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# Brain 101

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## The Neurotypical Brain

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# After completion of this module, the learner will be able to:

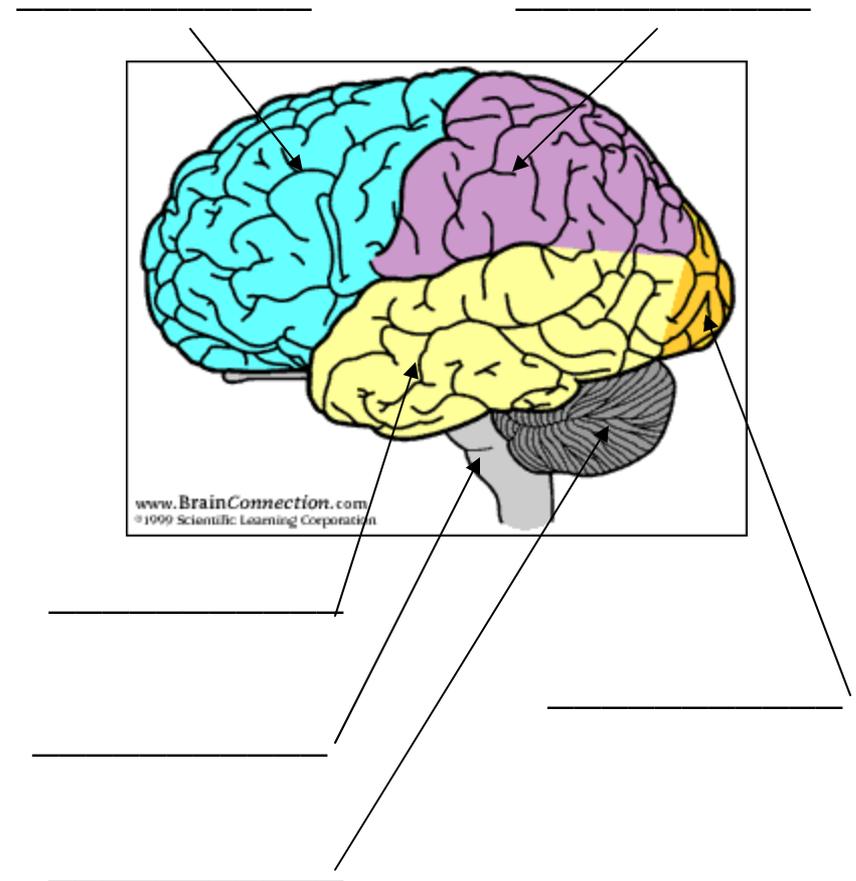
- Identify:
  - the basic structures of the brain: hemispheres, lobes, and levels.
  - the basic structures and functions of neurons, axons and dendrites.
  - the basic systems of the brain – physical, chemical, and electrical.
  
- Explain:
  - neurotypical development of the brain.
  - the basic functions of each lobe.

# Pre-Quiz – Part 1

## Label the Brain

### True or False

- \_\_\_\_\_ 1. The average brain weighs 7 pounds.
- \_\_\_\_\_ 2. The brain is attached to the skull.
- \_\_\_\_\_ 3. The corpus callosum connects the two hemispheres of the brain.
- \_\_\_\_\_ 4. There are four lobes in each hemisphere.
- \_\_\_\_\_ 5. The brain floats in cerebrospinal fluid.
- \_\_\_\_\_ 6. Neurons are the basic brain cells.
- \_\_\_\_\_ 7. The brain communicates via chemicals.
- \_\_\_\_\_ 8. Neurotransmitters pass directly from the axon to the dendrite.
- \_\_\_\_\_ 9. The brain continues to grow new neurons after birth.
- \_\_\_\_\_ 10. Each lobe of the brain has specific functions.



# Pre-Quiz – Part 2

For each statement, decide whether it is a function of the:

- |                    |                   |
|--------------------|-------------------|
| 1. Brain Stem      | 2. Cerebellum     |
| 3. Occipital Lobes | 4. Parietal Lobes |
| 5. Temporal Lobes  | 6. Frontal Lobes  |

