"How the Brain Works"
Jamaica Teachers Association
Education conference 2015
Reaching Every Learner-Understanding the Brain: New Insights on Learning and Brain Development
Jewels Hilton Rose Hall
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Carl Bruce

MBBS, FRCSEd, DM(SN), FCCS, FACS

Division of Neurosurgery

Section of Surgery

UWI

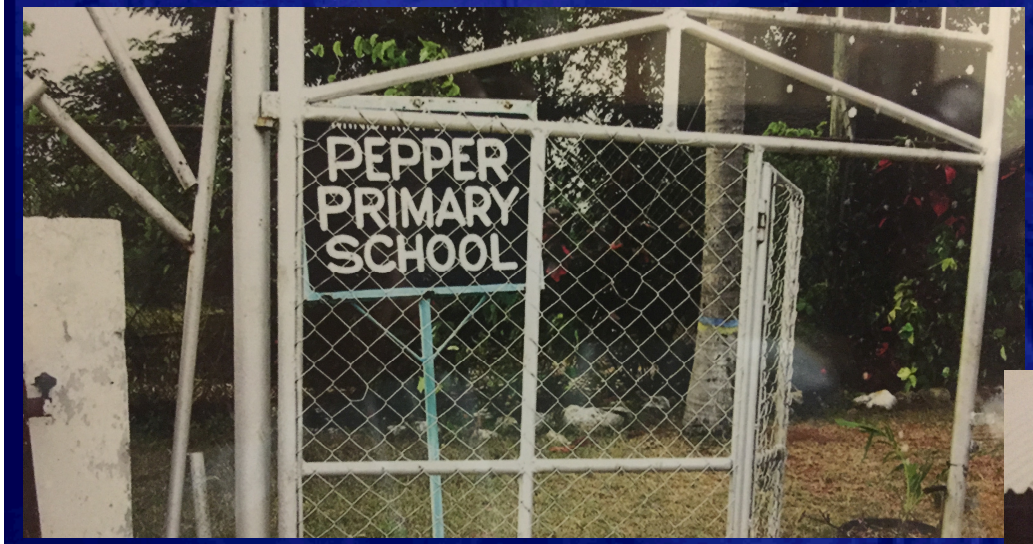
University Hospital of the West Indies

Mona Jamaica

OVERVIEW

- Introduction
- Basics

Common Entrance



Pepper All Age

Graduation 2014

Mentoring

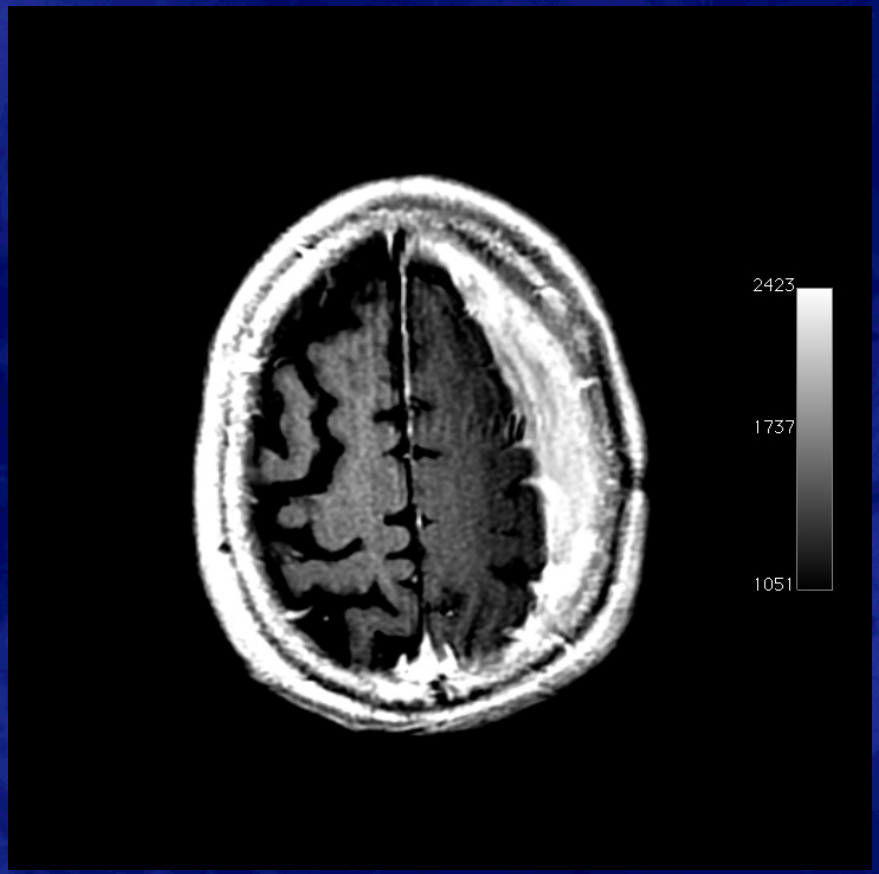
Manchester High PertnRoad Jamaica

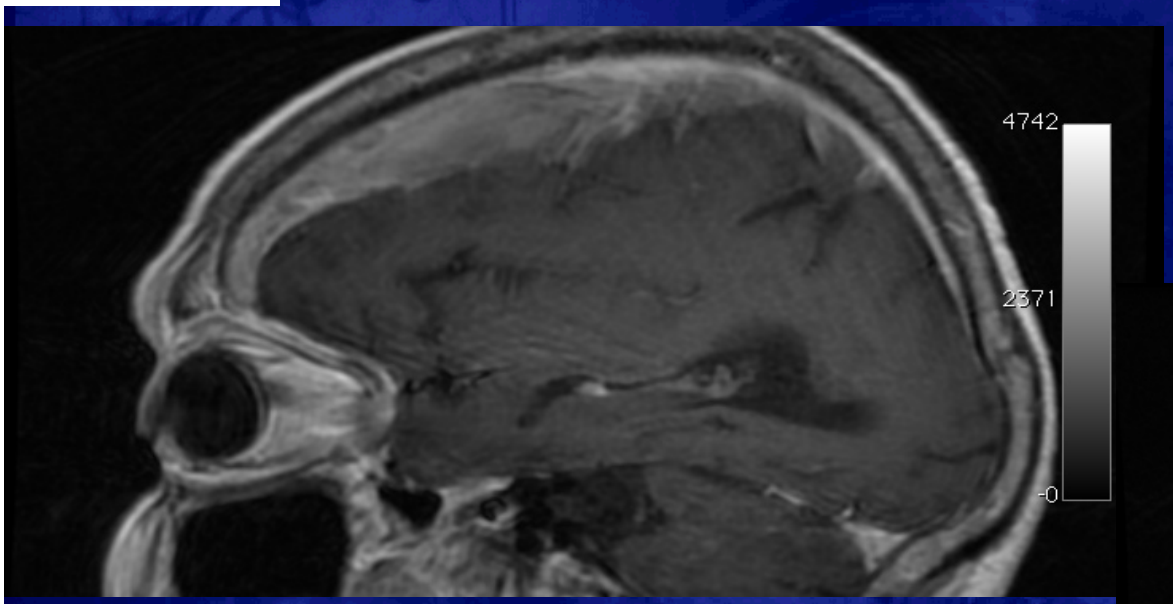
Pleasure of meeting people from all walks of life

