During meditation, our brains stop processing information as actively as they normally would. Mindfulness meditation, teaches you to focus your mind. When you're able to focus better, you're also better able to solidify concepts in your short-term memory.

The authors of a [2018 research paper](#) note that many studies show meditation improves brain function, reduces markers of brain degeneration, and improves both working memory and long term memory. The researchers observed the brains of people who regularly practiced meditation and those who did not.

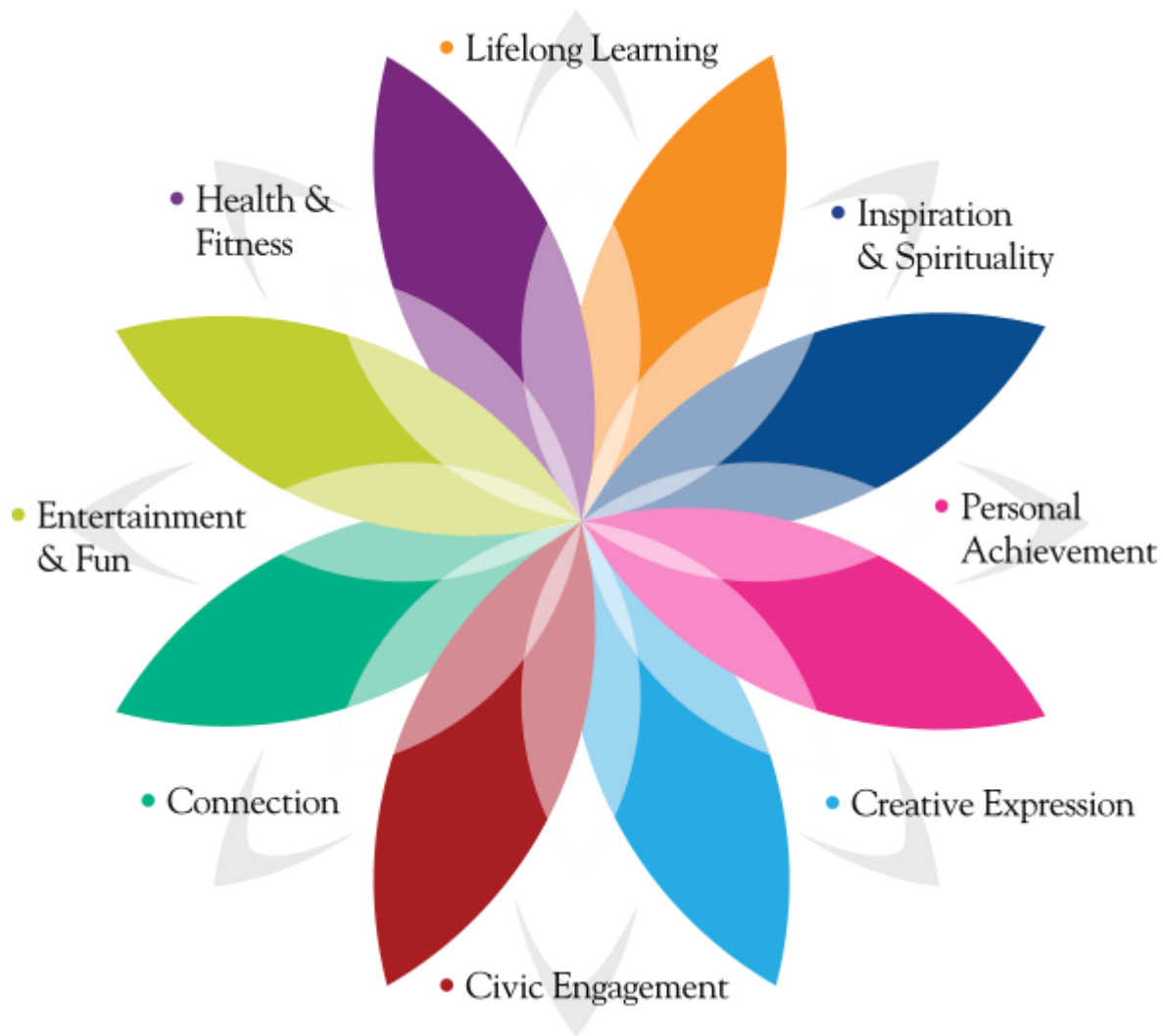
3.16 Learn something new.

Memory, like muscular strength, requires you to “use it or lose it.” Keep your brain stimulated and active by picking up something new. Practicing something new, forms new neural pathways in your brain. Repeating the same action over and over strengthens these newly formed brain pathways. The more you use your brain, the better it will work.

3.17 Maintain social relationships.

Interaction with friends and family can help reduce stress levels, enhance intellectual stimulation, combat depression, and potentially slow the rate of memory decline. countless studies show that a life [full of friends](#) and fun comes with cognitive benefits.

Psychology Today writer Angela K. Troyer, PhD, explains, “People who connect with others generally perform better on tests of memory and other cognitive skills. And, in the long run, people with active social lives are less likely to develop dementia than those who are more socially isolated.”



3.18 Use Acronyms

Acronym: an abbreviation formed from the initial letters of other words and pronounced as a word (e.g., [NASA](#)).

Try to use it always. Let us try this one:

List of Body Systems in Human Body

- I. Respiratory System
- II. Digestive System or Excretory System
- III. Cardiovascular or Circulatory System
- IV. Urinary System or Renal System
- V. Endocrine System

- VI. Nervous System
- VII. Muscular System
- VIII. Integumentary System or Exocrine System
- IX. Skeletal System
- X. Reproductive System

Can you remember these ten items easily? Maybe not!

But if you use it like this: **NICER DRUMS**

- I. Nervous System– N
- II. Integumentary System– I
- III. Cardiovascular or Circulatory System– C
- IV. Endocrine System–E
- V. Reproductive System– E
- VI. Digestive System–D
- VII. Respiratory System–R
- VIII. Urinary System–U
- IX. Muscular System–M
- X. Skeletal System –S

3.19 Use both Focused and the Diffuse modes

We have two different modes of thinking: the **focused mode** and **diffuse mode**. We are in either in one mode or the other. Both these modes are highly important for learning.

To learn something new – go back and forth between the **FOCUS** and **DIFFUSE** Modes

The **focused mode** is when we concentrate on solving an issue or to make a decision. Focus is doing one task or project, while minimizing time and attention on anything else. Focused mode is

direct, rational, sequential, and analytical. Focused thinking utilizes your brain's **prefrontal cortex**, the part right behind your forehead that controls attention and memory and helps with decision-making and problem-solving.

Diffuse mode is associated with “**big picture**” perspectives, and happens when you **relax and let your mind wander**. If you are trying to understand or figure out something new, turn off your focused thinking and turn on your diffuse mode.

The diffuse mode is when we give ourselves time to manage things; If we are trying to solve something new, we use the broad perspective of the diffuse mode. We all access this mode naturally when we do things like go for a walk. Diffuse thinking isn't centered in any one part of your brain; instead, the work is spread over multiple areas.

Keep work sessions in focused mode short to use diffuse mode after focused mode sessions.

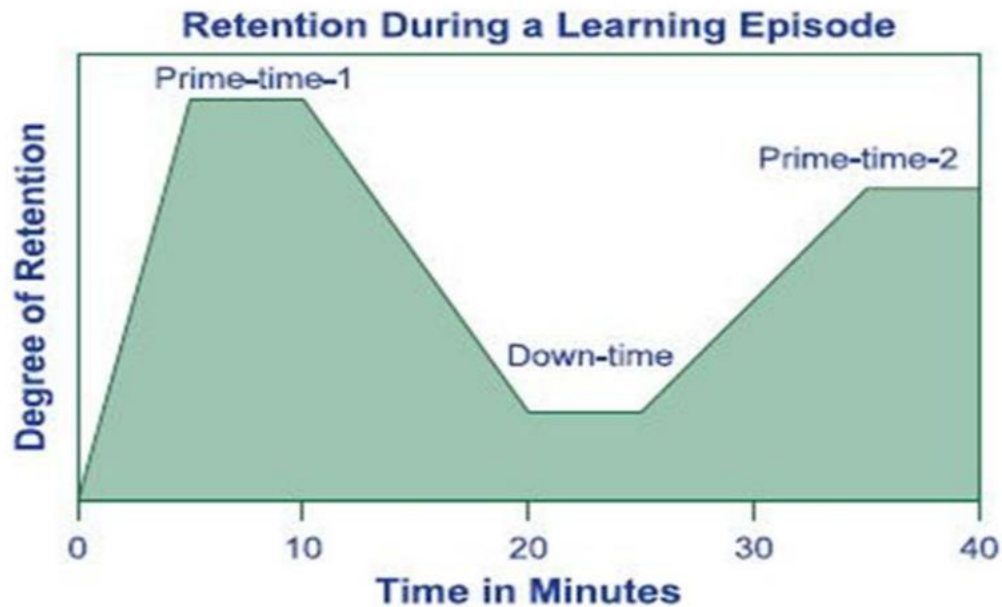
Blink or close your eyes for a few second to refresh and renew consciousness and perspective. You should toggle back and forth between modes!