\_\_\_\_\_ 1. Breathing

\_\_\_\_\_ 2. Vision

\_\_\_\_\_ 3. Judgment

\_\_\_\_\_ 4. Language

\_\_\_\_\_ 5. Balance

\_\_\_\_\_ 6. Attention

\_\_\_\_\_ 7. Goal Setting

\_\_\_\_\_ 8. Touch Perception

\_\_\_\_\_ 9. Coordination

\_\_\_\_\_ 10. Memory Acquisition

\_\_\_\_\_ 11. Sensory Integration

\_\_\_\_\_ 12. Time Perception

\_\_\_\_\_ 13. Swallowing

\_\_\_\_\_ 14. Recognition of Printed Words

\_\_\_\_\_ 15. Control of Emotional Response

\_\_\_\_\_ 16. Hearing Ability

\_\_\_\_\_ 17. Inhibition

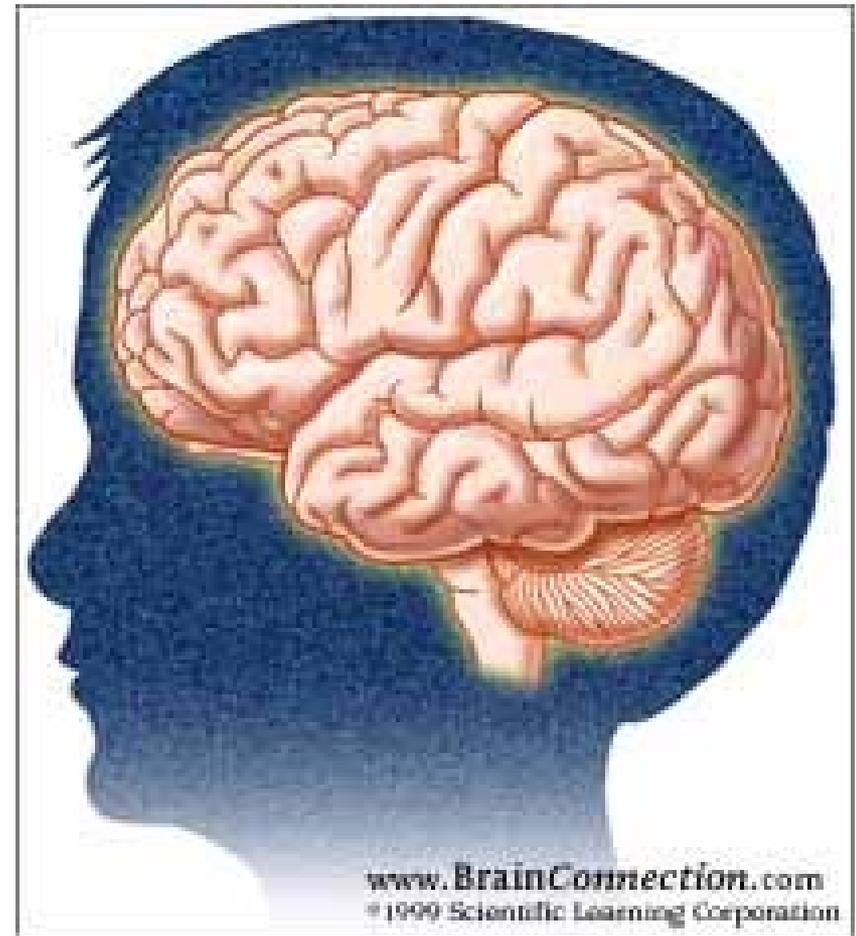
\_\_\_\_\_ 18. Initiation

\_\_\_\_\_ 19. Startle Response

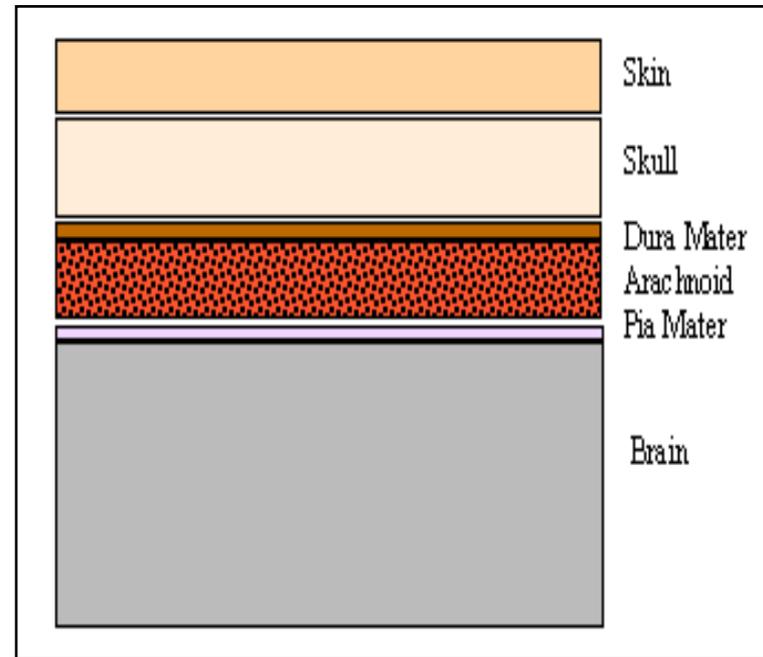
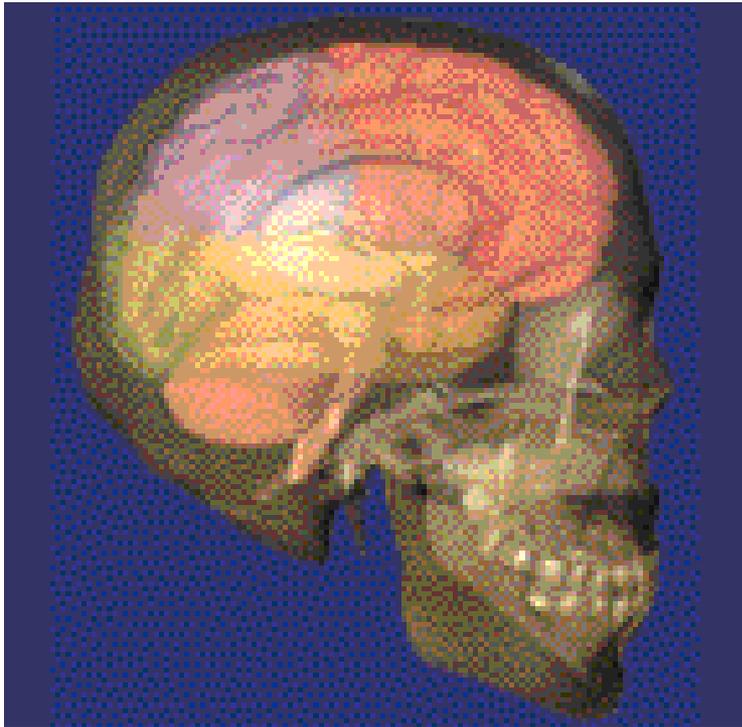
\_\_\_\_\_ 20. Categorization of Objects

# The Brain - Overview

- The Average Brain:
  - Weighs 3.3 pounds.
  - Is protected by layers:
    - Hair.
    - Skin.
    - Cranium (Skull).
    - Meninges.
    - Maters.
  - Has 100 billion Neurons.
  - Has 100 trillion Snyapses.