Caribbean Neurosciences Conference

Neurosurgery Congress Boston

Something is wrong

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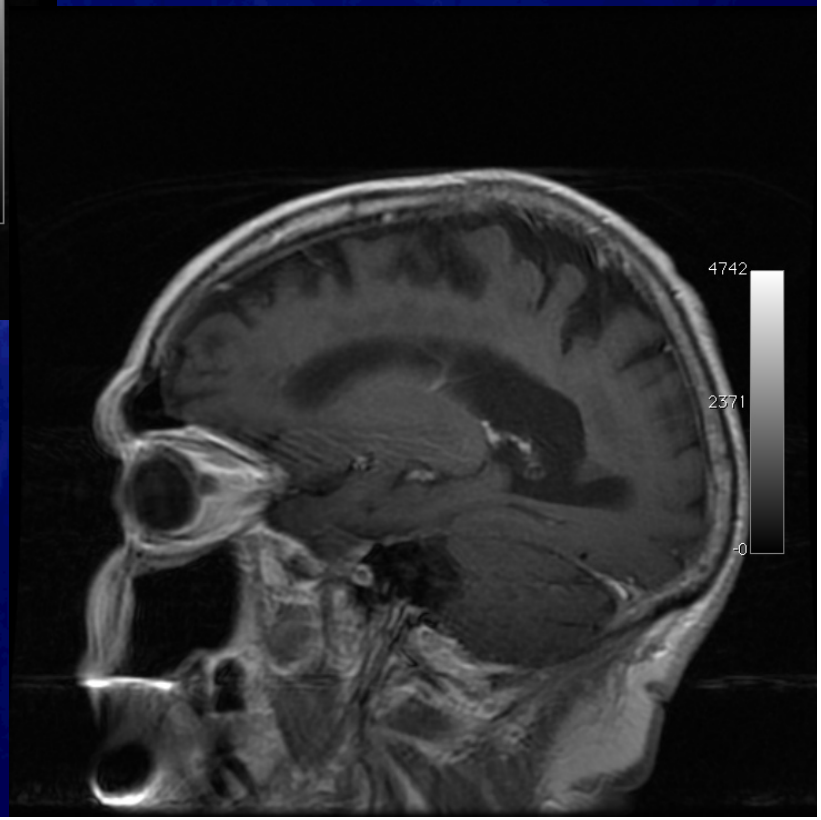
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The Brain

- **The brain is a soft mass of supportive tissues and nerves connected to the spinal cord.** Some of the nerves in the brain go right to the eyes, ears and other parts of the head.
- The brain controls your ability to think, talk, feel, see, hear, remember things, walk and much more. It even controls your breathing.

The Brain

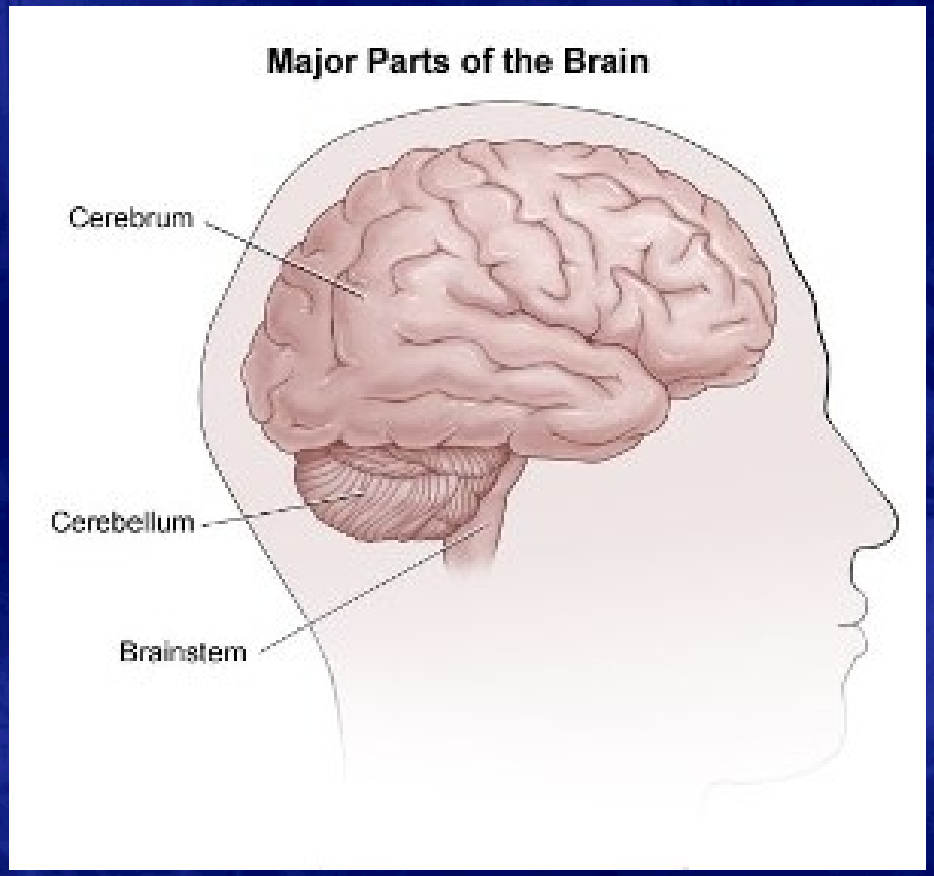
- The crown Jewel of creation – Albert Rhoton Jnr

The Brain

- The brain has three main parts:

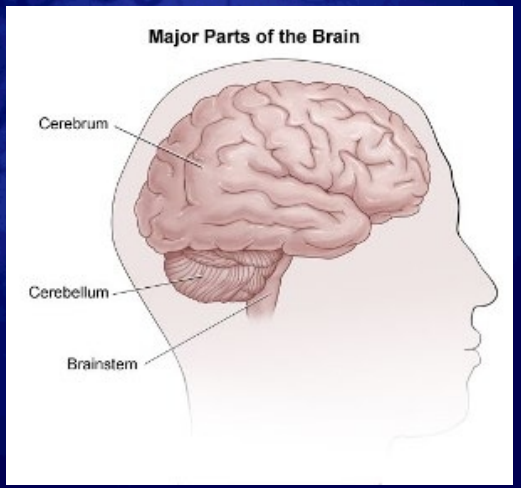
- **Cerebrum**
- **Cerebellum**
- **Brain stem**

The Brain



The cerebrum

- The cerebrum, the large, outer part of the brain, controls reading, thinking, learning, speech, emotions and planned muscle movements like walking. It also controls vision, hearing and other senses.

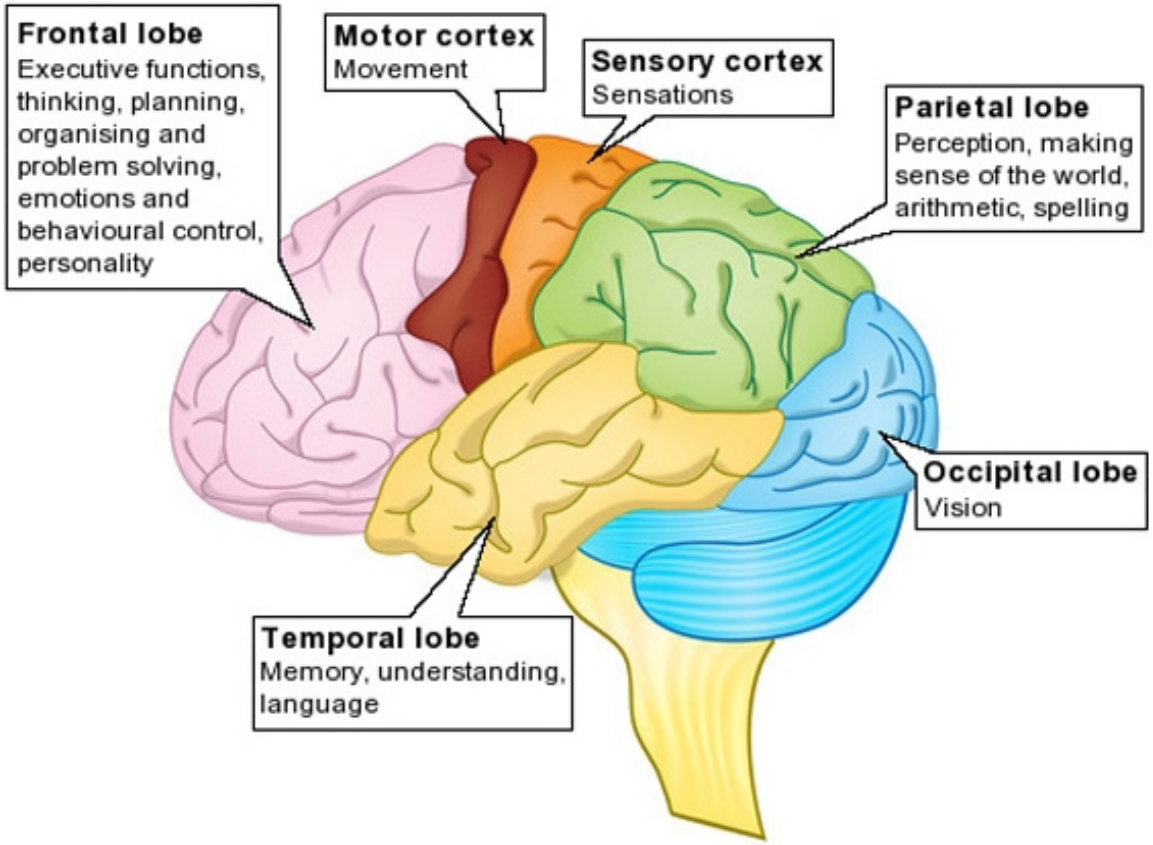


The cerebrum

The cerebrum is divided two cerebral hemispheres (halves): left and right. The right half controls the left side of the body. The left half controls the right side of the body.