3.20 Know about the Primacy/Recency Effect

The **Primacy/Recency** Effect is the observation that information presented at the beginning (**Primacy**) and end (**Recency**) of a learning episode tends to be retained better than information presented in the middle. We remember best which comes first,

second best which comes last, and least which comes just past the middle.

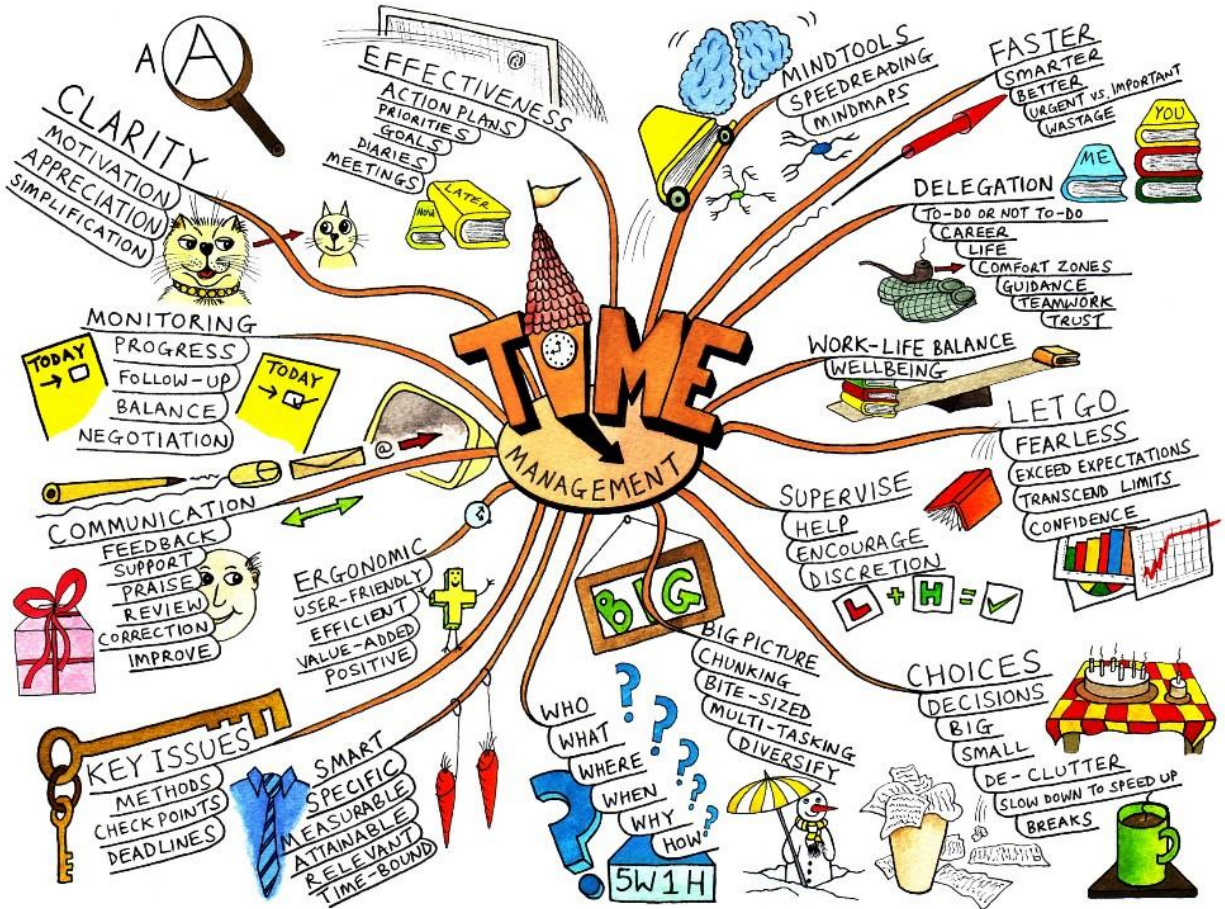
The Primacy/Recency Effect



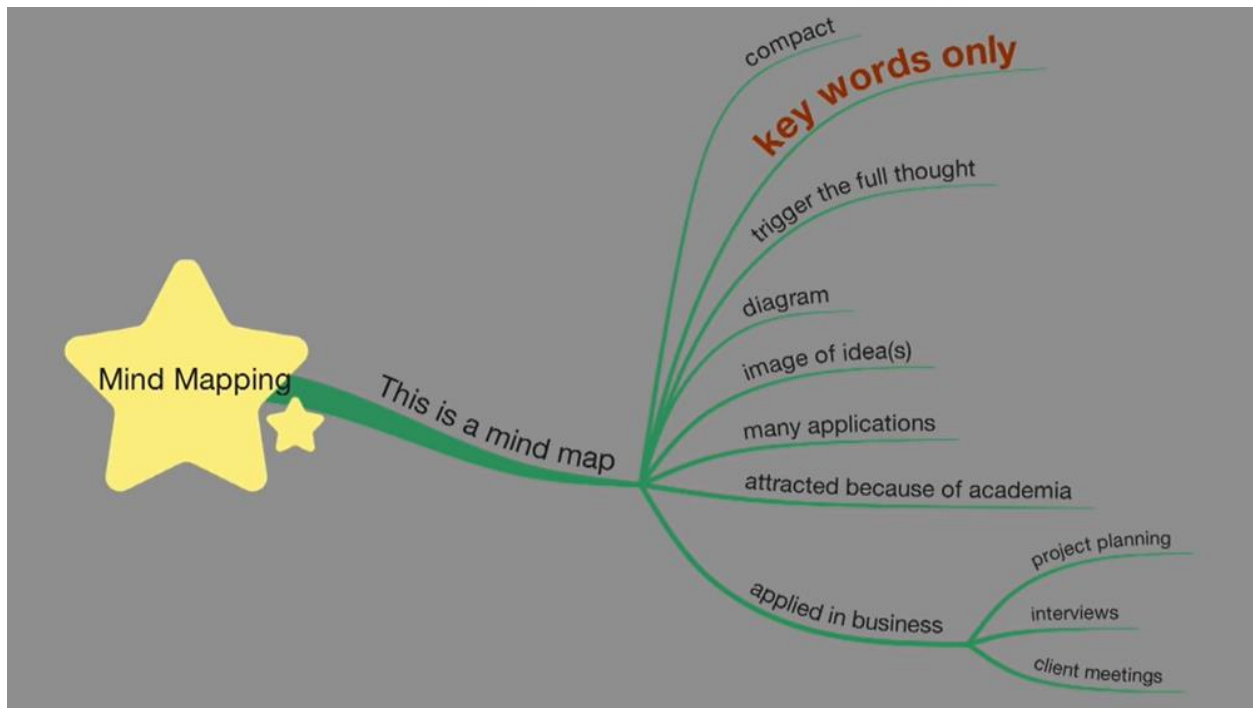
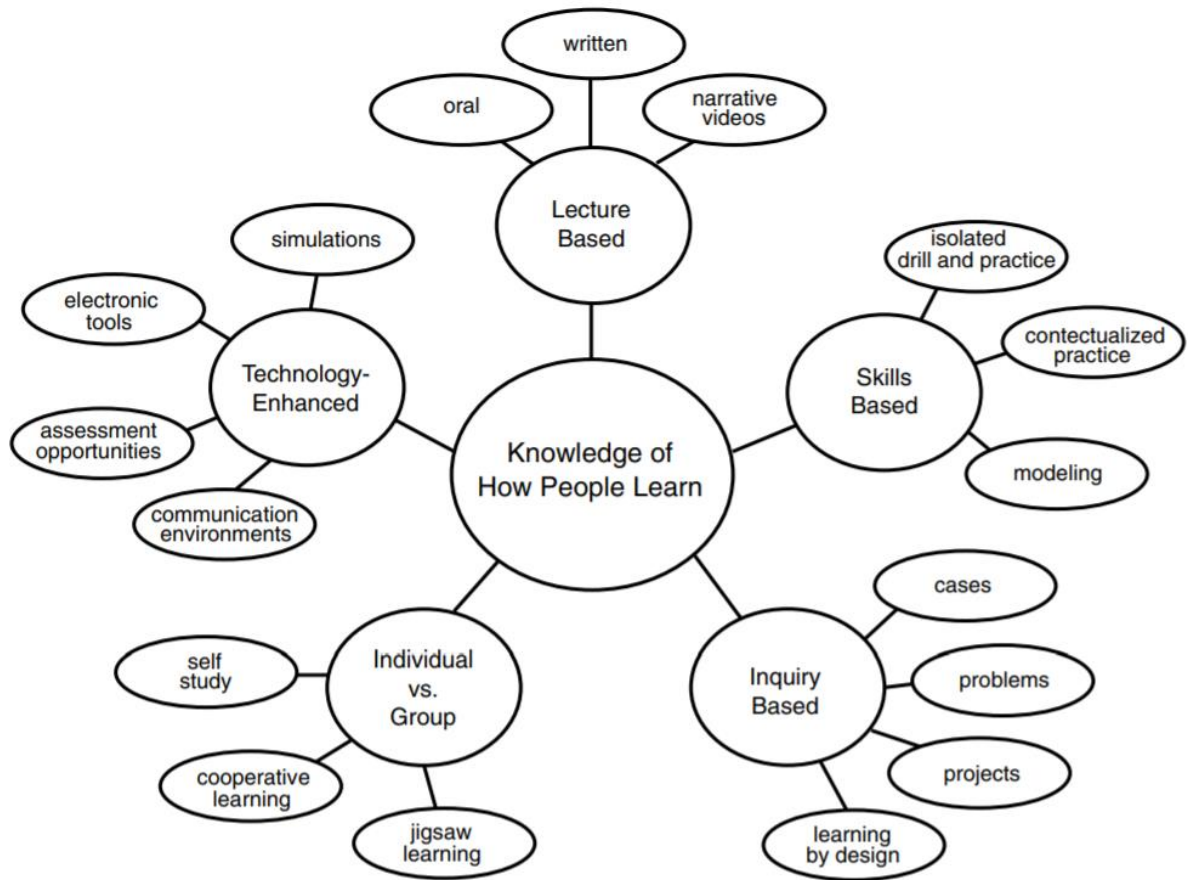
In order for effective learning to take place, it is important to plan learning sessions to take advantage of both the Primacy and the Recency Effects.

