

# **Basic Brain Anatomy and Development in Relation to Mental Illness**

Mental Health 102

Oct. 7, 2011

Dr. Ted Bowlus

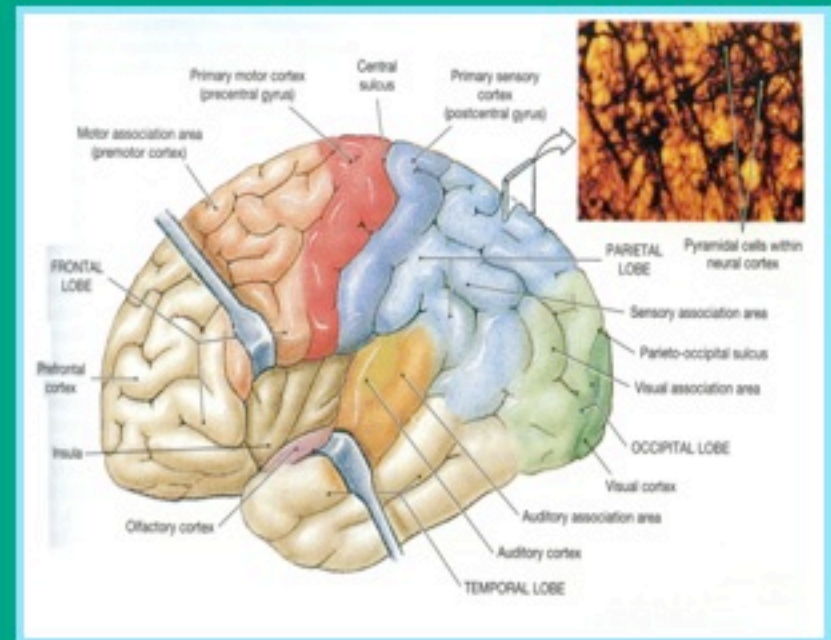
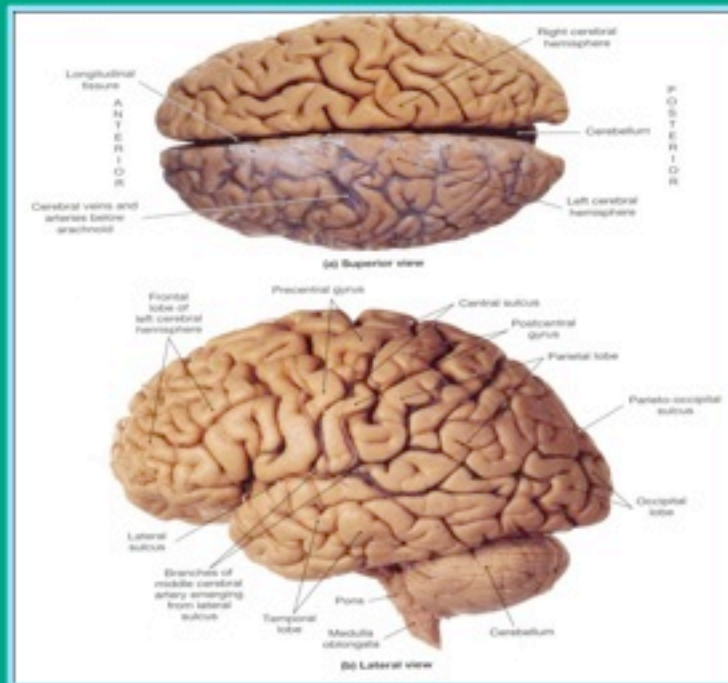
Graduate Degree (MSBS) Anatomy and  
Neuroscience

University of Toledo Medical College

# Basic Brain Anatomy

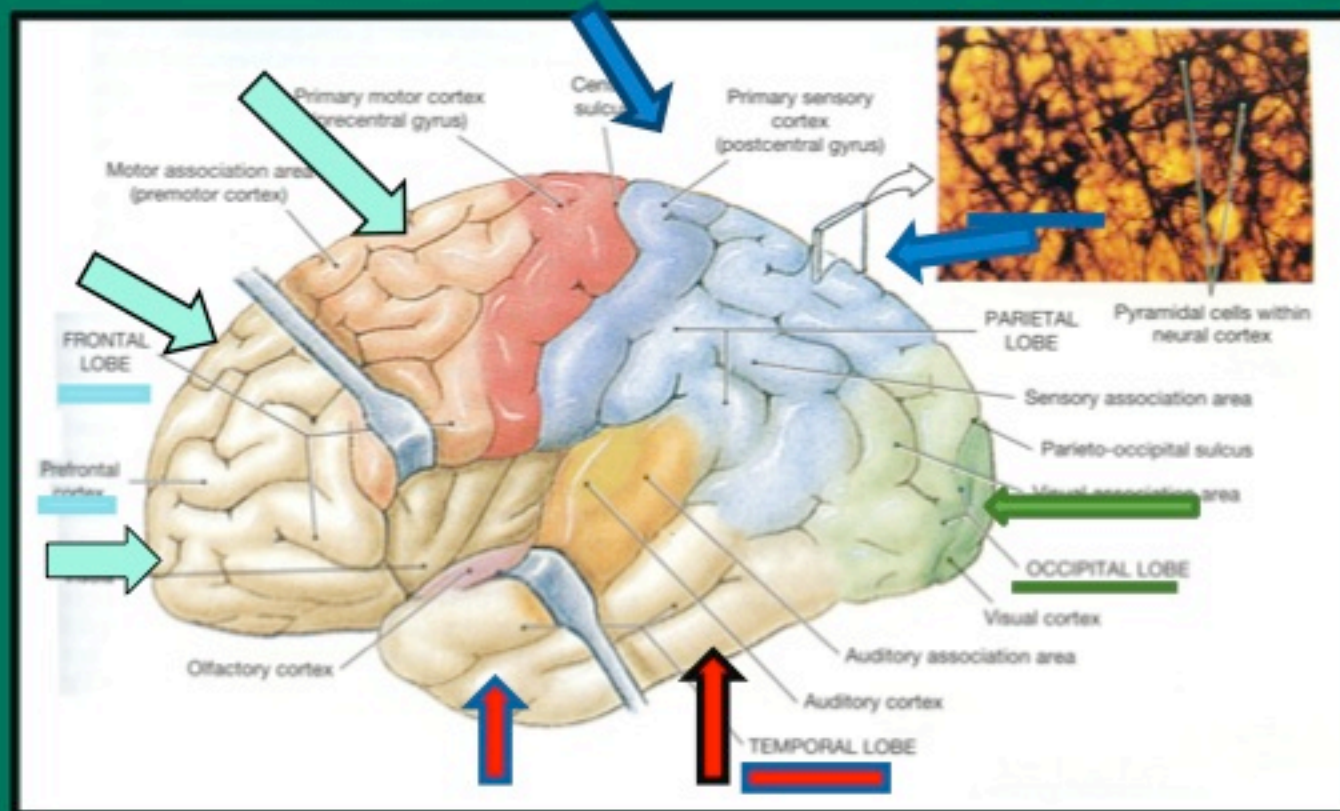
- 1. Central Nervous System**
- 2. Lobes (divisions) of the brain**
- 3. Neurons**
- 4. Synapses**
- 5. Glia (neuroglia)**