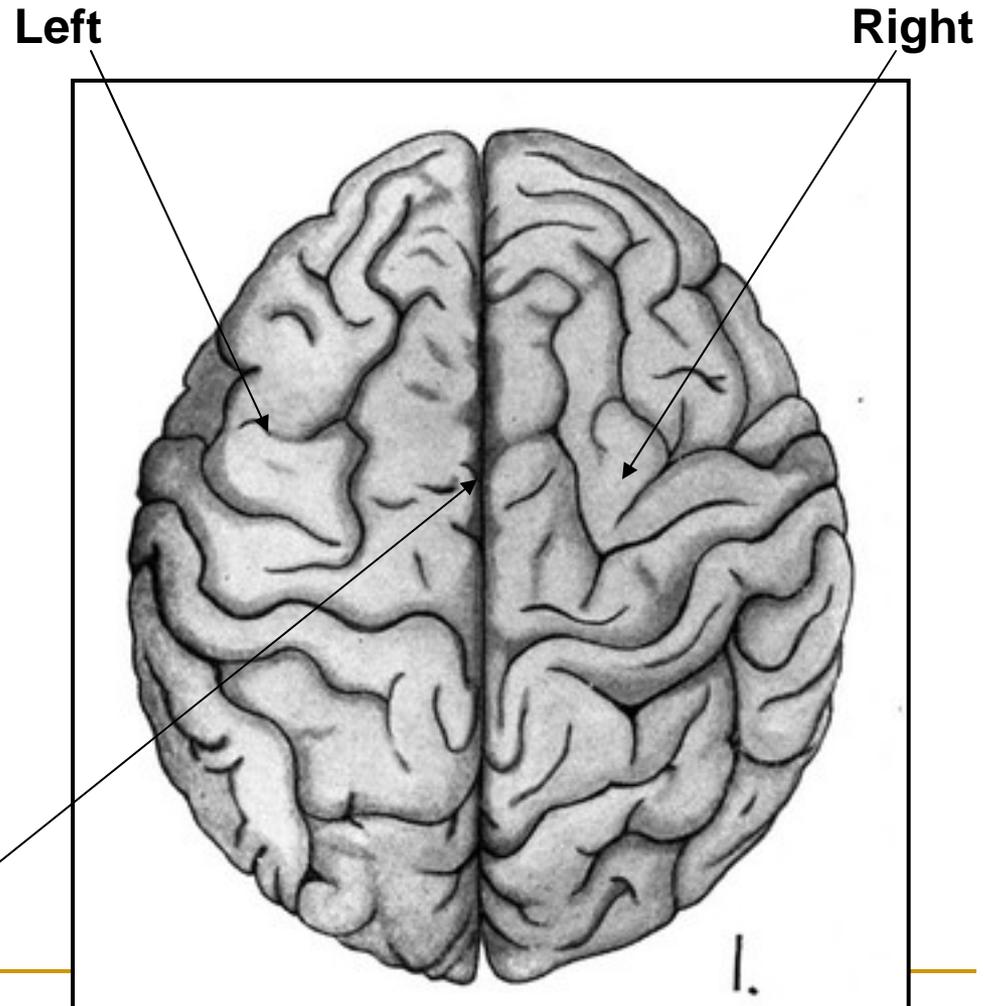
# The Skull & Meninges



# The Hemispheres

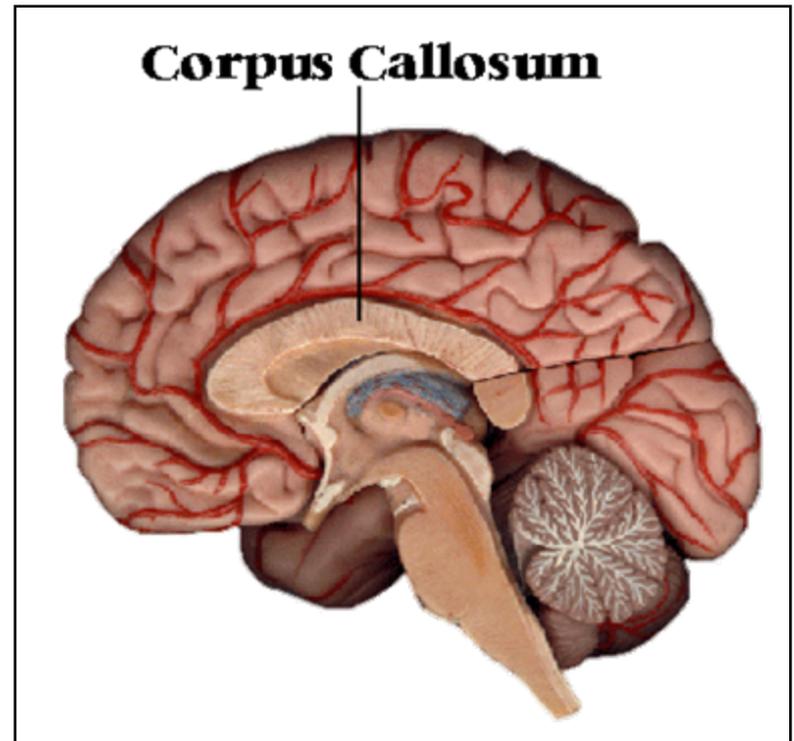
- There are:
  - 2 Hemispheres:
    - Left.
    - Right.
  - Connected by:
    - 1 Corpus Callosum.

**Corpus Callosum**



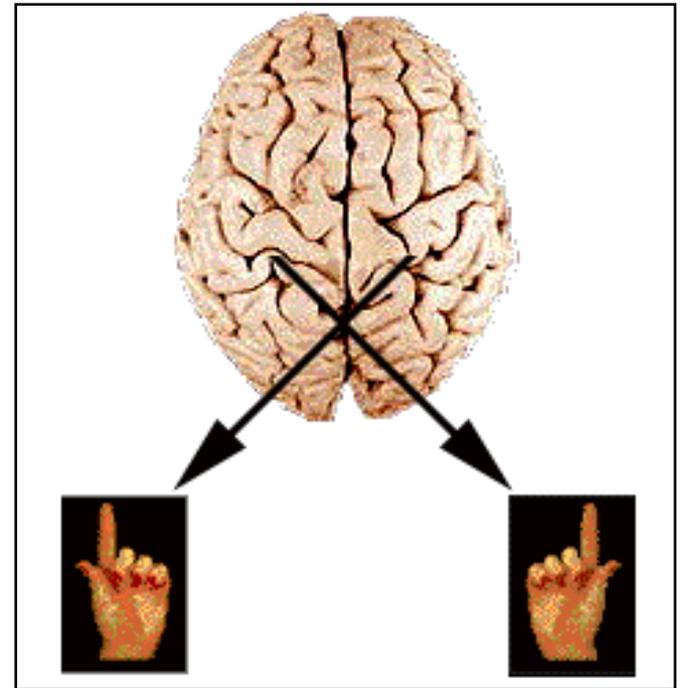
# Corpus Callosum

- Major tract of “White Matter” connecting the left and right hemispheres.
- Composed of approximately 200 million nerve fibers.
- Contain both myelinated and unmyelinated axons.
- Majority of connections are between the cortical association areas.