3.21 Mind Mapping

Mind maps are diagrams used to **visually organize information hierarchically**. It is a highly effective way of note-taking and note-making that literally "maps out" your ideas. The aim is *'to structure, remember and show linkages between information and ideas both quickly and easily'*.



A beautiful, visual-heavy, mind map on the topic of time management. [Source](#)



Four Essential Characteristics of Mind Mapping:

- The main idea or focus or subject is placed in a central image
- For Each idea/concept create a branch. These 'branches' radiate from the central image
- The branches comprise a key image or key word drawn on its associated line
- Topics of lesser importance are represented as 'twigs' (2nd and 3rd level branch, from thick to thin) of the relevant branch

3.22 Mastering Metacognition: What, Why, and How

Mastering Metacognition: The Metacognition is “Thinking about One’s Thinking,”

It refers to the processes used to plan, monitor, and assess one’s understanding and performance. Metacognition includes a critical awareness of a) one’s thinking and learning and b) oneself as a thinker and learner.

It refers to people’s abilities to predict their performances on various tasks (e.g., how well they will be able to remember various stimuli) and to monitor their current levels of mastery and understanding

Metacognitive practices help students become aware of their strengths and weaknesses as learners, writers, readers, test-takers, group members, etc. A key element is recognizing the limit of one’s knowledge or ability and then figuring out how to expand that knowledge or extend the ability.

Practicing:

- *Preassessments—Encouraging Students to Examine Their Current Thinking: “What do I already know about this topic that could guide my learning?”*
- *Confusions —Giving Students Practice in Identifying Confusions: “What was most confusing to me about the material explored in class today?”*
- *Post assessments—Pushing Students to Recognize Conceptual Change: “Before this lecture, I thought such....., now I think....”*
Or how this lecture has changed my knowledge.
- *Reflection– Thinking about past failures, underperformance etc. and what should be done next time.*

Think- “how you start, how you decide what to do first and then next, how you check your work, how you know when you are done”.

3.23 Beware of Illusions of Competence

Misplaced self-confidence in one’s abilities can sometimes reach almost delusional levels. You can feel that you have learned but the learning did not actually settle down (deep learning).

we can make ourselves feel like we have “learned” a concept. For example, looking at a solution and thinking that you know how to arrive at that solution is one of the most common illusions of competence in learning.

3.24 Share or Teach What You Know

By teaching what you already know, you'll learn more. Teach or share with fellow students, a colleague, etc. Plan how you would

explain and relay the information to them so that they will be able to understand it thoroughly. Try using Metaphors and Analogies.

3.25 Brain Plasticity or Neuroplasticity

Mind, Brain, and Education Program at Harvard University

According to **Kurt Fischer**, education professor and director of the Mind, Brain, and Education Program at Harvard University, "The brain is remarkably plastic, even in middle or old age, it's still adapting very actively to its environment."

Researchers found that Intelligence is not fixed, nor planted firmly in our brains since birth, rather it is forming and developing throughout our lives.

It turns out that, when people repeatedly practice an activity or access a memory, their neural networks -- groups of neurons that fire together, creating electrochemical pathways -- shape themselves according to that activity or memory. When people stop practicing new things, the brain will eventually eliminate, or "prune," the connecting cells that formed the pathways.

[Put information in context](#)

According to neurologist and educator **Judy Willis**,
"neuroplasticity is defined as the selective organizing of connections between neurons in our brains."

"Whenever new material is presented in such a way that students see relationships between concepts, they generate greater brain cell activity and achieve more successful long-term memory storage and retrieval."

Therefore, tap the information into already-existing pathways, for instance, by integrating academic subjects or creating projects relevant to the lives.

3.26 Use Acrostics (or sentence)

It means a poem, word puzzle, or other composition in which certain letters in each line form a word or words.

Example: **Math order of operations:**

"Please Excuse My Dear Aunt Sally"

<i>Please</i>	Parentheses
<i>Excuse</i>	Exponents
<i>My</i>	{ Multiplication }
<i>Dear</i>	
<i>Aunt</i>	{ Addition }
<i>Sally</i>	

"My Very Educated Mother Just Served Us Nine Pizzas" (where the first letter of each word stands for Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto, respectively).

"30 days hath September, April, June, and November"

3.27 Study in Groups / Teamwork

Group working can make study more efficient and fun.

Students engaged in group work, or cooperative learning, show increased individual achievement compared to students working alone.

Student group work enhances communication and other professional development skills.

3.28 Serendipity in Learning

Law of Serendipity in Learning: serendipity is “the art of finding what we’re not seeking.”

At a basic level, the English word ‘serendipity’ refers to an unexpected and pleasant discovery by accident.

Serendipitous experiences are valuable to learning at a personal level. Companies like Yahoo, Google, and Facebook try engineering serendipity in the workplace. Their goal is to foster a work environment that leads to more innovation due to chance encounters. One common technique is designing office spaces where chance encounters and conversations with colleagues are likely to occur.

Serendipity currently has two related meanings: 1) Looking for something and finding something even better. 2) Looking for something and finding just what you needed.

3.29 Motivation

You have to put Emotion in Motion.

Motivation put Emotion into action.

The way our brains are structured, when thought and feelings compete, feelings almost always win.

And we can’t fight our feelings. Research shows this just makes them stronger.

1) Get Positive **When do we procrastinate the most? When we’re in a bad mood.**

2) Get Rewarded: Rewards feel good. Penalties feel bad. And that’s why they both can work well to motivate you.

3) Get Peer Pressure: Research shows peer pressure helps kids more than it hurts them

Alexander Rothman's theory of behavior maintenance suggests that your ability to maintain a positive behavior or habit is dependent on your perception of the benefits:

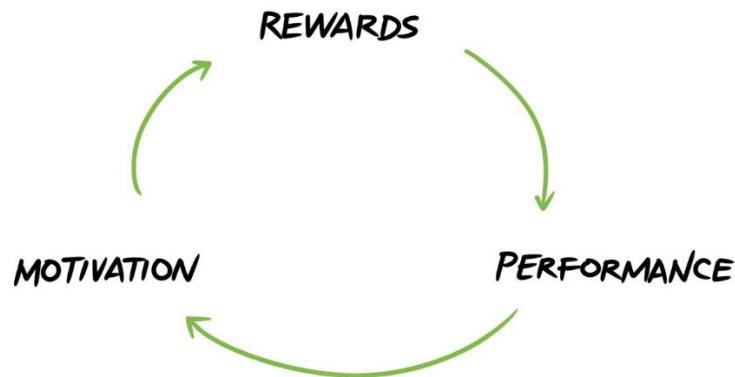


Table 2 Comparison of Intrinsic vs. Extrinsic Motivation

Love of Learning/Intrinsic	Desire for Reward/Extrinsic
Assumes the learning activity itself is satisfying	Assumes that an extrinsic motivator is necessary
Transferable to other contexts and situations	Not transferable outside the context that the reward is present
Can take time to support and cultivate	Can be relied upon after only a short period of introduction
Primarily process-focused	Primarily product-focused
Implies that the learning/task itself has value and meaning	Implies the learning/task is a means to an end (the reward)
Natural condition	Manufactured condition
Has long-term benefits	Benefits are short-term
Promotes a mentality that is useful when transferred into the context of building relationships	Promotes a mentality that may hinder the inclination to invest in the relationship-building process
Promotes ever-increasing levels of self-motivation	Promotes an ever-increasing need for rewards
Can be difficult to rely upon with a new group of students who are not accustomed to using these sources of motivation	Can be useful to incorporate to motivate a behavior that is unfamiliar or unformed

3.30 Einstellung Effect

The Einstellung Effect is a type of mindset that causes humans to repeat the use of "tried and true" strategies for problem solving,

even when a simpler solution strategy exists. This can be seen frequently when a worker is presented with a problem and they continue to use a solution that has worked in the past rather than seeking a new or simpler solution. This is a somewhat "mechanical" state of mind that keeps a person from using very much creativity. Although this mental fixedness works well in some work settings (such as assembly lines) it can be a hindrance in other functions such a management, research and development.