# Central Nervous System



## Brain and Spinal Cord

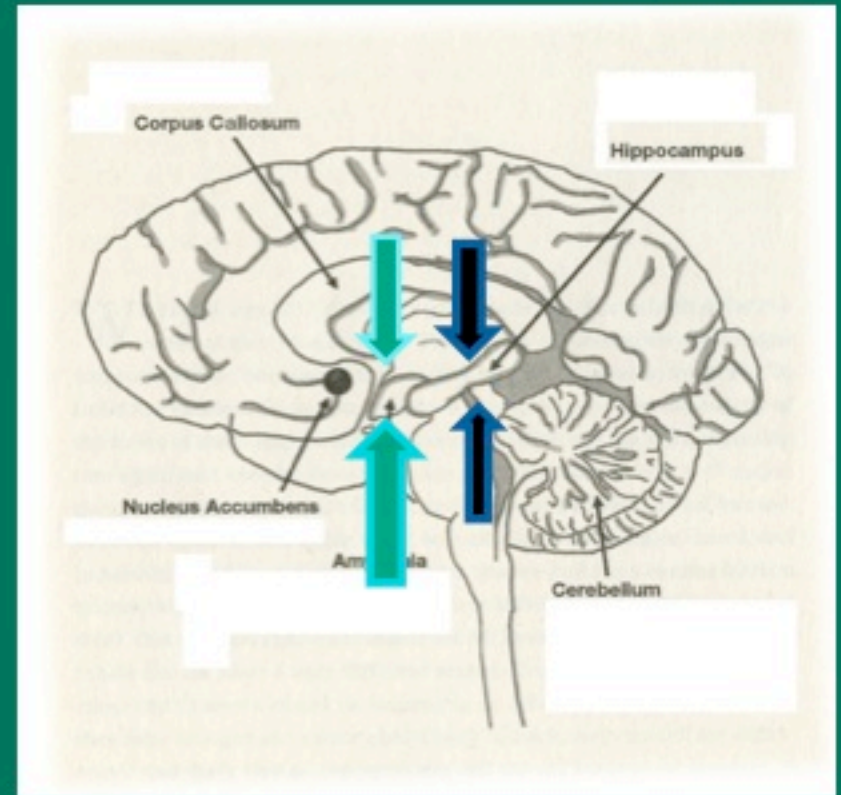
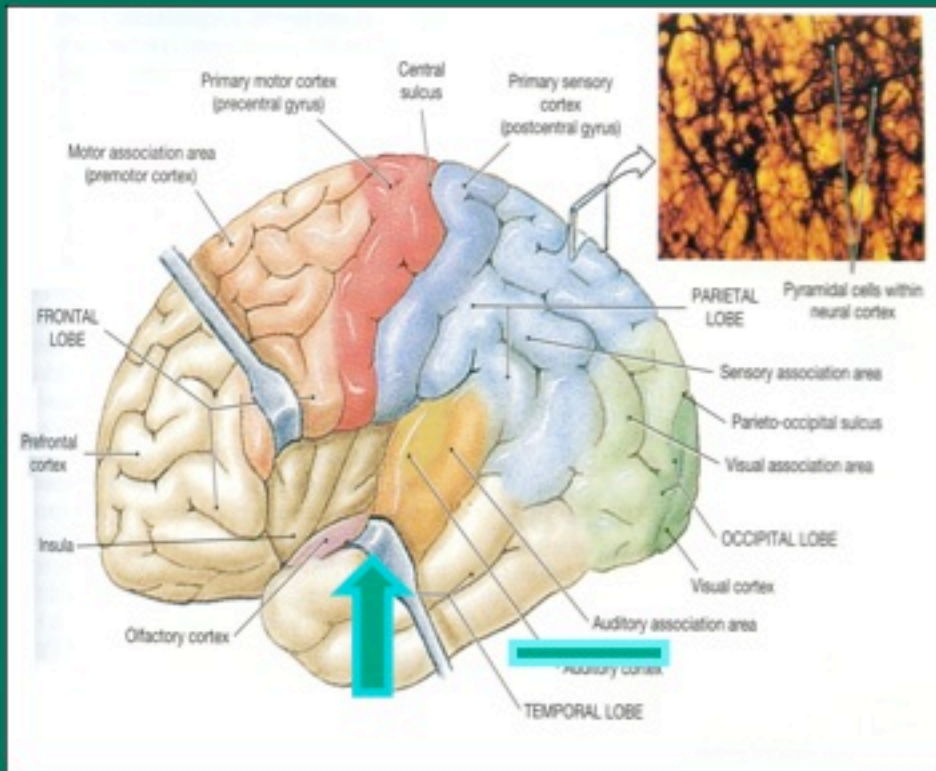
# The Lobes (Divisions) of the Brain