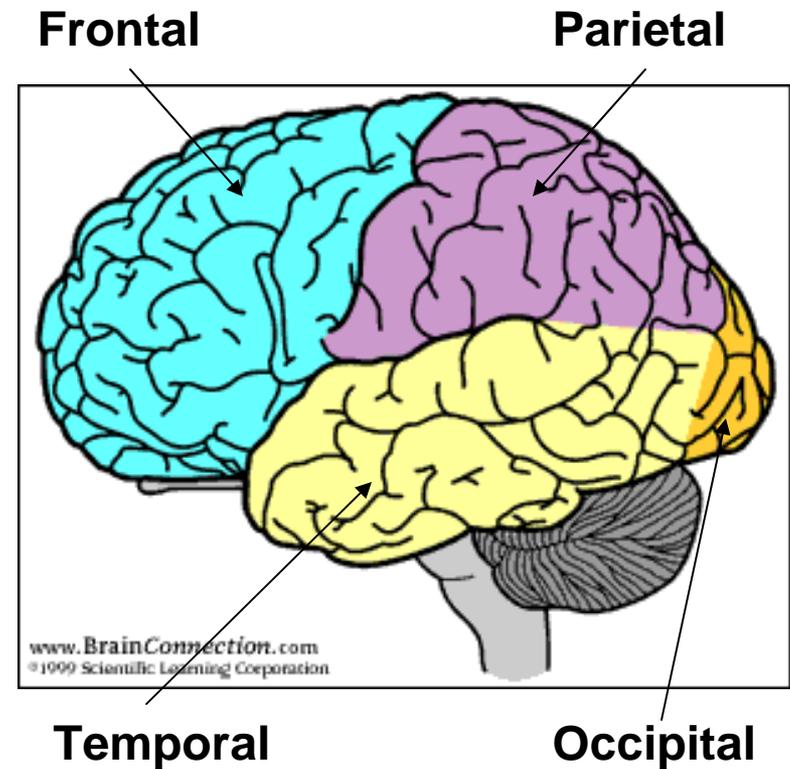
# Left & Right

- The Corpus Callosum enables the two hemispheres to communicate with each other.
- The right hemisphere controls the left side of the body.
- The left hemisphere controls the right side of the body.
- The hemispheres mirror each other physically.



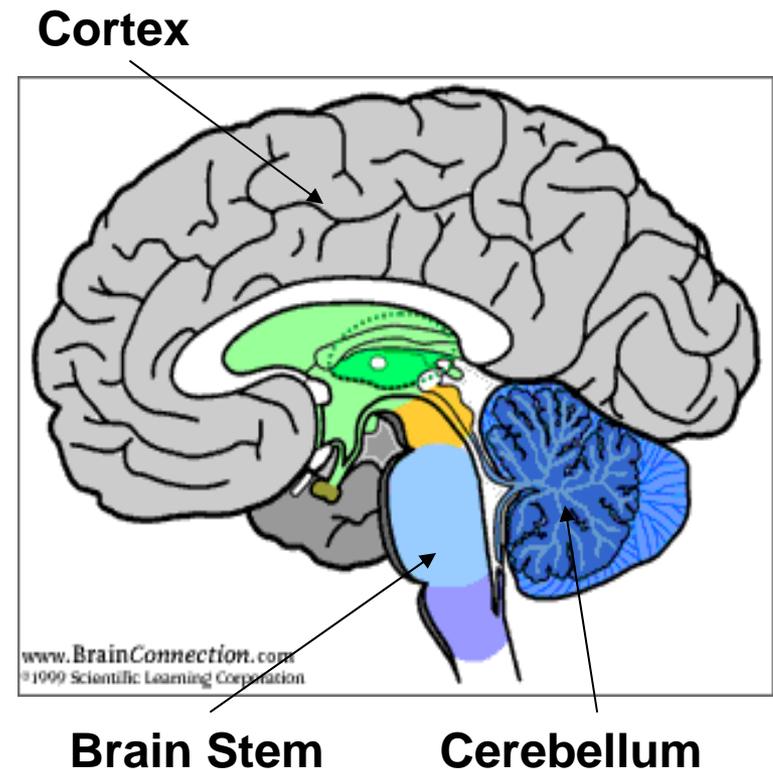
# The Lobes

- There are 4 Lobes in each hemisphere:
  - Frontal.
  - Parietal.
  - Temporal.
  - Occipital.



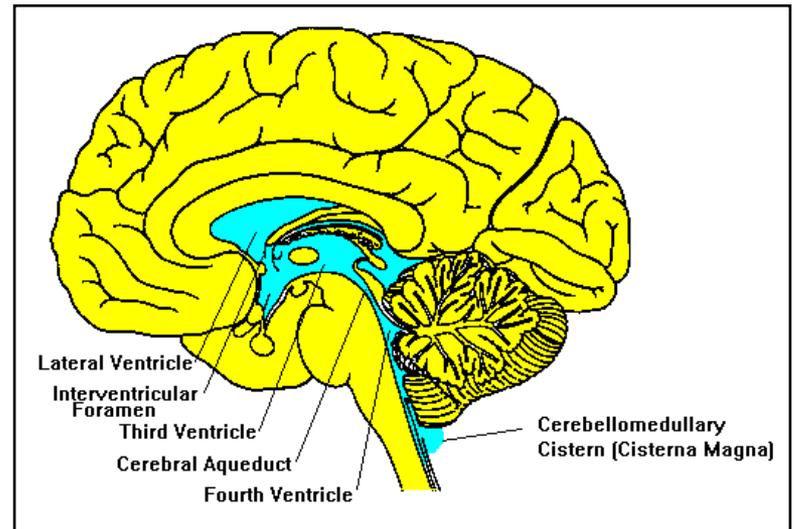
# Three Brains in One

- The human brain as evolved over time and has three levels:
  - Oldest - Brain Stem.
  - Middle – Cerebellum.
  - Newest – Cortex.