3.31 Take Care of Your Heart

What's good for the heart is good for the brain.

[Emory University researchers](#) published study in the *Journal of Alzheimer's Disease* that good heart health (cardiovascular health) can equal good brain health. Good cardiovascular health promotes good cognitive health.

Note: The American Heart Association defines ideal cardiovascular health (CVH) across seven modifiable risk factors –blood sugar, serum cholesterol, blood pressure, body mass index, physical activity, diet and cigarette smoking.

3.32 Tea Could Improve brain circuits, structure and memory

A [recent study](#) showed that people who drink tea regularly, have better functioning brains and a greater degree of organization. Drinking tea could help prevent dementia. The study also examined structural brain changes with tea drinking.

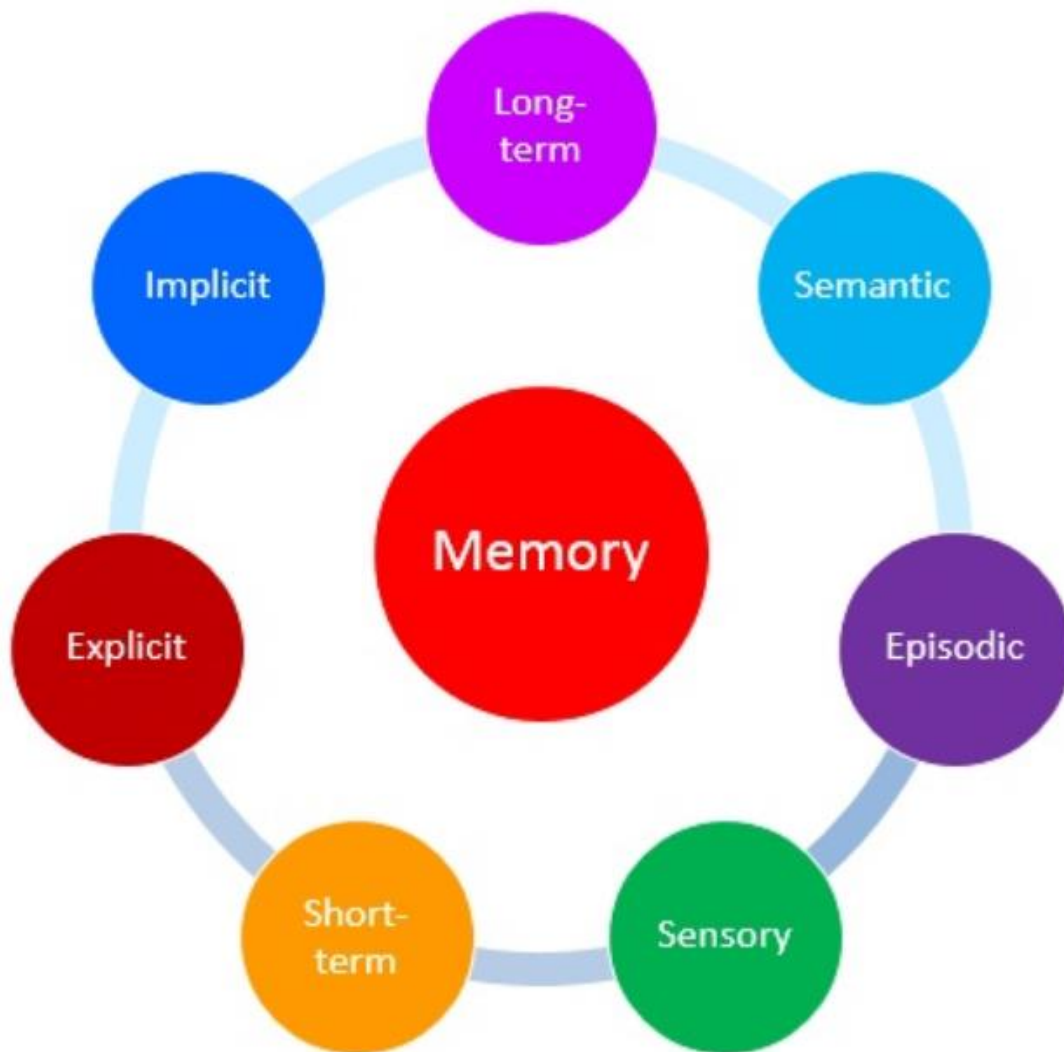
["Unlike most other beverages, drinking tea is unequivocally linked to better heart health, better memory and thinking, less stress, a](#)

lower cancer risk and an overall reduced risk of premature death. This is attributed to plant compounds like catechin and L-theanine which are associated with positive effects on memory, stress, and other psychological measures.”

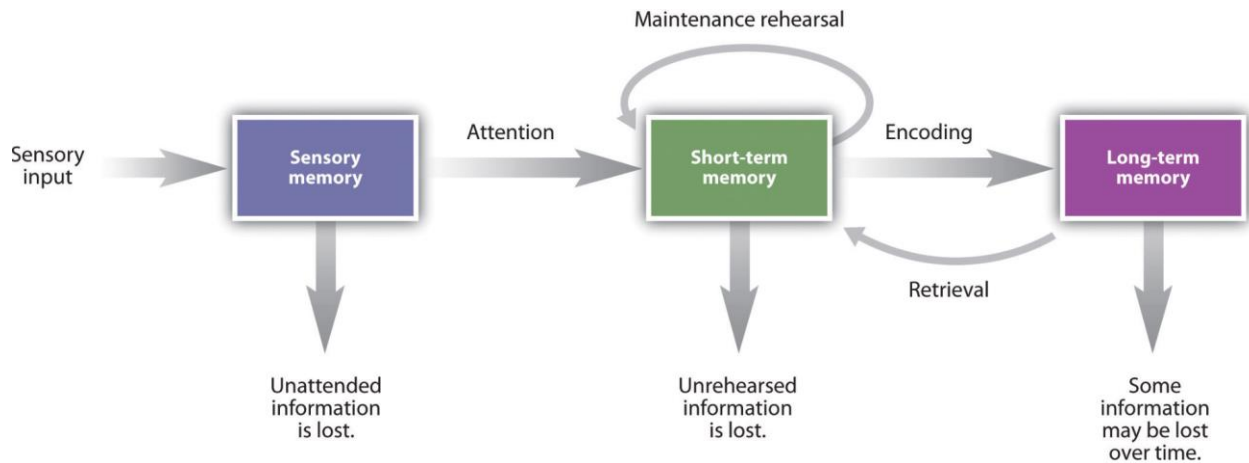
3.33 Fasting changes brain chemistry to improve memory and learning

Neuroscientists at the National Institute on Aging, Johns Hopkins University, revealed that fasting can boost brain function by increasing levels of a protein that promotes neuron growth.

Four: Introduction to Memory



4. Memory



The creation of a memory begins with perception, occurs in the brief sensory stage that usually lasts only a fraction of a second. It's your **Sensory memory** that allows a perception (raw data) such as a visual pattern, a sound, etc. linger for a brief moment after the stimulation is over.

The sensation is stored in short-term memory. It is considered to be outside of cognitive control and is instead an automatic response.