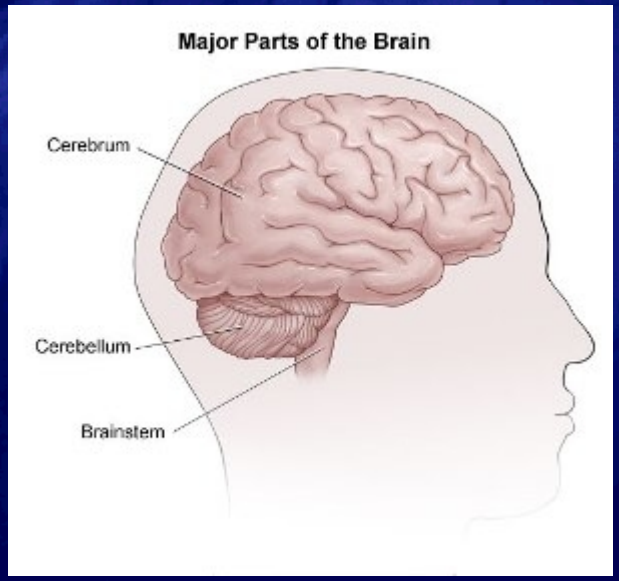
Cerebrum

- Each hemisphere has four sections, called lobes: **frontal**, **parietal**, **temporal** and **occipital**. Each lobe controls specific functions. For example, the frontal lobe controls personality, decision-making and reasoning, while the temporal lobe controls, memory, speech, and sense of smell.


Frontal lobe
Executive functions, thinking, planning, organising and problem solving, emotions and behavioural control, personality
Motor cortex
Movement
Sensory cortex
Sensations
Parietal lobe
Perception, making sense of the world, arithmetic, spelling
Occipital lobe
Vision
Temporal lobe
Memory, understanding, language

The cerebellum

- The **cerebellum**, in the back of the brain, controls balance, coordination and fine muscle control (e.g., walking). It also functions to maintain posture and equilibrium.



The cerebellum

Balancing Act

- The cerebellum - also known as the "little brain" because it's folded into many lobes, lies above and behind the pons.
- Second biggest area of the brain, it receives
  - sensory input from the spinal cord,
  - motor input from the cortex and basal ganglia
  - position information from the vestibular system.

The cerebellum

- The "little brain" then integrates this information and influences outgoing motor pathways from the brain to coordinate movements.
- To demonstrate this, reach out and touch a point in front of you e.g. your desk/Glass

  -- your hand makes one smooth motion.

The cerebellum

- If your cerebellum were damaged, that same motion would be very jerky, as your cortex initiated a series of small muscle contractions to home in on the target point
- The cerebellum may also be involved in language (fine muscle contractions of the lips and larynx),
- as well as other cognitive functions.

The brain stem

- The **brain stem**, at the bottom of the brain, connects the **cerebrum** with the **spinal cord**.
- It includes the **midbrain**, the **pons**, and the **medulla**.
- It controls fundamental body functions such as breathing, eye movements, blood pressure, heartbeat, and swallowing.

Central Nervous System

- Other nerves connect the brain with other parts of the body through the spinal cord to control personality, senses and body functions from breathing to walking.
- Together, the brain, spinal cord and nerves form the central nervous system.

Memory

- Memory is far more complex and elusive – it is located not in one particular place in the brain but is a brain-wide process
- What seems to be a single memory is actually a complex construction
- The process of memory begins with encoding, then proceeds to storage and, eventually, retrieval.

Memory

- “Memory" is really made up of a group of systems that each play a different role in creating, storing, and recalling your memories.
- When the brain processes information normally, all of these different systems work together perfectly to provide cohesive thought.