# Temporal Lobe



# Amygdala and Hippocampus



**In the Limbic System**

## Amygdala

- Key roles: **emotion and emotional memories**, regulates appetite, aggression, sexual and social behavior
- Roles in Mental Illness: Post-traumatic stress dis., Anxiety / panic disorder, depression,

## HIPPOCAMPUS

Key roles: **memories and learning**

Roles in Mental Illness: Alzheimer's disease, schizophrenia

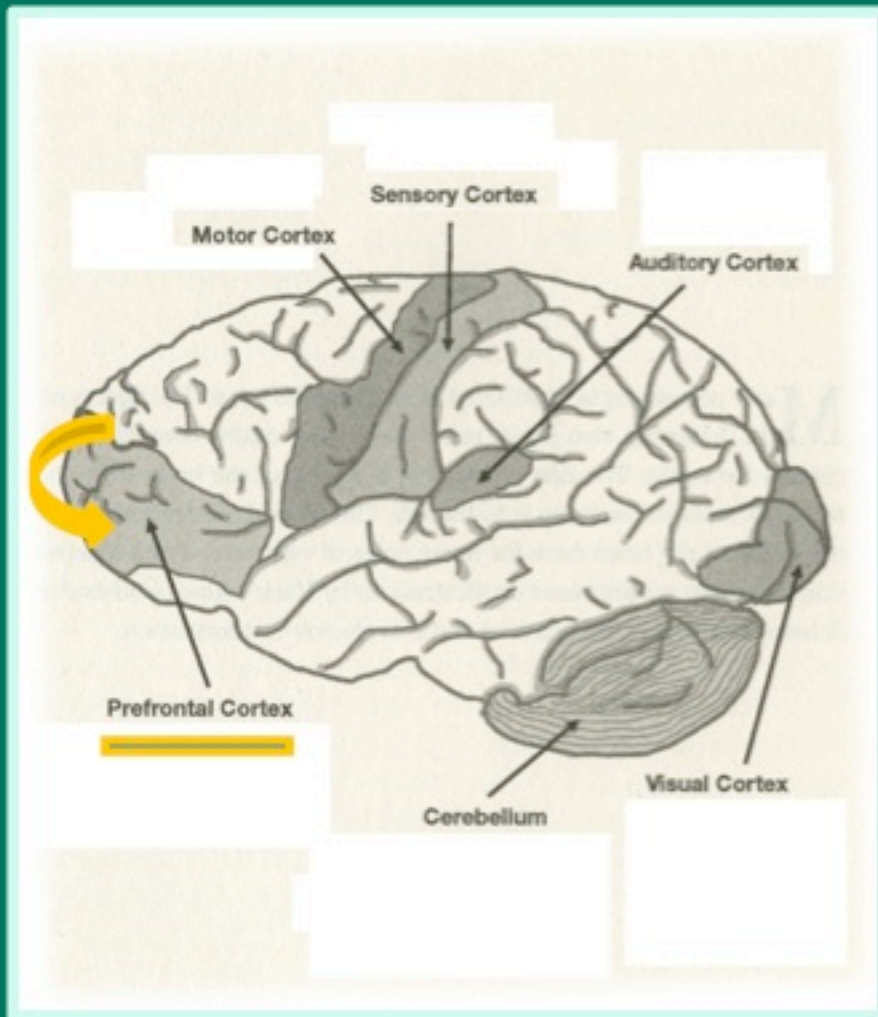
**In the Temporal Lobe**

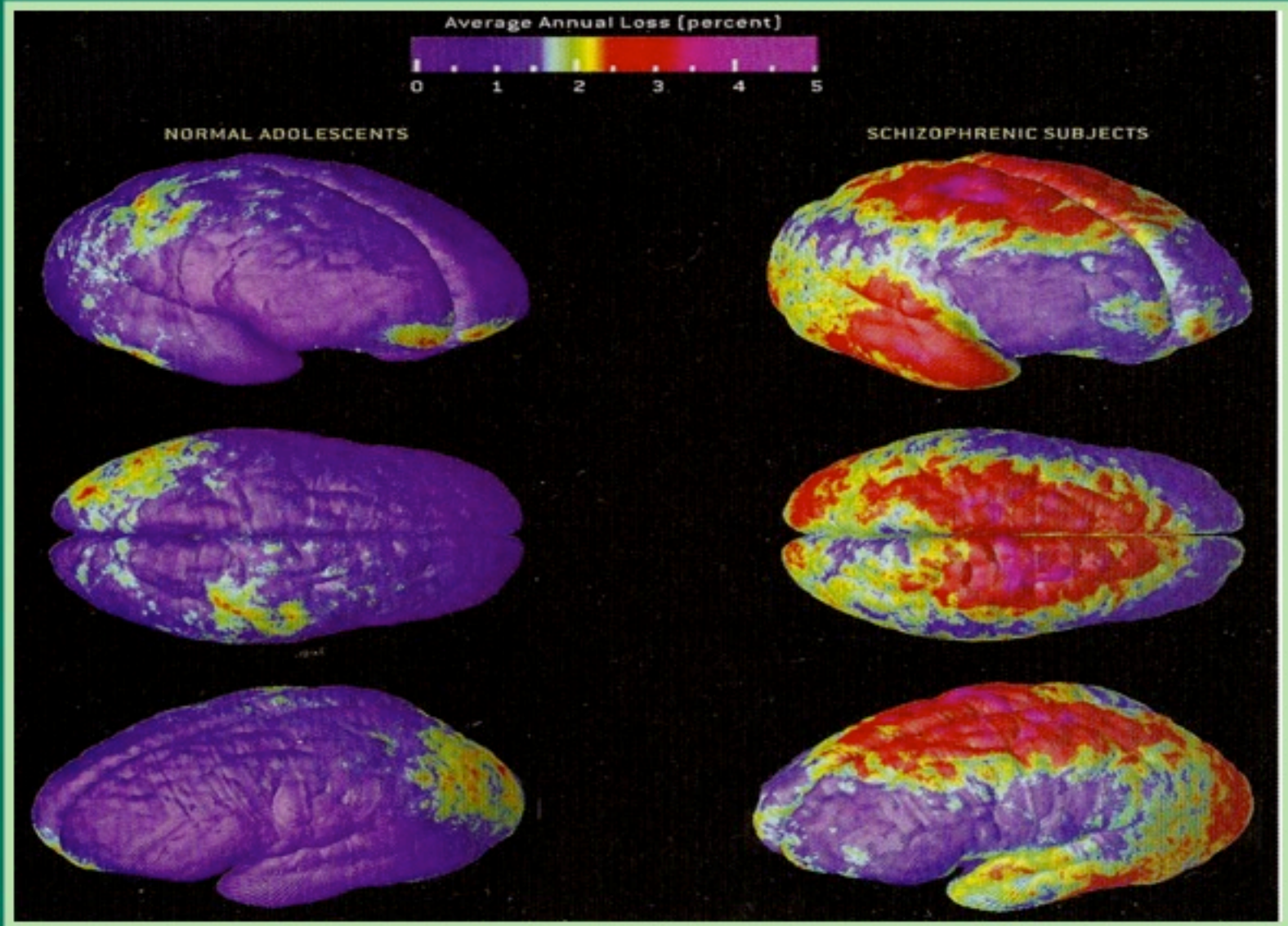
## Pre-Frontal Cortex

“Executive Cortex”

Relationship to normal aging, dementia, and Alzheimer’s disease.