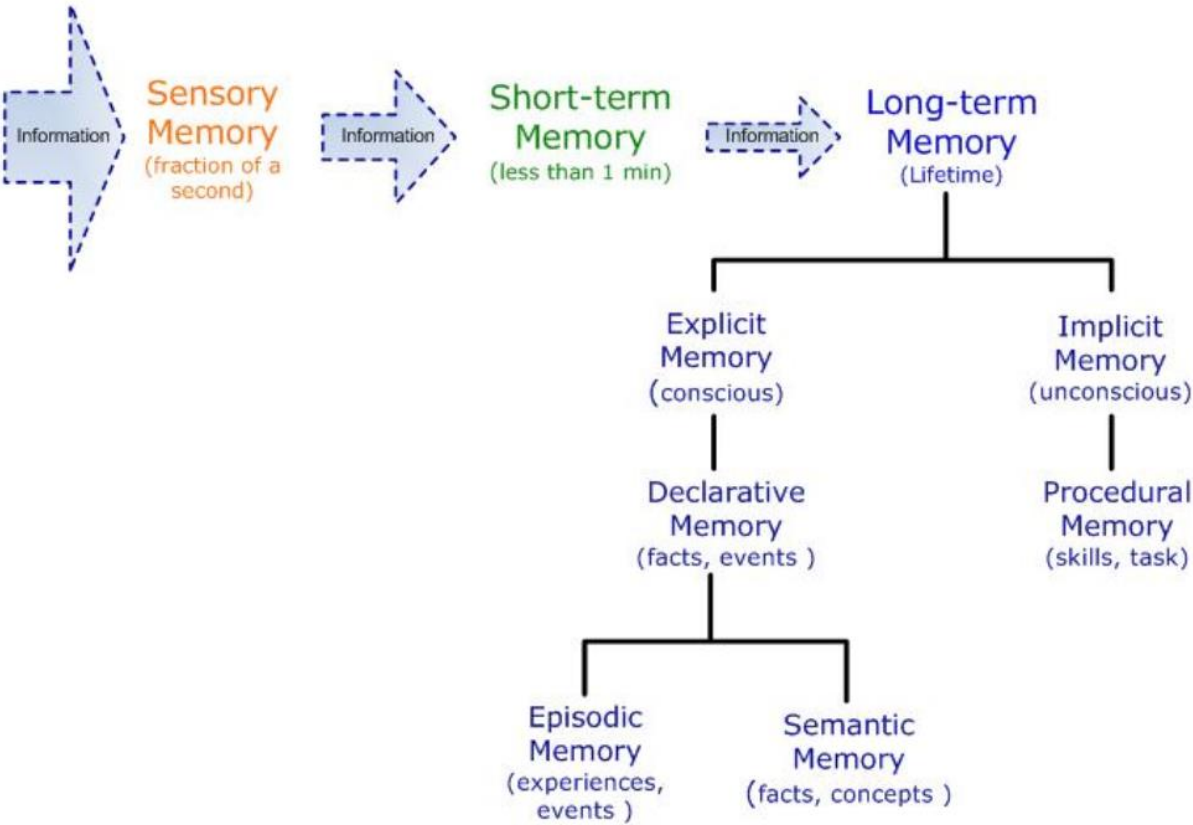
Short-term memory, working memory, has a fairly limited capacity; it can hold about seven items (7 ± 2 items), readily available state for no more than 20 or 30 seconds at a time.

Important information is gradually transferred from short-term memory into **Long-term memory**. The more the information is repeated or used, the more likely it is to eventually end up in long-term memory which is thought to be **Unlimited**.

The Three-Stage Model of Stage Model of Memory

Table1: Memory Conceptualized in Terms of Types, Stages, and Processes

As stages	Sensory memory Short-term memory Long-term memory (LTM)
As types-related to LTM	Explicit memory Implicit memory
As processes -related to LTM	Encoding Storage Retrieval



Memory is neither a single entity nor a phenomenon that occurs in a single area of the brain. There are two basic memory processes: declarative memory, or memory for facts and events which occurs primarily in brain systems involving the hippocampus; and procedural or nondeclarative memory, which is memory for skills and other cognitive operations, or memory that cannot be represented in declarative sentences, which occurs principally in the brain systems involving the neostriatum.

What Is the Hippocampus?

"It's part of our limbic brain — a deep, primitive part of our brain that's associated with emotion and memory," says New York City-based holistic psychiatrist, Ellen Vora, MD. "The hippocampus in particular is associated with consolidation of memory."

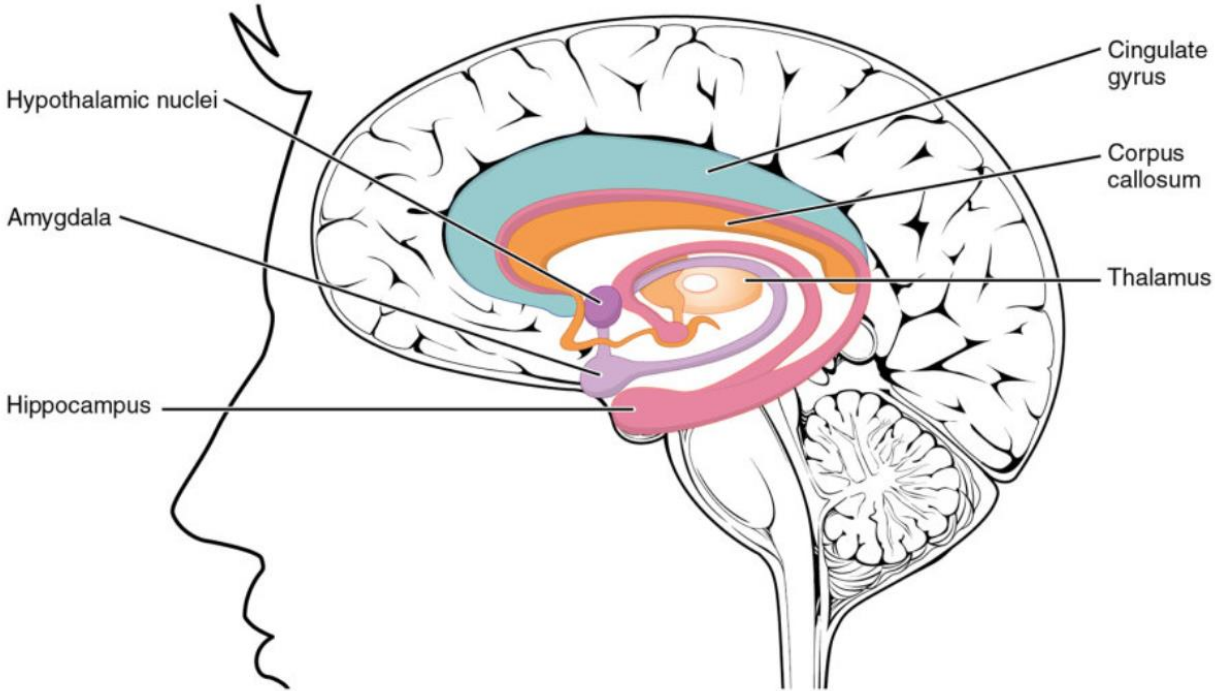
Experts believe that the hippocampus, along with another part of the brain called the frontal cortex, is responsible for analyzing the various sensory inputs and deciding if they're worth remembering. If they are, they may become part of your long-term memory.

Encoding

Although a memory begins with perception, it is encoded and stored using the language of electricity and chemicals. Here's how it works: Nerve cells connect with other cells at a point called a synapse. All the action in your brain occurs at these synapses, where electrical pulses carrying messages leap across gaps between cells.

The electrical firing of a pulse across the gap triggers the release of chemical messengers called neurotransmitters. These neurotransmitters diffuse across the spaces between cells, attaching

themselves to neighboring cells. Each brain cell can form thousands of links like this, giving a typical brain about **100 trillion synapses**. The parts of the brain cells that receive these electric impulses are called dendrites