Memory

- If you think of an object -- say, a pen –
- Your brain retrieves the object's name,
- Its shape, its function, the sound when it scratches across the page.
- Each part of the memory of what a "pen" is comes from a different region of the brain

Memory

- The entire image of "pen" is actively reconstructed by the brain from many different areas
- Research for how the brain organizes memories and where those memories are acquired and stored has been a never-ending quest

Memory Encoding

- Encoding is the first step in creating a memory. It's a biological phenomenon, rooted in the senses, that begins with perception. E.g. – First time you fell in love
- Sensations traveled to the part of your brain called the hippocampus, which integrated these perceptions

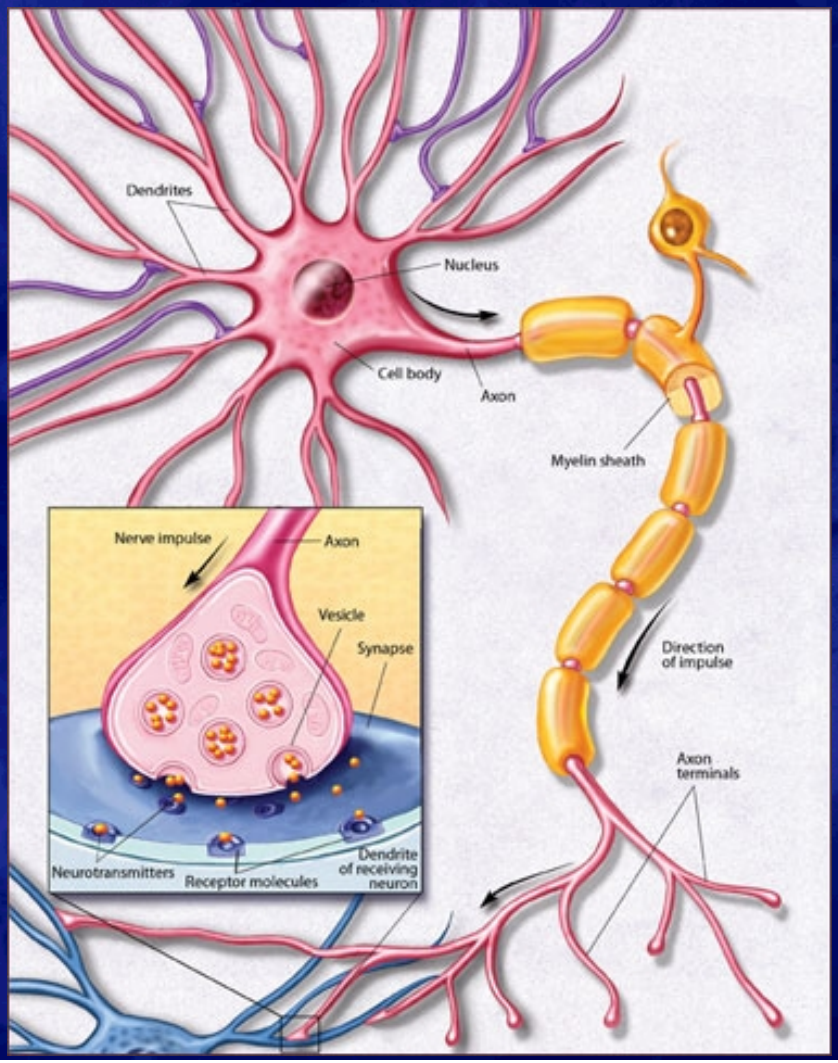
Neurophysiology of memory

- Hippocampus, along with the frontal cortex is responsible for analyzing these various sensory inputs and deciding if they are worth remembering.
- If they are they become long term memory

Neurophysiology of memory

- Memory is encoded and stored using the language of electricity and chemicals.
- 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.