Schizophrenia

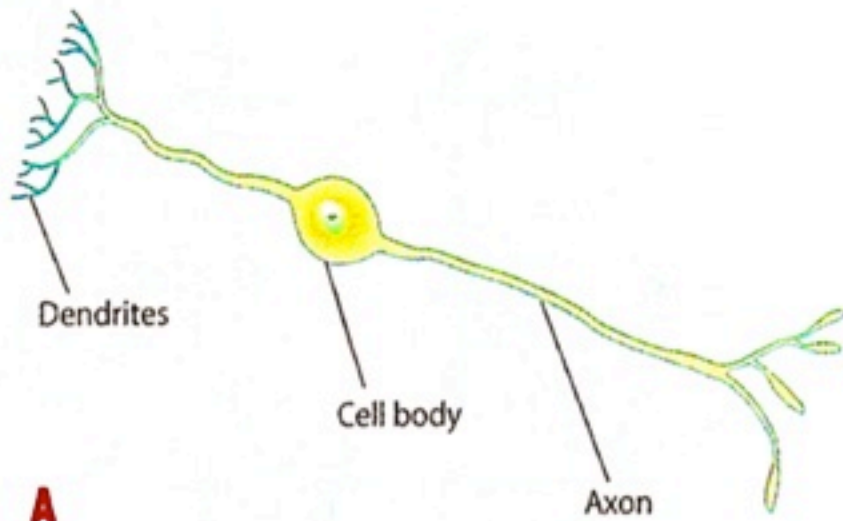




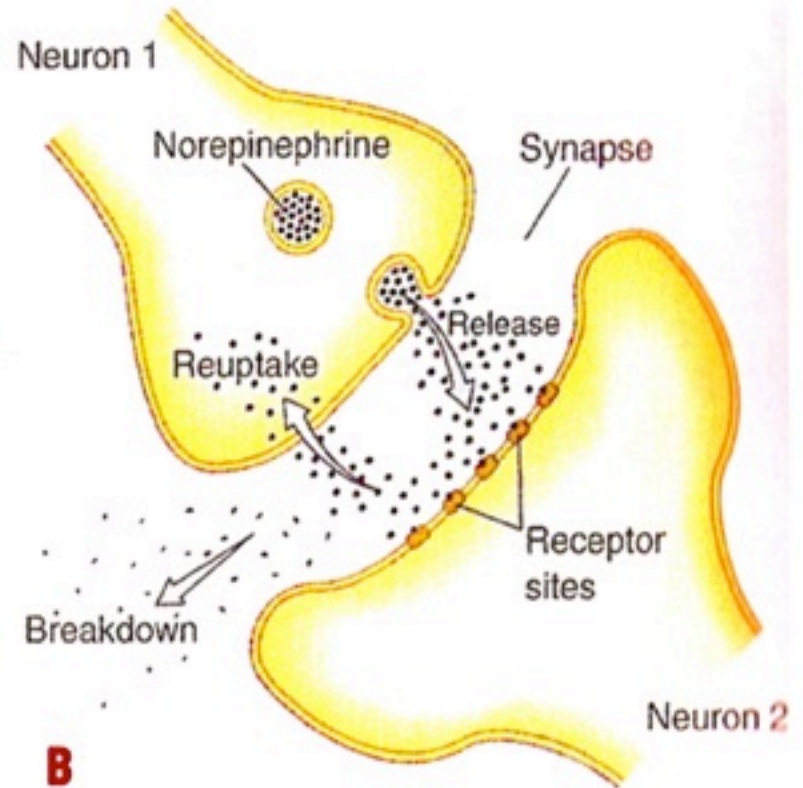