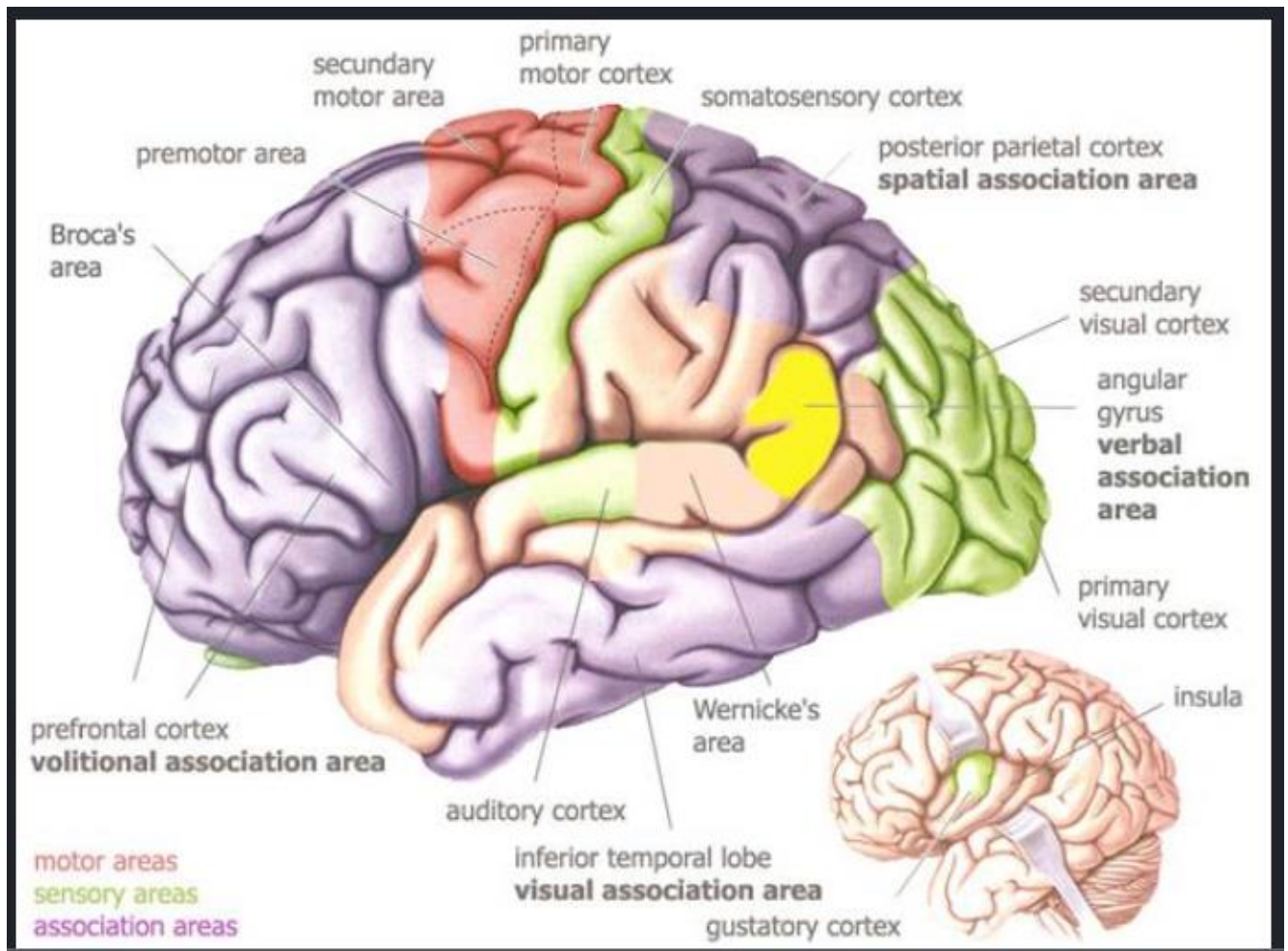


The hippocampus is part of the limbic system, the deep, primitive part of our brain that's associated with emotion and memory. WIKIMEDIA COMMONS (CC BY-3.0)

Storage

All of the pieces of information are stored in different areas of your brain. Your neurons pass signals to each other about what you perceived, effectively "talking" with each other and building either temporary or long-lasting connections. It's that neural activity and the strength of those connections that make a **memory**.

Five: Brain Basics



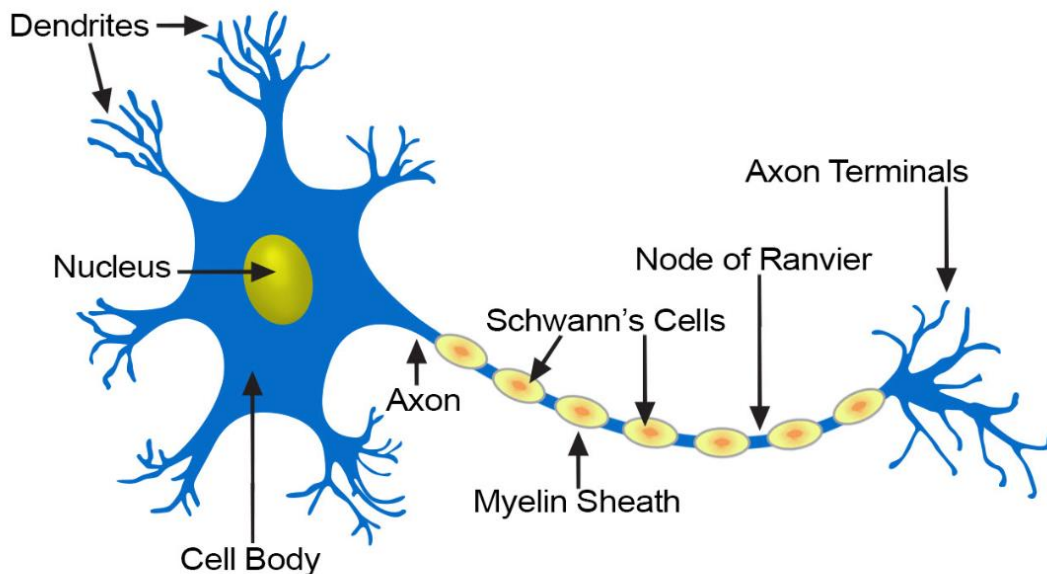
5. Brain Basics:

Your brain is made of approximately **100 billion nerve cells**.

A nerve cell, or neuron, is a cell that receives information from other nerve cells or from the sensory organs and then projects that information to other nerve cells, while still other neurons project it back to the parts of the body that interact with the environment, such as the muscles. Nerve cells are equipped with a cell body—a sort of metabolic heart—and an enormous treelike structure called the dendritic field, which is the input side of the neuron.

Information comes into the cell from projections called axons. Most of the excitatory information comes into the cell from the dendritic field, often through tiny dendritic projections called spines. The junctions through which information passes from one neuron to another are called synapses, which can be excitatory or inhibitory in nature. It's possible to have up to one quadrillion (1×10^{15}) synaptic (electro-chemical) connections in one brain! Isn't that incredible!

Structure of a Typical Neuron



Each neuron has three basic parts: cell body (soma), one or more dendrites, and a single axon.

The *synapse* is the terminal region of the axon and it is here where one neuron forms a connection with another and conveys information through the process of *synaptic transmission*.

Each neuron may be connected to up to **10,000 other neurons**, passing signals to each other via as many as **1,000 trillion synaptic connections**.

The neuron integrates the information it receives from all of its synapses and this determines its output.

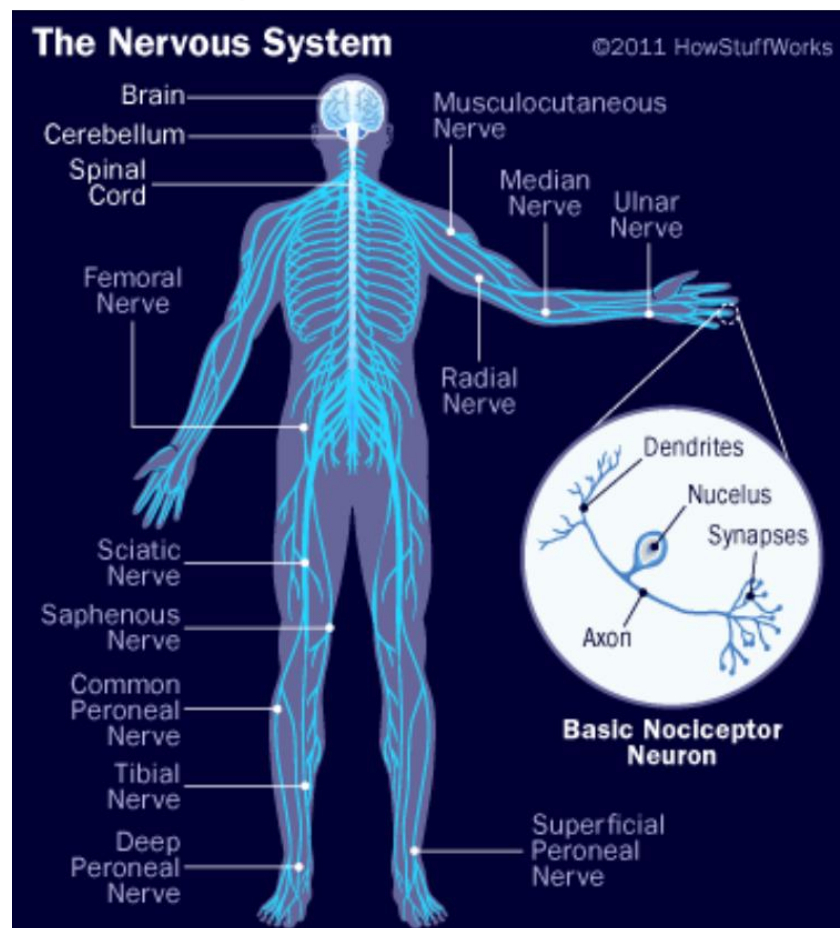
Your brain never shuts off:

Even when you're sleeping at night, the brain consumes roughly as much energy as it does during the day. While you rest, your neurons are constantly communicating, updating each other on what is happening. Their constant vigilance is where the bulk of the energy is consumed.