Typical Brain cell – The Neuron



Neurophysiology of memory

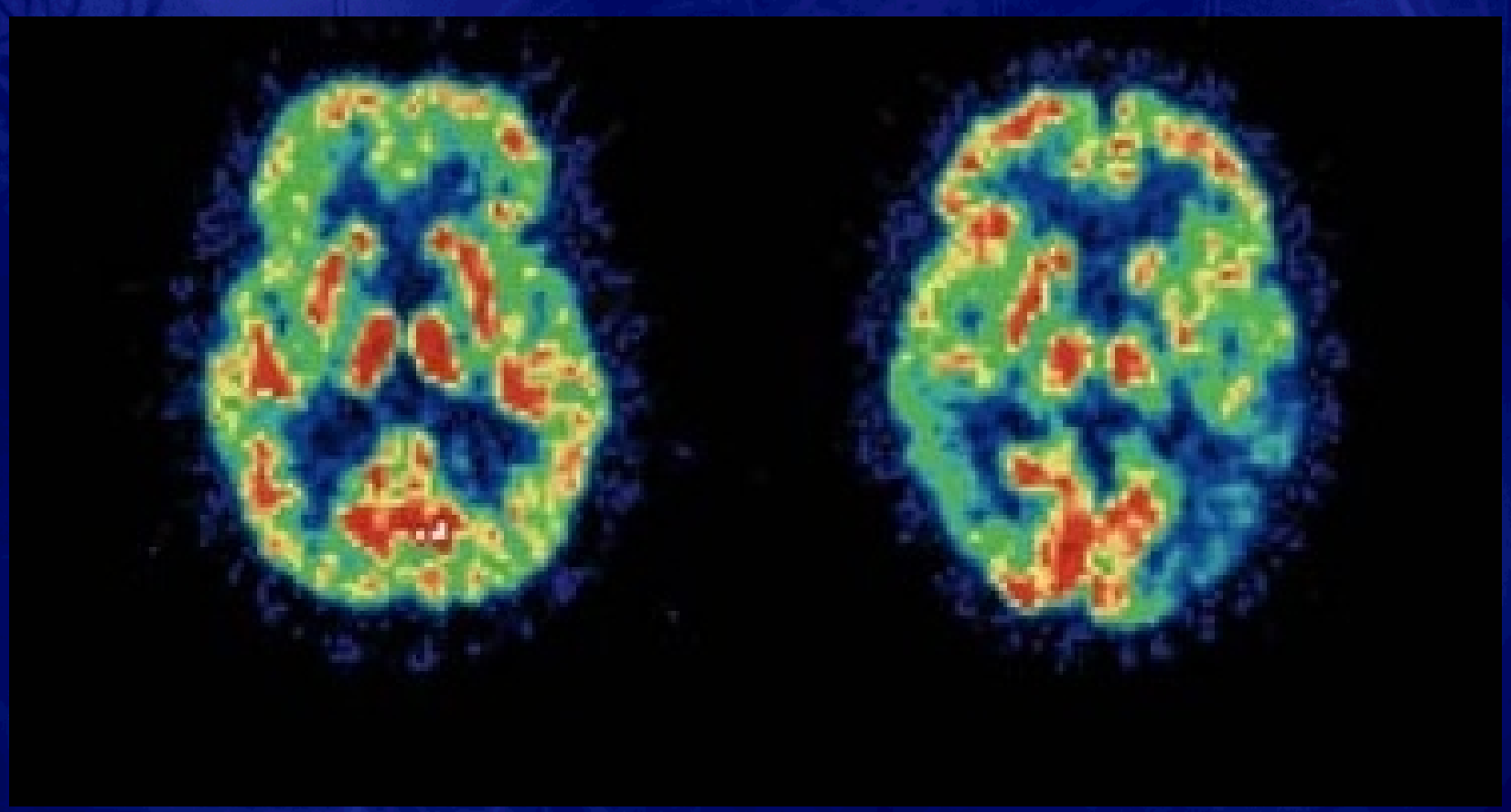
- The pulse across the gap triggers the release of chemical messengers called neurotransmitters
- Neurotransmitters diffuse across the spaces between cells, attaching themselves to neighboring cells.
- The parts of the brain cells that receive these electric impulses are called dendrites

Neurophysiology of memory

- Connections between brain cells aren't set in concrete -- they change all the time
- As one brain cell sends signals to another, the synapse between the two gets stronger. The more signals sent between them, the stronger the connection grows
- With each new experience, your brain slightly rewires its physical structure

Mohs et al

- With each new experience, your brain slightly rewires its physical structure
- This flexibility, which scientists call plasticity, that can help your brain rewire itself if it is ever damaged.
- As you learn and experience the world and changes occur at the synapses and dendrites, more connections in your brain are created



Neuroplasticity

- The brain organizes and reorganizes itself in response to your experiences, forming memories triggered by the effects of outside input prompted by experience, education, or training.