**NORMAL**

**PET SCAN**

**SCHIZOPHRENIA**

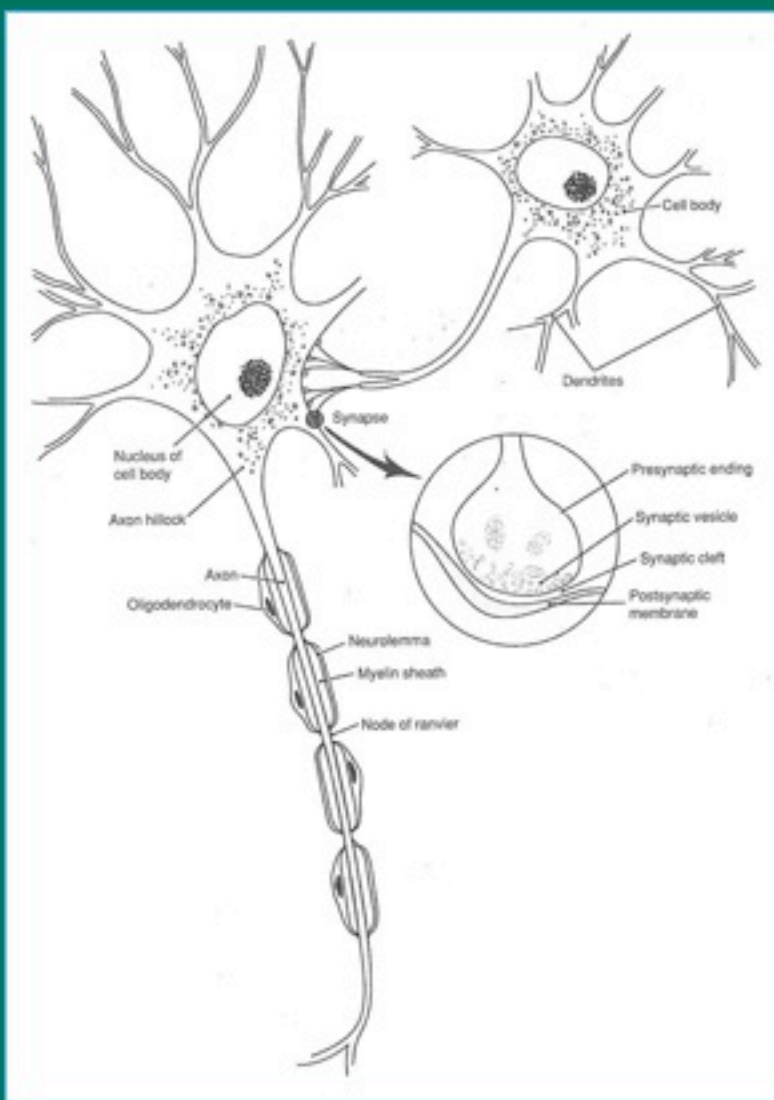
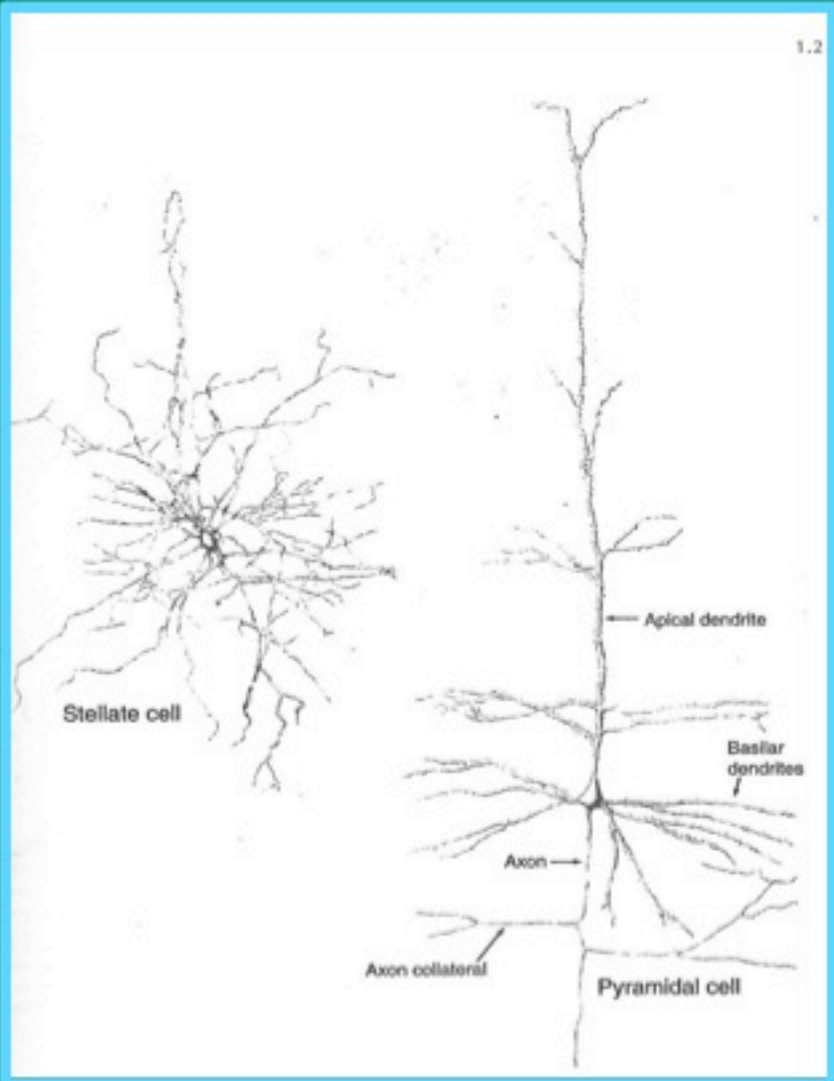