A lot of the memory consolidation process happens while we're sleeping, as our brains recreate that same pattern of brain activity to strengthen the synapses we created earlier. Sleep has proven to be one of the most important elements in having a good memory. Even a short nap can improve your memory recall.

Knowing your Brain!

Your brain, spinal cord and peripheral nerves make up a complex, integrated information-processing and control system known as your **central nervous system**. In tandem, they regulate all the conscious and unconscious facets of your life. The scientific study of the brain and nervous system is called **neuroscience** or **neurobiology**.



Nearly **86 billion neurons** work together within the nervous system to communicate with the rest of the body. They are responsible for everything from consciousness and thought to pain and hunger. There are three primary types of neuron: sensory neurons, motor neurons, and interneurons.

- **How long is a neuron?**

Some neurons are very short...less than a millimeter in length. Some neurons are very long—a meter or more! The axon of a motor neuron in the spinal cord that innervates a muscle in the foot can be about 1 meter (3.28 feet) in length.

- **How fast does information travel in the nervous system?**

Information travels at different speeds within different types of neurons. Transmission can be as slow as 0.5 meters/sec or as fast as 120 meters/sec. Traveling at 120 meters/sec is the same as going 268 miles/hr!!!

- The primary components of the neuron are the soma (cell body), the axon (a long slender projection that conducts electrical impulses away from the cell body), dendrites (tree-like structures that receive messages from other neurons), and **synapses** (specialized **junctions between neurons**). The synapse is not a physical component of a cell but rather a name for the gap between two cells. **The typical brain has about 100 trillion synapses,**
- Some axons are covered with myelin, a fatty material that acts as an insulator and conductor to speed up the process of communication.
- Sensory neurons are neurons responsible for converting external stimuli from the environment into corresponding internal stimuli.

- Motor neurons are neurons located in the central nervous system (CNS); they project their axons outside of the CNS to directly or indirectly control muscles.
- Interneurons act as the “middle men” between sensory and motor neurons, which convert external stimuli to internal stimuli and control muscle movement, respectively.

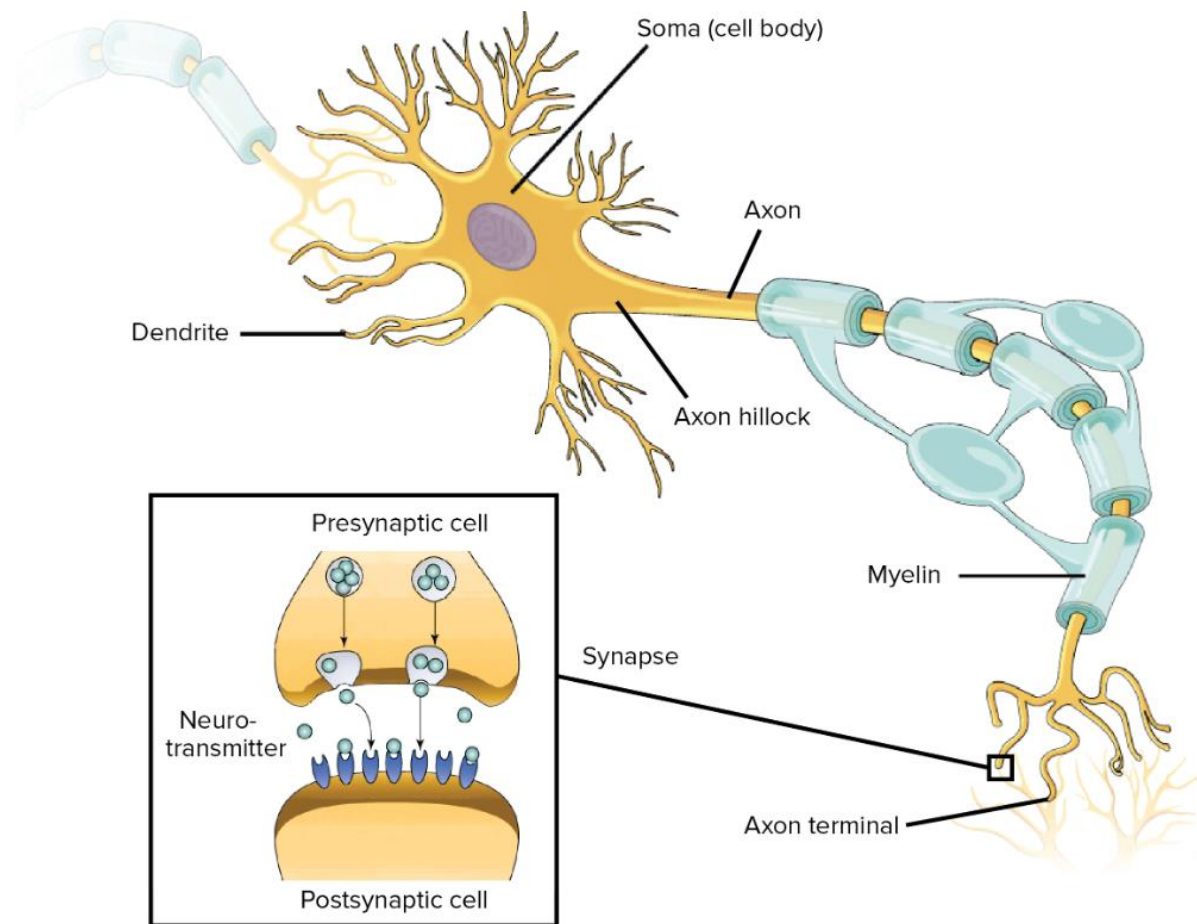
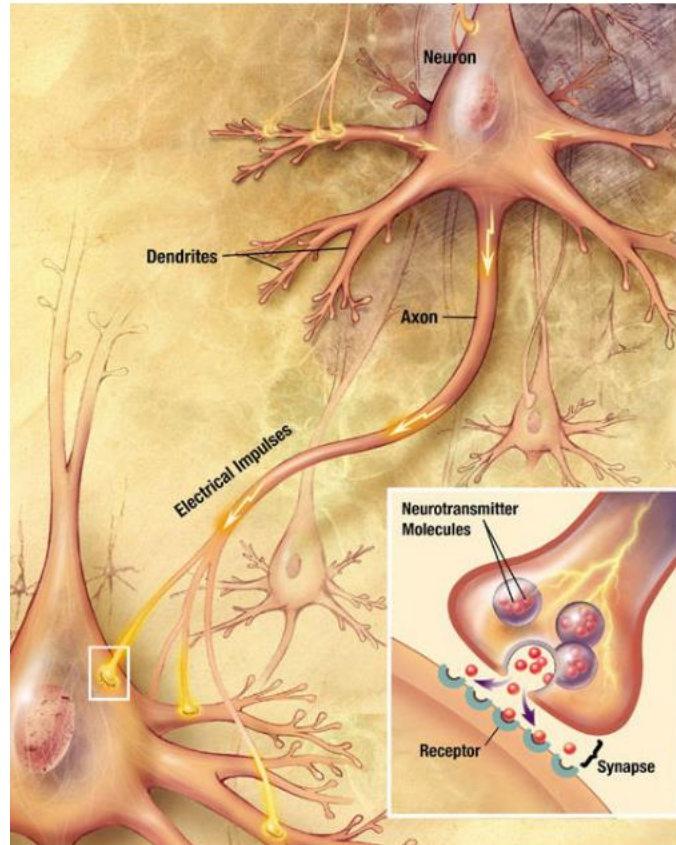


Image modified from "Neurons and glial cells: Figure 2" and "Synapse," by OpenStax College, Biology (CC BY 3.0).



Neuron & chemical synapse: This image shows electric impulses traveling between neurons; the inset shows a chemical reaction occurring at the synapse.

Three major brain elements help control what information your brain takes in:

1. the reticular activating system (RAS),
2. the limbic system, and
3. the transmitter dopamine.

RAS receives input from sensory nerves that come from nerve endings in your eyes, ears, mouth, face, skin, muscles, and internal organs and meet at the top of your spinal cord. These sensory messages must pass through the RAS to gain entry to your higher, thinking brain.

You will learn more successfully if you keep the RAS filter open to the flow of information you want to enter your prefrontal cortex.

Making your brain work optimally:

To keep yourself physically healthy and well rested and to develop awareness of and some control over your emotions. If you feel not so good, then find a way to return to a better mood.

The Limbic System: Your Emotional Core

After the information coming in through your senses gets through the RAS, it travels to the sensory intake centers of your brain. New information that becomes memory is eventually stored in the sensory cortex areas located in brain lobes that are each specialized to analyze data from one of your five senses. These data must first pass through your brain's emotional core, the limbic system, where your *amygdala and hippocampus* evaluate whether this information is useful because it will help you physically survive or bring you pleasure.