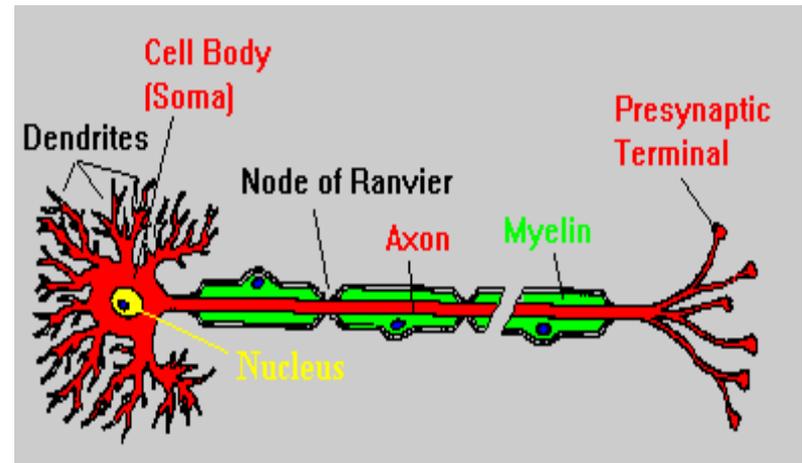
# Cerebrospinal Fluid (CSF)

- CSF:
  - Clear, colorless fluid.
  - Contained in ventricles.
  - Volume: 125-150 ml.
  - Has 4 functions:
    - Buffers brain from skull.
    - Buoys brain on spine.
    - Excretes waste products.
    - Transports hormones.



# The Neuron

- The working cells of the brain.
- Parts of the Neuron:
  - Cell Body (Soma).
  - Nucleus.
  - Dendrites.
  - Axon.
  - Myelin.
  - Synapses.



# Neurons Communicate

- Electrochemically:

- Chemicals cause electrical signal.

- Chemicals become ions:

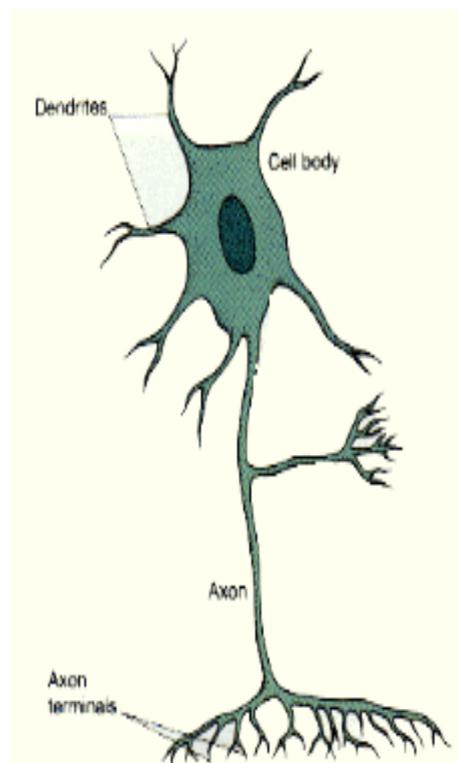
- Sodium.

- Potassium.

- Calcium.

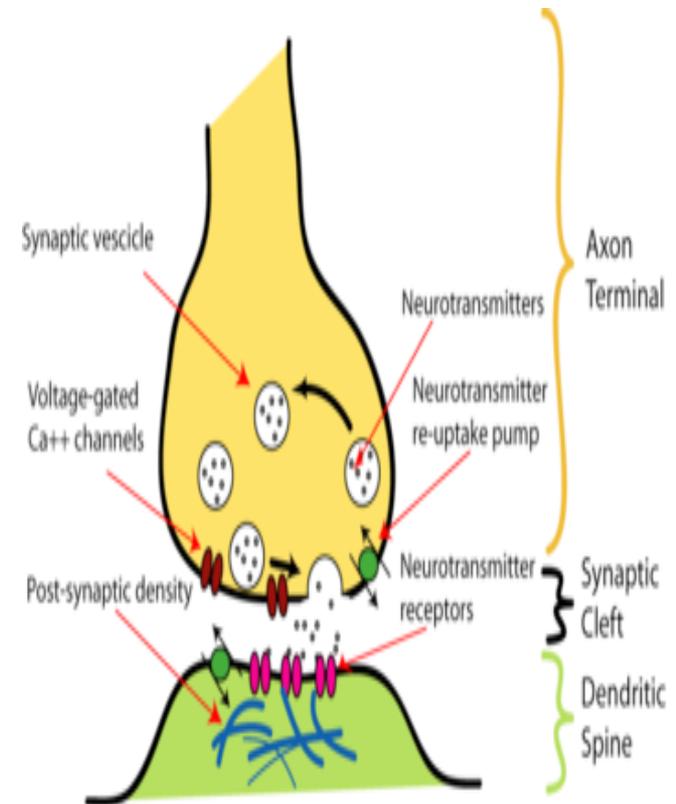
- Chloride.

- Axon membranes limit which ones pass through.



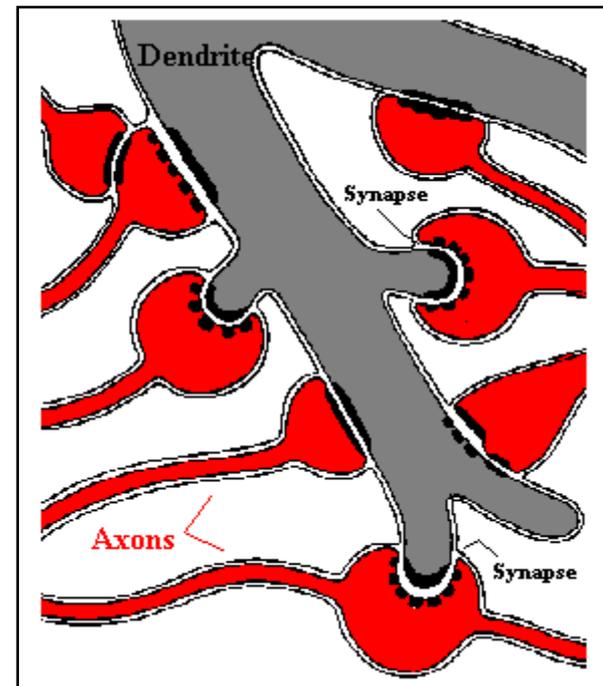
# Neurotransmitters

- Neurotransmitters:
  - Are chemicals:
    - Created in the neuron.
    - Transported down the axon.
    - Stored in vesicles.
  - Pass messages:
    - From axon terminal.
    - Across the synapse (gap).
    - Accepted by receptor.
  - Outcome:
    - Excite action potential.
    - Inhibit action potential.