**A**

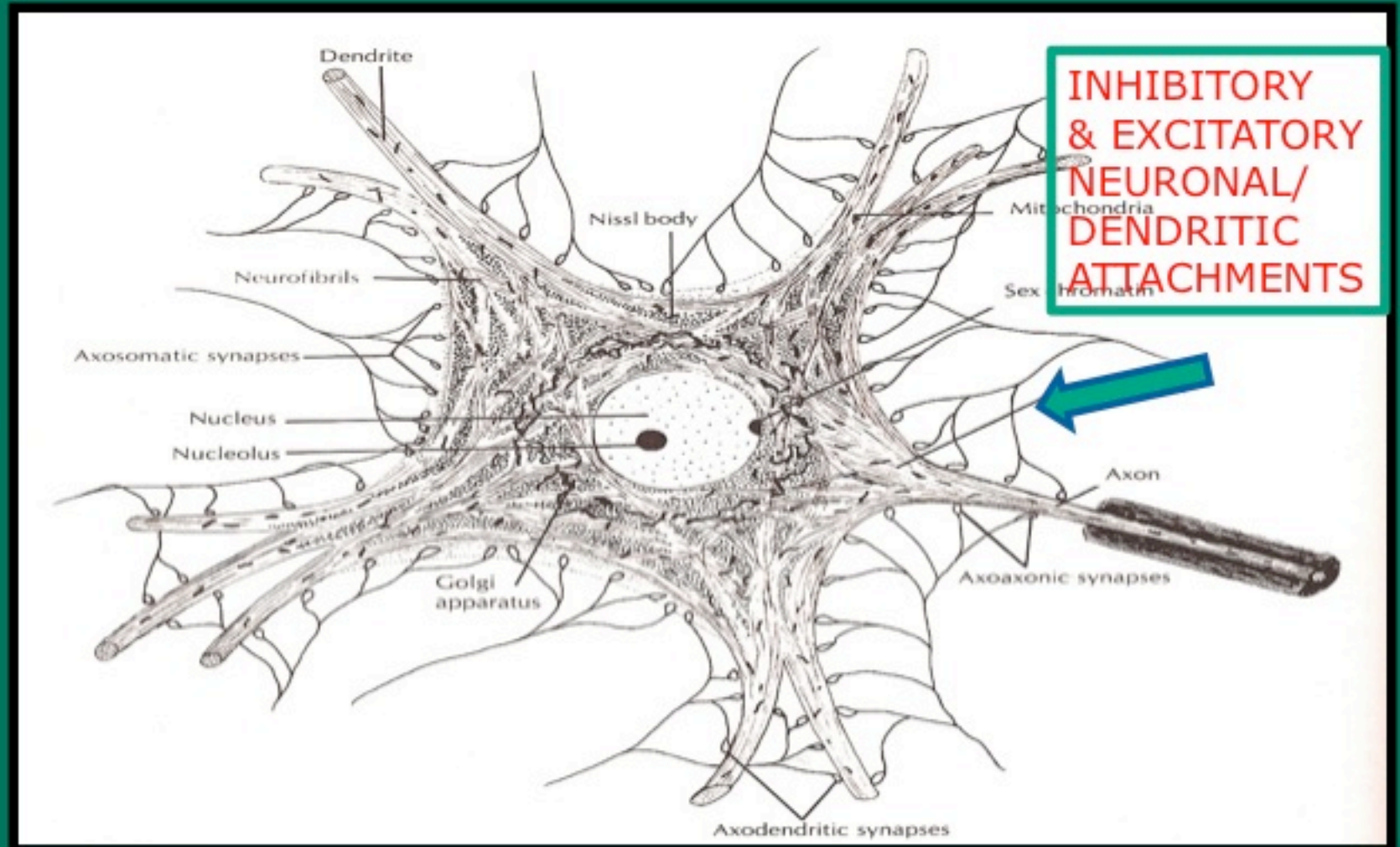


**B**

# The Neuron and its Synaptic Activity



# Types of Neurons

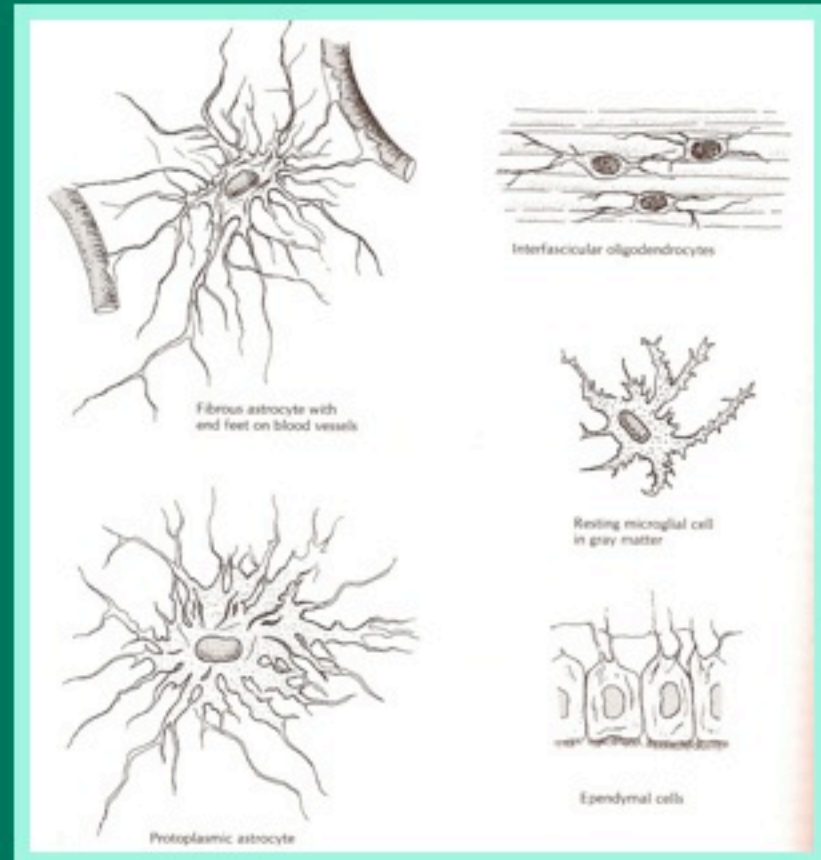


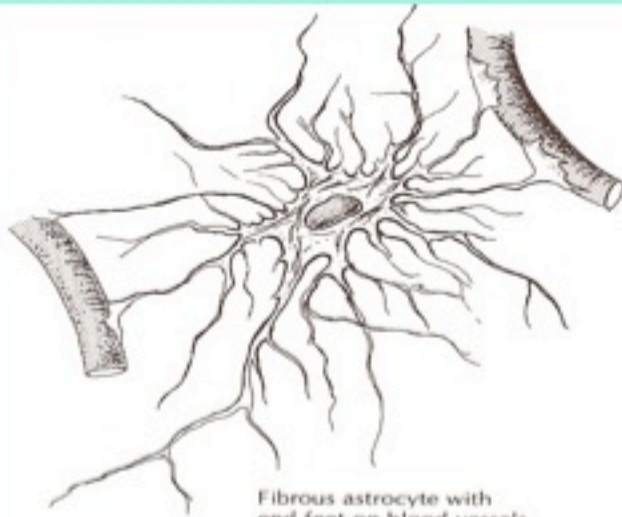
**Neuron with dendritic attachments**

# Glia (NEUROGLIA CELLS)

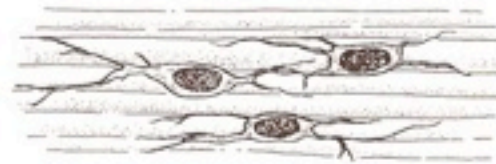
Functions:

1. support neurons
2. nourish neurons
3. guide pathways of neurons during development (by secreting trophic factors)





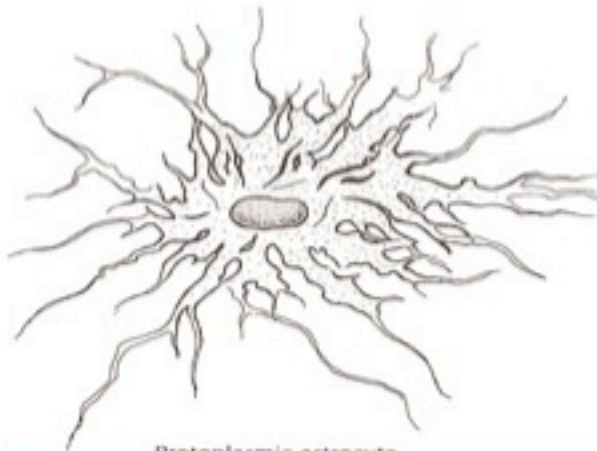
Fibrous astrocyte with  
end feet on blood vessels