Repetition

- These changes are reinforced with use, so that as you learn and practice new information, intricate circuits of knowledge and memory are built in the brain.
- If you play a piece of music over and over, for example, the repeated firing of certain cells in a certain order in your brain makes it easier to repeat this firing later on

Repetition

- You get better at playing the music. You can play it faster, with fewer mistakes.
- Practice it long enough and you will play it perfectly.
- Stop practicing for several weeks -the result is no longer perfect.
- Your brain has already begun to forget what you once knew so well.

Memory

- To encode a memory
- Must first be paying attention.
- Since you cannot pay attention to everything all the time, most of what you encounter every day is simply filtered out
- Only a few stimuli pass into your conscious awareness.

Storage of memory

- Three ways we store memories:
- first in the sensory stage;
- then in short-term memory;
- and ultimately, for some memories, in long-term memory

Sensory stage

- The registration of information during 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 such as a visual pattern, a sound, or a touch for a breif moment after the stimulation is over

Short term memory

- After that first flicker, the sensation is stored in short-term memory.
- Short-term memory has a fairly limited capacity
- It can hold about seven items for no more than 20 or 30 seconds at a time.
- You may be able to increase this capacity somewhat by using various memory strategies.

Short term memory

- Example, a ten-digit number 8769773916 may be too much for your short-term memory to hold.
- Divided into parts, as in a telephone number, 876-977-3916 may actually stay in your short-term memory long enough for you to dial the telephone.
- Also repeating the number to yourself, can keep resetting the short-term memory clock.

Long term memory

- 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, or to be "retained."
- (That's why studying helps people to perform better on tests.)

Mastery takes 10,000 hours

Long term memory

- Long-term memory can store unlimited amounts of information indefinitely.
- We more easily store material on subjects that they already know
- It is more meaningful and can be mentally connected to related information that is already stored in their long-term memory

Familiarity

- An average memory may be able to remember a greater depth of information about one particular subject

Recall

- How memories are recalled and what happens
- when a memory cannot be retrieved –
- a phenomenon you might call "forgetting."

Memory Retrieval

- The information is retrieve on an unconscious level
- either a "bad" or a "good" memory
- Not the fault of your entire memory system - but an inefficient component of one part of your memory system.

Why we forget

- If you've forgotten pen, one of several things could have happened:
- You may not have registered clearly where you put them down to begin with.
- You may not have retained what you registered.
- You may not be able to retrieve the memory accurately.

Why we forget

- If you've forgotten something
- Maybe you didn't encode it very effectively
- Because you were distracted while encoding should have taken place
- Because you're having trouble retrieving it.
- Distractions that occur while you're trying to remember something can really get in the way of encoding memories.

Why we forget

- Give good memory aids
- Repetition is key
- Let students avoid distractions

Why we forget

- A mismatch between retrieval cues and the encoding of the information you were searching for
- As you begin to age, these synapses begin to falter, which begins to affect how easily you can retrieve memories.

Aging

- Aging causes major cell loss in a tiny region in the front of the brain that leads to a drop in the production of a neurotransmitter called acetylcholine.
- Acetylcholine is vital to learning and memory.

Forgetting

- Odds are you're not suddenly developing Alzheimer’s disease
- The hippocampus, loses 5 percent of its nerve cells with each passing decade -- for a total loss of 20 percent by the time you reach your 80s
- The brain itself shrinks and becomes less efficient as you age.

Memory decline

- Inheritance of unhealthy genes,
- Exposure to poisons,
- Smoking and drinking

- All these things speed up memory decline.

Memory loss and dementia are NOT inevitable

- Some specific abilities do decline with age,
- Overall memory remains strong for most people throughout their 70s.
- The average 70-year-old performs as well on certain cognitive tests as do many 20-year-olds
- Many in the 60s and 70s score significantly better in verbal intelligence than do younger people.

Improving mental function

- Patients were able to make significant improvements in memory when given
- Rewards and challenges.
- Physical exercise
- Mental stimulation

Evidence

- Stimulating the brain can stop cells from shrinking and can even increase brain size
- In animals an enriched environments with challenges can lead to larger outer brains with larger, healthier brain cells
- Mental exercise results in more dendrites, which allow cells to communicate with each other

Stimulation

- A stimulating environment encourages the growth of these dendrites, while a dull environment impedes it.

Summary

- With age, you may not learn or remember as quickly as you did when you were in school
- -- but you will likely learn and remember nearly as well

Summary

- An older person's brain may be less effective not because of a structural or organic problem

but

- as a result of lack of use