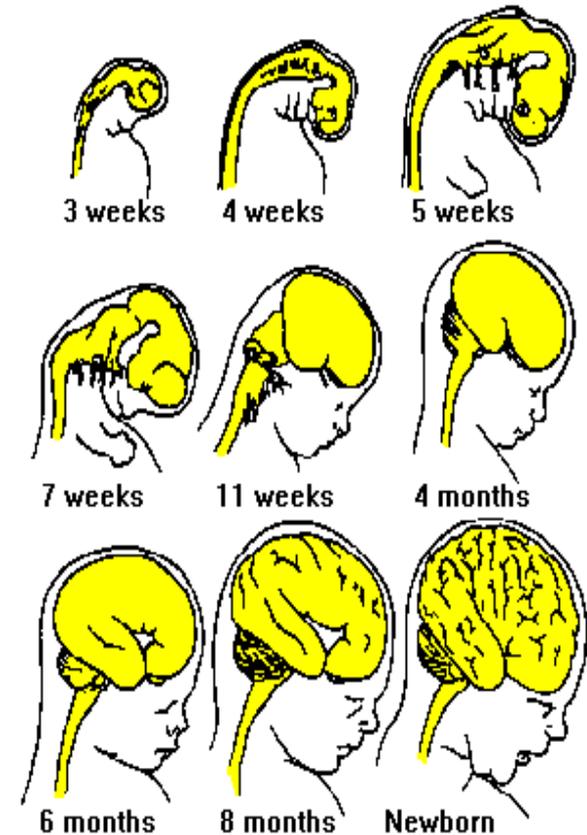
# Neurotransmitters

- 7 basic substances:
  - Acetylcholine
  - Serotonin
  - Dopamine
  - Histamine
  - Norepinephrine
  - Epinephrine
  - GABA



# In-Utero Brain Development

- Typical Development:
  - 250,000 neurons daily.
  - 16<sup>th</sup> day - Neural Plate.
  - 18<sup>th</sup> day – Neural Groove.
  - 21<sup>st</sup> day – Neural Tube.
  - 7<sup>th</sup> week – 3 major areas:
    - Forebrain.
    - Midbrain.
    - Hindbrain.



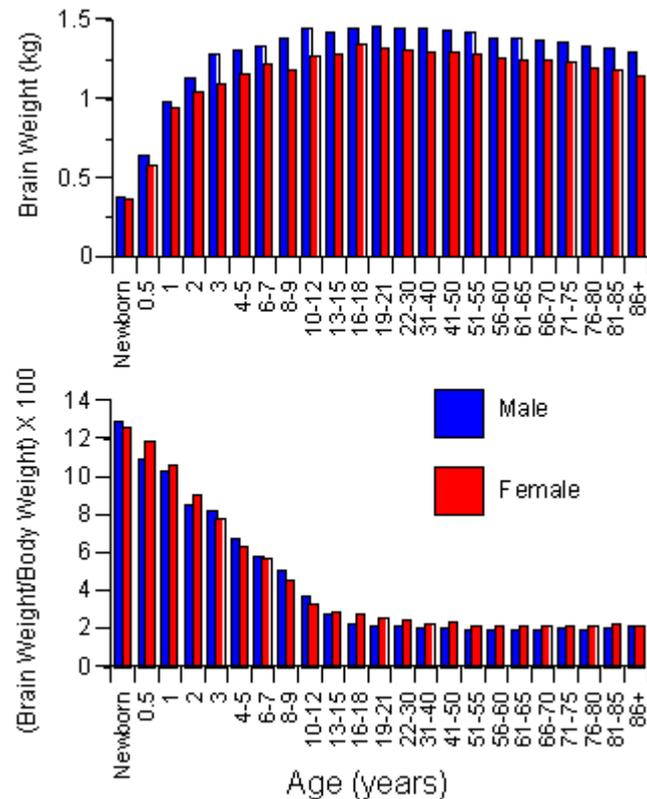
# Development Continues

Feeling brain-dead? Don't worry - your tired old gray matter may work hard for you yet. Research to be published November in the journal *Nature Medicine* suggests that at least one area of the adult brain can reproduce and generate new cells, even after death. That is, of course, utterly contrary to everything we thought about the brain up until now. It was assumed that at some point in your grown-up life, brain cells stopped generating and started dying off. Not true - at least not in the hippocampus, according to a team of American and Swedish scientists who took samples of this portion of the brain from cancer patient autopsies.

The results confirm a number of other studies made - but essentially ignored -- over the past 30 years, which saw the same growth occur in the same area of the brain in rats and birds. The hippocampus is our learning and memory center - and in adult birds, it grew every time they learned new songs. Could lifelong education literally boost your brainpower? "We have to try to determine whether we might be able to have some positive control over how the human brain cells divide," said Dr. Fred Gage, the team leader.

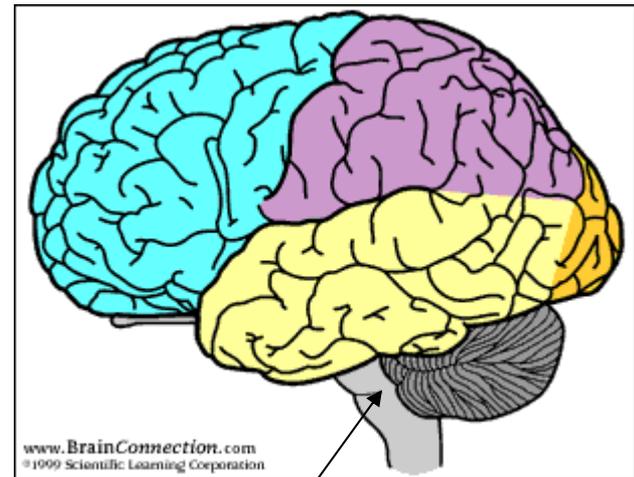
**FIND THIS ARTICLE AT:**

<http://www.time.com/time/nation/article/0,8599,15541,00.html>



# Brain Stem - Functions

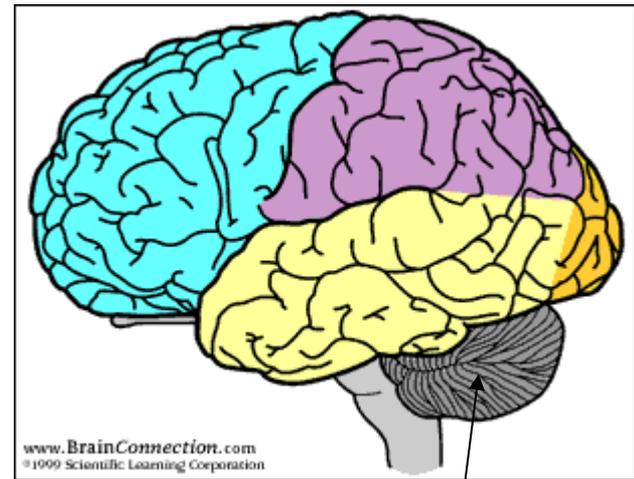
- Functions:
  - Breathing.
  - Heart rate.
  - Swallowing.
  - Startle response.
  - Autonomic nervous system.
  - Level of alertness.
  - Ability to sleep.
  - Sense of balance.