Interfascicular oligodendrocytes



Resting microglial cell  
in gray matter



Protoplasmic astrocyte



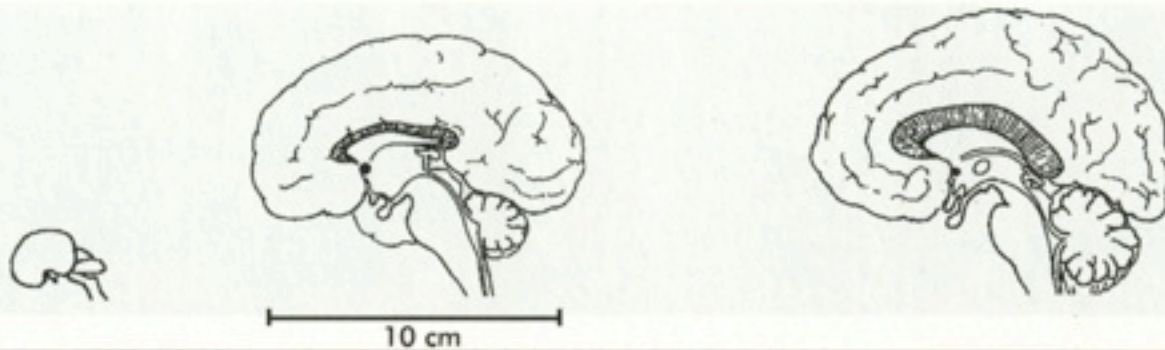
Ependymal cells

# Types of Glial Cells

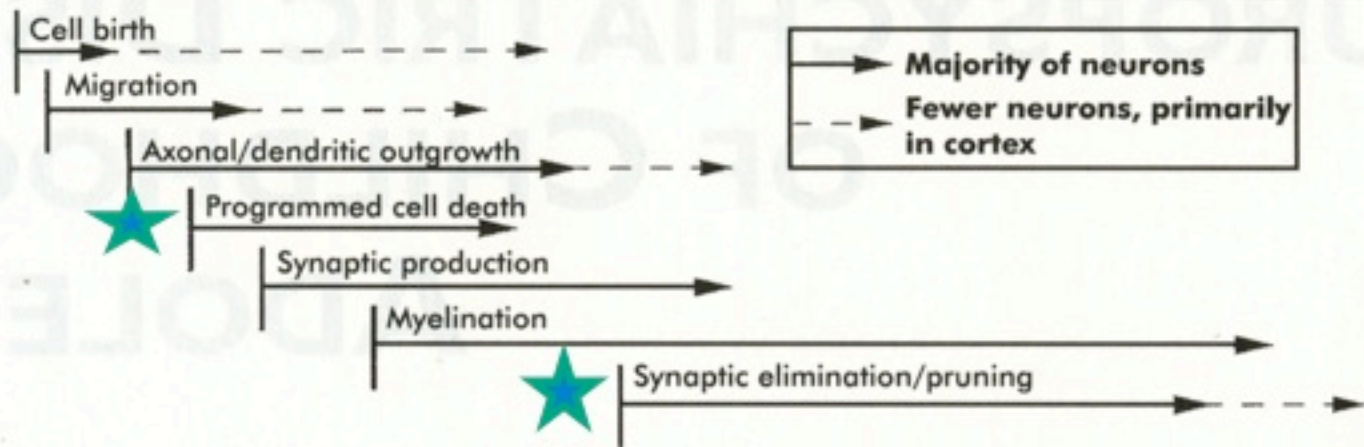
# NORMAL BRAIN DEVELOPMENT



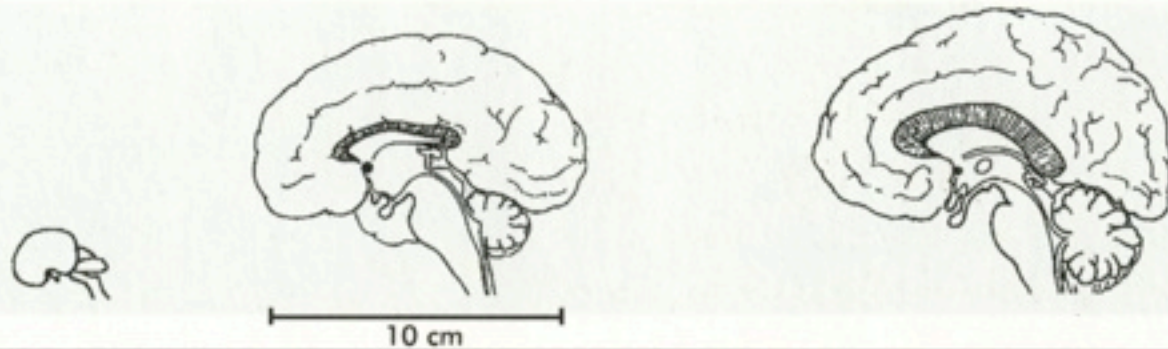
FETUS TO ADULT



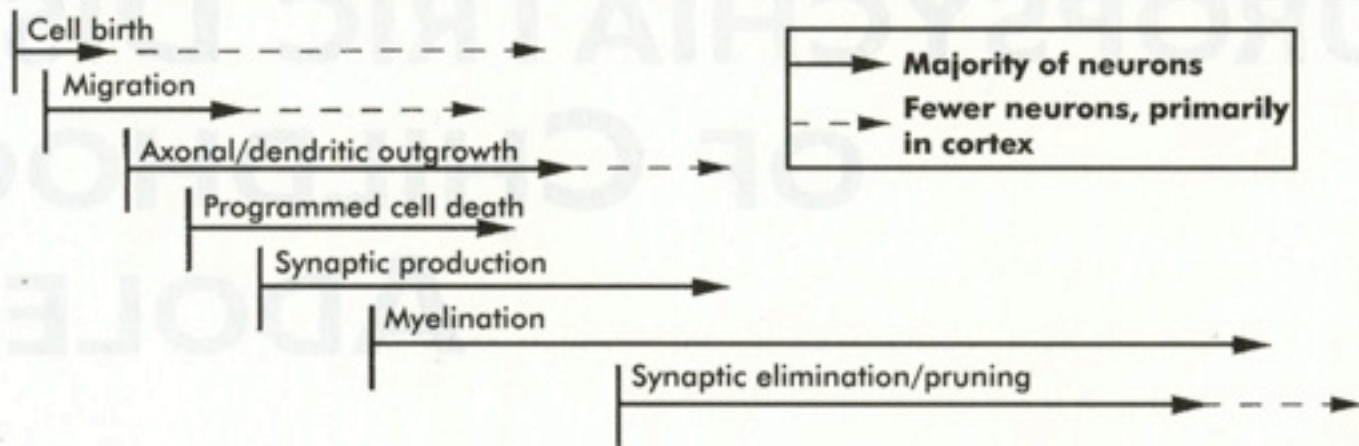
| Embryonic |   |    |    |    |    |    | Postnatal |   |    |    |    |    |    |         |   |    |    |    |    |
|-----------|---|----|----|----|----|----|-----------|---|----|----|----|----|----|---------|---|----|----|----|----|
| Week: 0   | 6 | 12 | 18 | 24 | 30 | 36 | Month: 0  | 6 | 12 | 18 | 24 | 30 | 36 | Year: 4 | 8 | 12 | 16 | 20 | 24 |



# BRAIN DEVELOPMENT



| Embryonic |   |    |    |    |    |    | Postnatal |   |    |    |    |    |    |         |   |    |    |    |    |
|-----------|---|----|----|----|----|----|-----------|---|----|----|----|----|----|---------|---|----|----|----|----|
| Week: 0   | 6 | 12 | 18 | 24 | 30 | 36 | Month: 0  | 6 | 12 | 18 | 24 | 30 | 36 | Year: 4 | 8 | 12 | 16 | 20 | 24 |