The Amygdala is a system for routing information based on your emotional state. When you experience negative emotions like fear, anxiety, or even boredom, your amygdala's filter takes up excessive amounts of your brain's available nutrients and oxygen.

Your brain is also stressed. This stress closes off the pathways through the RAS and amygdala that direct information into your thinking brain and memory centers.

Unless you restore a positive mood, you won't learn much!!!

The Hippocampus

Next to the amygdala is the *hippocampus*. Here, your brain links new sensory input to both memories of your past and knowledge already stored in your long-term memory to make new *relational memories*.

Although the average adult human brain weighs about 1.4 kilograms, only 2 percent of total body weight, it demands 20 percent of our resting metabolic rate (RMR)—the total amount of energy our bodies expend in one very lazy day of no activity. we can convert that number into a measure of power:

—Resting metabolic rate: 1300 kilocalories, or kcal, the kind used in nutrition

—1,300 kcal over 24 hours = 54.16 kcal per hour = 15.04 gram calories per second

—15.04 gram calories/sec = 62.93 joules/sec = about 63 watts

—20 percent of 63 watts = 12.6 watts

So, a typical adult human brain runs on around 12 watts—a fifth of the power required by a standard 60-watt lightbulb.

Scientists have revealed that the brain continues to adapt throughout our lifetime.

Dr. Salcido said, “The Brain Wires the Way It Fires”

It means the more you do the action, your brain engages that pattern more and more so that it is trained that way, so that matter becomes easier.

Belly -the Second Brain (Gut/Stomach)

More than half of your body is not human!

[Human cells make up only 43% of the body's total cell count.](#) The rest are microscopic colonists– microbiome. This includes bacteria, viruses, fungi and archaea.

"They are essential to your health," says Prof Ruth Ley, the director of the department of microbiome science at the Max Planck Institute, "[your body isn't just you](#)".

Originally it was thought our cells were outnumbered 10 to one.

"That's been refined much closer to one-to-one, so the current estimate is you're about 43% human if you're counting up all the cells," he says.

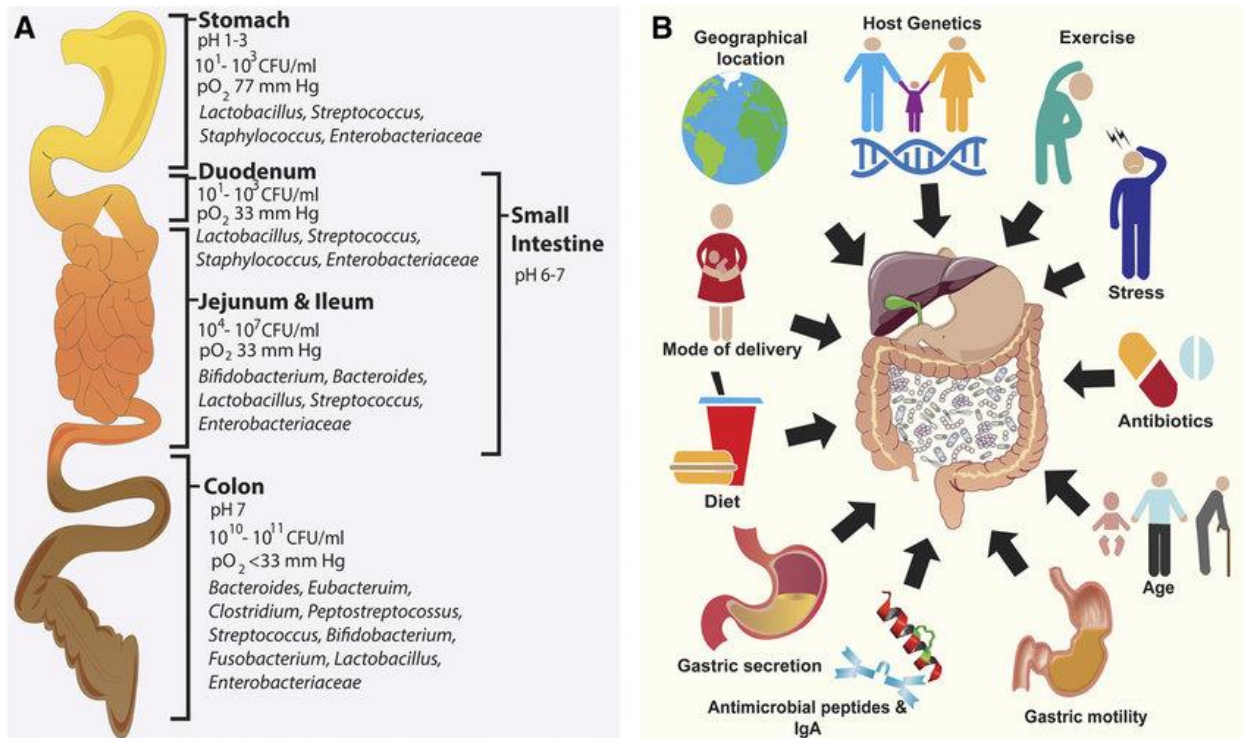
But genetically we're even more outgunned.

The human genome – the full set of genetic instructions for a human being – is made up of 20,000 instructions called genes.

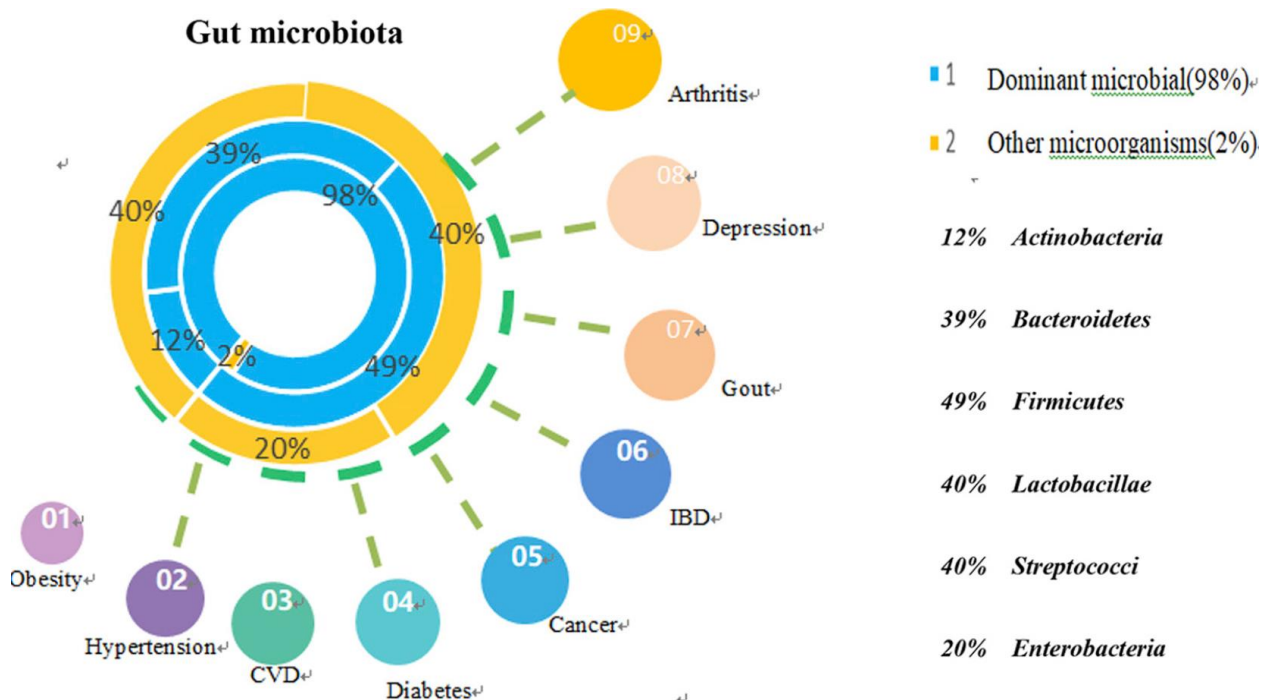
But add all the genes in our microbiome together and the figure comes out between two and 20 million microbial genes.

[Prof Sarkis Mazmanian](#), a microbiologist from Caltech, argues: "We don't have just one genome, the genes of our microbiome present essentially a second genome which augment the activity of our own.

"What makes us human is, in my opinion, the combination of our own DNA, plus the DNA of our gut microbes."



Source: DOI: [10.1124/pr.118.015768](https://doi.org/10.1124/pr.118.015768)



Source: <https://doi.org/10.1016/j.jfda.2018.12.012>

PostScript

Suggestions for Teachers:

- Teachers must work with the preexisting understandings of their students.
- Teachers must teach the important subject matter in depth, providing many examples in which the same concept is used and provides a firm foundation of knowledge supported by facts.
- Important things should be repeated again and again.

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