Brain Stem

# Cerebellum - Functions

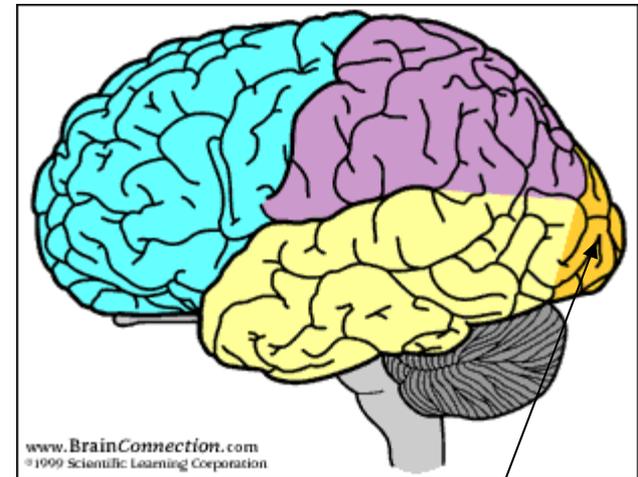
- Functions:
  - Balance.
  - Equilibrium.
  - Coordination of voluntary movement.
  - Memory for reflex motor acts.



Cerebellum

# Occipital Lobes - Functions

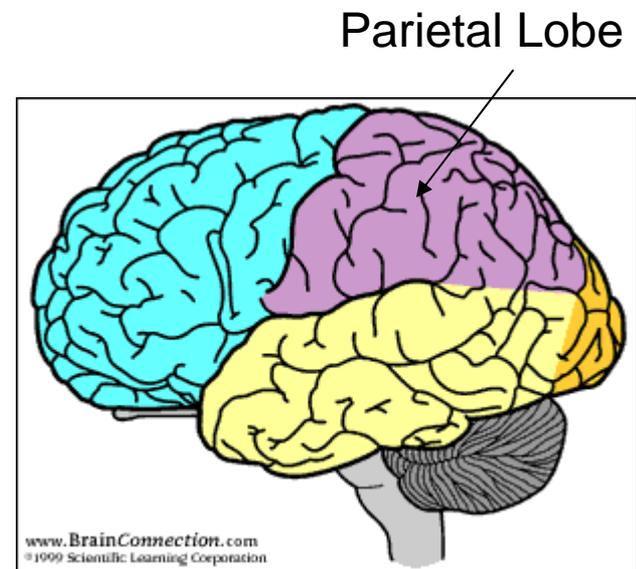
- Functions:
  - Visual input.
  - Visual perception.
  - Recognition of printed words.



Occipital Lobe

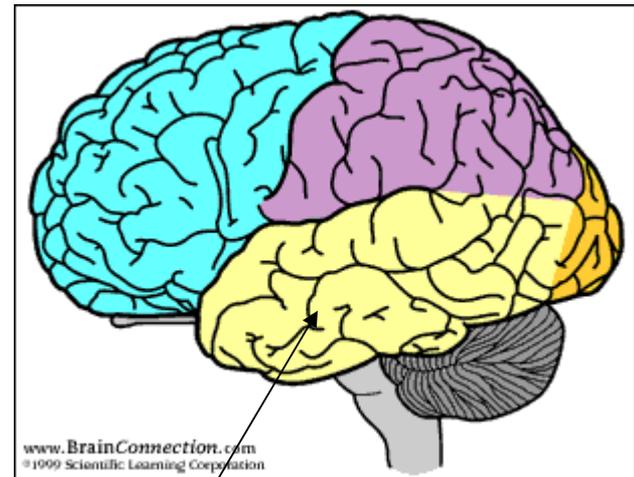
# Parietal Lobes - Functions

- Functions:
  - Visual attention.
  - Touch perception.
  - Goal-oriented voluntary movements.
  - Manipulation of objects.
  - Integration of different senses that allows for understanding of a single concept.



# Temporal Lobes - Functions

- Functions:
  - Hearing ability.
  - Memory acquisition.
  - Some visual perceptions.
  - Categorization of objects.
  - Emotions.
  - Language.
    - Wernicke's Area – Receptive.
    - Broca's Area – Expressive.