# Apoptosis (cell death or pruning)

# STAGES OF BRAIN DEVELOPMENT

- 1<sup>ST</sup> STAGE    MITOSIS
- 2<sup>ND</sup> STAGE    MIGRATION OF NEURONS TO FINAL DESTINATION
- 3<sup>RD</sup> STAGE    NEURON OUTGROWTH
- 4<sup>TH</sup> STAGE    **PROGRAM CELL DEATH**
- 5<sup>TH</sup> STAGE    SYNAPTIC PRODUCTION
- 6<sup>TH</sup> STAGE    MYELINATION
- 7<sup>TH</sup> STAGE    **SYNAPTIC ELIMINATION / PRUNING**

**Concept of APOPTOSIS  
during brain development:**

**apoptosis definition: genetic  
guided cell death applying to  
neurons and synapses.**

**“Pruning or trimming” are  
synonyms.**

**Overly extensive or insufficient pruning (apoptosis) of synaptic density has been associated with:**

**→ autism**

**→ mental retardation**

**→ a key role in emergence of schizophrenia**

ENVIRONMENT

LIFE EXPERIENCE

FINAL FORM AND FUNCTION OF THE BRAIN

BILLIONS OF NEURONS & TRILLIONS OF SYNAPSES

GENOME = 20,000 PROTEIN-CODING GENES

VULNERABLE TO NUMEROUS ERRORS

BILLIONS OF NEURONS & TRILLIONS OF SYNAPTIC INTERCONNECTIONS

EMERGENCE OF CHILDHOOD AND ADOLESCENT NEUROPSYCHIATRIC DISORDERS