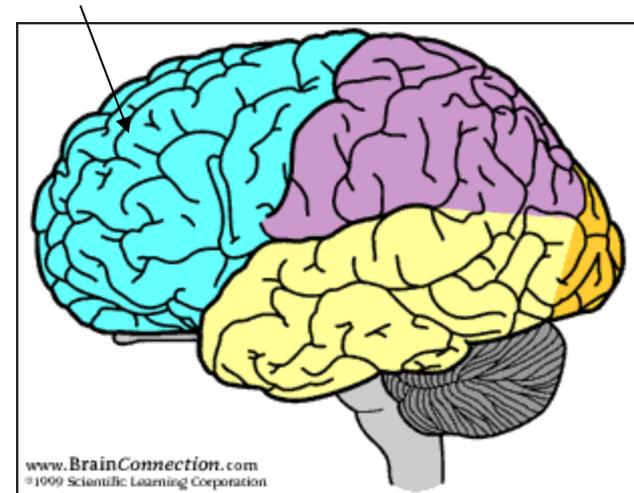
Temporal Lobe

# Frontal Lobes - Functions

## ■ Functions:

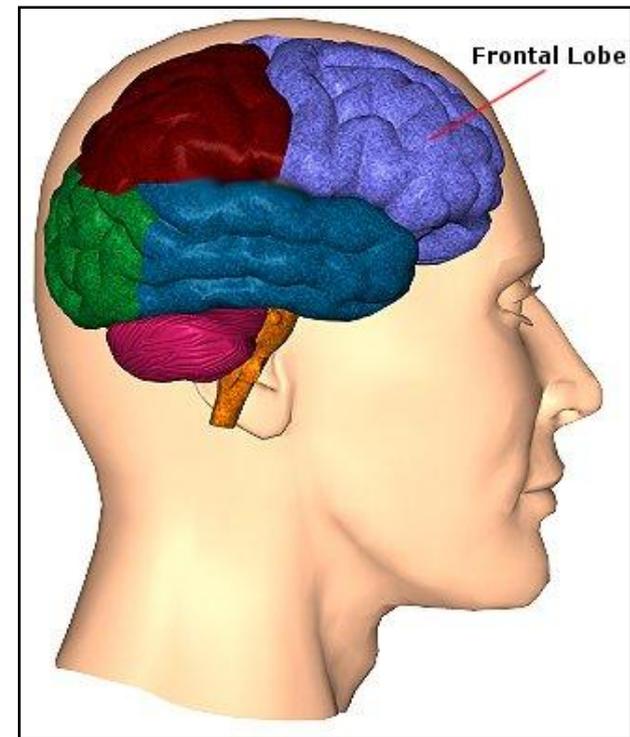
- Consciousness.
- Goal setting.
- Inhibition.
- Attention.
- Time perception.
- Initiation of response of environment.
- Judgment.
- Control of emotional response.
- Internalization of language.
- Volition.
- Memory for habits & motor activities.

Frontal Lobe



# Prefrontal Lobes – Uniqueness

- Functions continue developing and maturing through adolescence.
- Reach maturity around age 25.
- Almost nothing is done by the brain without prefrontal lobe involvement.
- Most vulnerable part of brain in accidents – due to location and boney protrusions inside front of skull.



# Prefrontal Lobes – Executive Functions

Everyone's Executive Functions fall along a continuum of development.

**Child.....Adult**

Disinhibition

Inhibition

Inattention

Attention

No Concept of Time

Time Perception

No Delaying Gratification

Self-Regulation

No Self-Starting

Initiation

Poor Judgment

Ability to Judge

Live in Moment

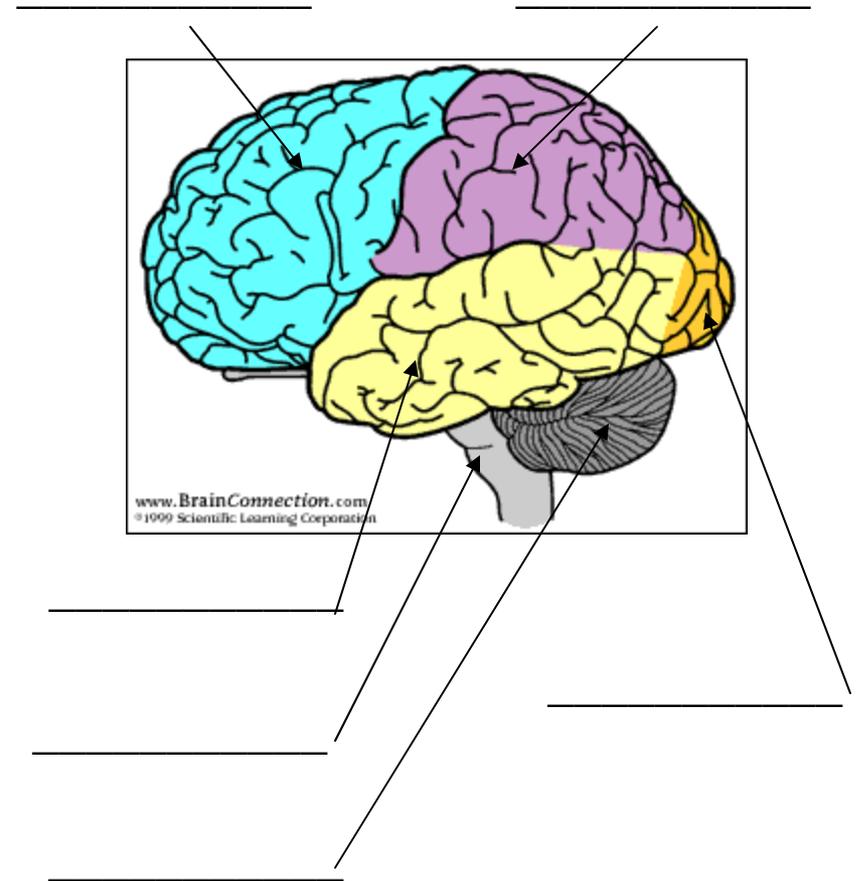
Goal-Setting

# Post-Quiz – Part 1

## Label the Brain

### True or False

- \_\_\_\_\_ 1. The average brain weighs 7 pounds.
- \_\_\_\_\_ 2. The brain is attached to the skull.
- \_\_\_\_\_ 3. The corpus callosum connects the two hemispheres of the brain.
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# Post-Quiz – Part 2

For each statement, decide whether it is a function of the:

1. Brain Stem
2. Cerebellum
3. Occipital Lobes
4. Parietal Lobes
5. Temporal Lobes
6. Frontal Lobes

\_\_\_\_\_ 1. Breathing

\_\_\_\_\_ 2. Vision

\_\_\_\_\_ 3. Judgment

\_\_\_\_\_ 4. Language

\_\_\_\_\_ 5. Balance

\_\_\_\_\_ 6. Attention

\_\_\_\_\_ 7. Goal Setting

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\_\_\_\_\_ 19. Startle Response

\_\_\_\_\_ 20. Categorization of Objects

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# Post-Quiz – Part 3

- Explain the neurotypical development of the brain.
  
- Explain the basic function(s) of each lobe of the brain:

# Learning Outcomes Checklist

Can you:

Identify:

- the basic structures of the brain: hemispheres, lobes, and levels.
- the basic structures and functions of neurons, axons and dendrites.
- the basic systems of the brain – physical, chemical, and electrical.

Explain:

- neurotypical development of the brain.
- the basic functions of each lobe.