Neuroanatomy of Dementia

Lab 8

March 24, 2026 - Dr. Stiver (mikaela.stiver@ubc.ca)

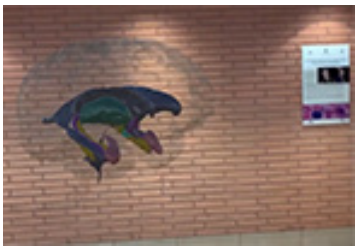
Objectives:

1. Describe the neuroanatomy of attention, memory, and cognitive intellectual capacities using gross specimens.
2. Outline brain neuroanatomical areas implicated in cognitive disorders.
3. Describe different pathologies associated with various cognitive disorders (ie. Alzheimer's dementia, Frontotemporal dementia, Lewy Body dementia).
4. Describe the histopathological and molecular pathological changes that characterize the common causes of dementia.
5. Describe the appropriate use of imaging in the diagnostic work up of patients with new onset cognitive decline including the strengths and limitations of CT, MRI and PET/CT.
6. Recognize the imaging findings of the various types of dementia presented in lab.

Web Syllabus & Links

Hypothalamus & Limbic System (Video)

Limbic Structures in 3D (Video)



Limbic System (Module)

Limbic System (3D)

Half Brain (3D)

Whole Brain (3D)

Limbic System Model (3D)

** NOTE: Interactive PDFs are best viewed on desktop/laptop computers - functionality is not reliable on mobile devices **

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Limbic System

Micrographs (Web)

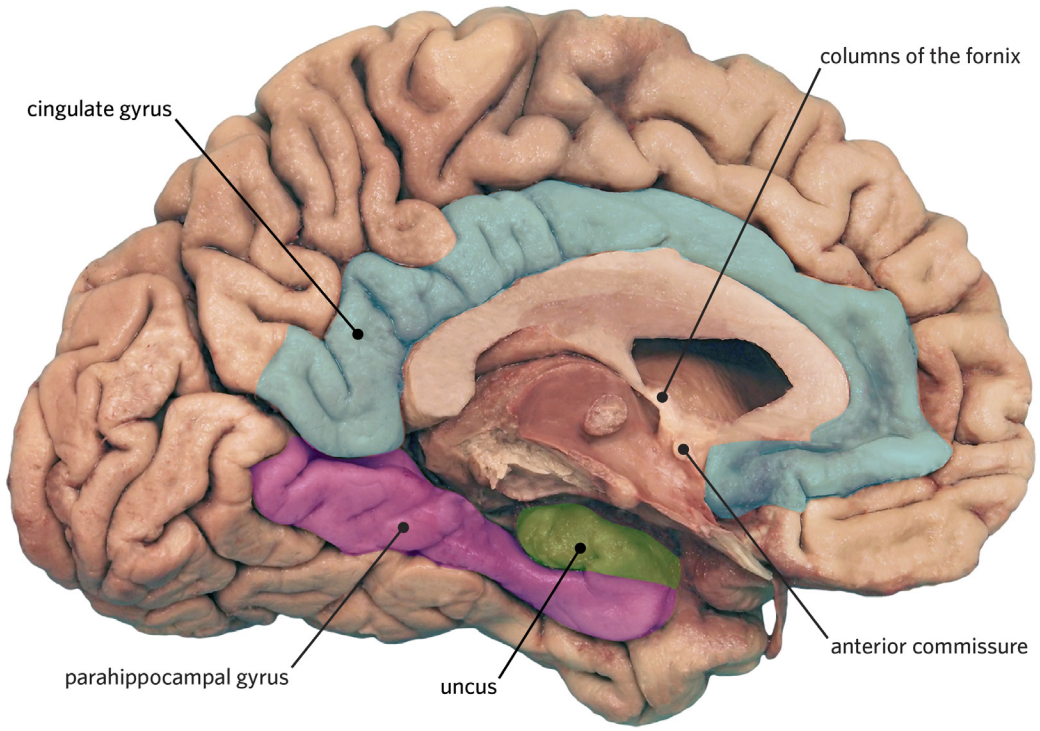
Identify on gross specimens and/or micrographs:

- ◯ Limbic lobe/cortex
  - ◯ Cingulate gyrus
  - ◯ Parahippocampal gyrus
  - ◯ Uncus
- ◯ Fornix
  - ◯ Columns of the fornix
- ◯ Anterior commissure
- ◯ Amygdala
- ◯ Hippocampus
- ◯ Mammillothalamic tracts
- ◯ Mammillary bodies
- ◯ Anterior nucleus of thalamus
- ◯ Locus coeruleus (noradrenergic neurons)
- ◯ Raphe nuclei (serotonergic neurons)
- ◯ Ventral tegmental area (dopaminergic neurons)

Identify on coronal brain sections:

Coronal Sections (Web)

- ◯ Amygdala
- ◯ Hippocampus
- ◯ Fornix
- ◯ Mammillothalamic tracts
- ◯ Mammillary bodies
- ◯ Anterior nucleus of thalamus
- ◯ Anterior nucleus of hypothalamus (general location)



Medial Cortex

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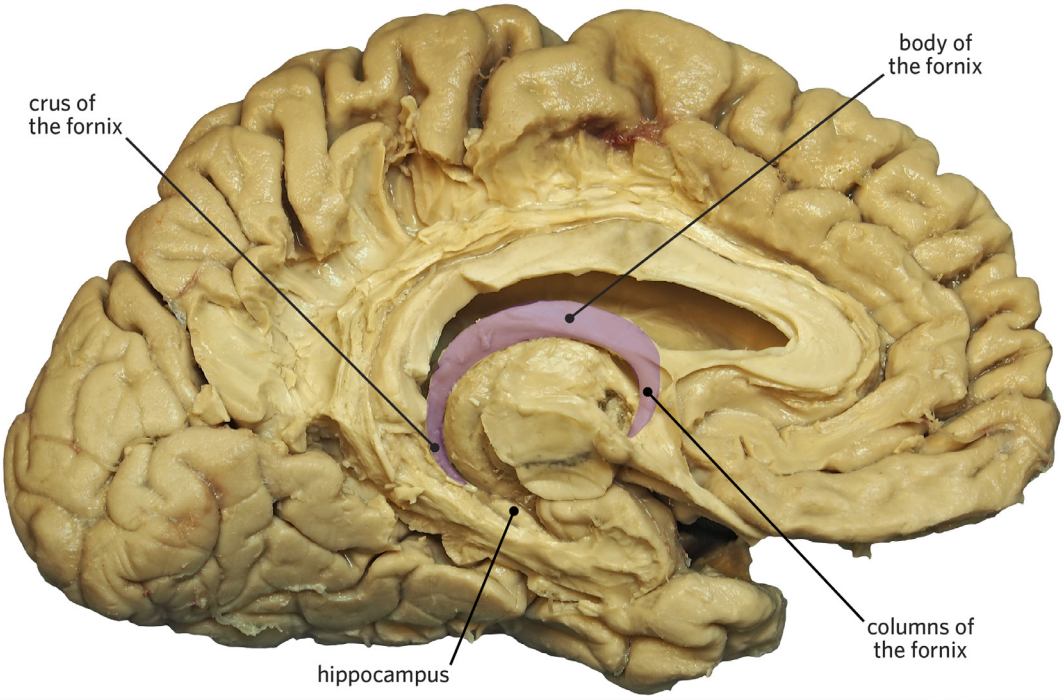

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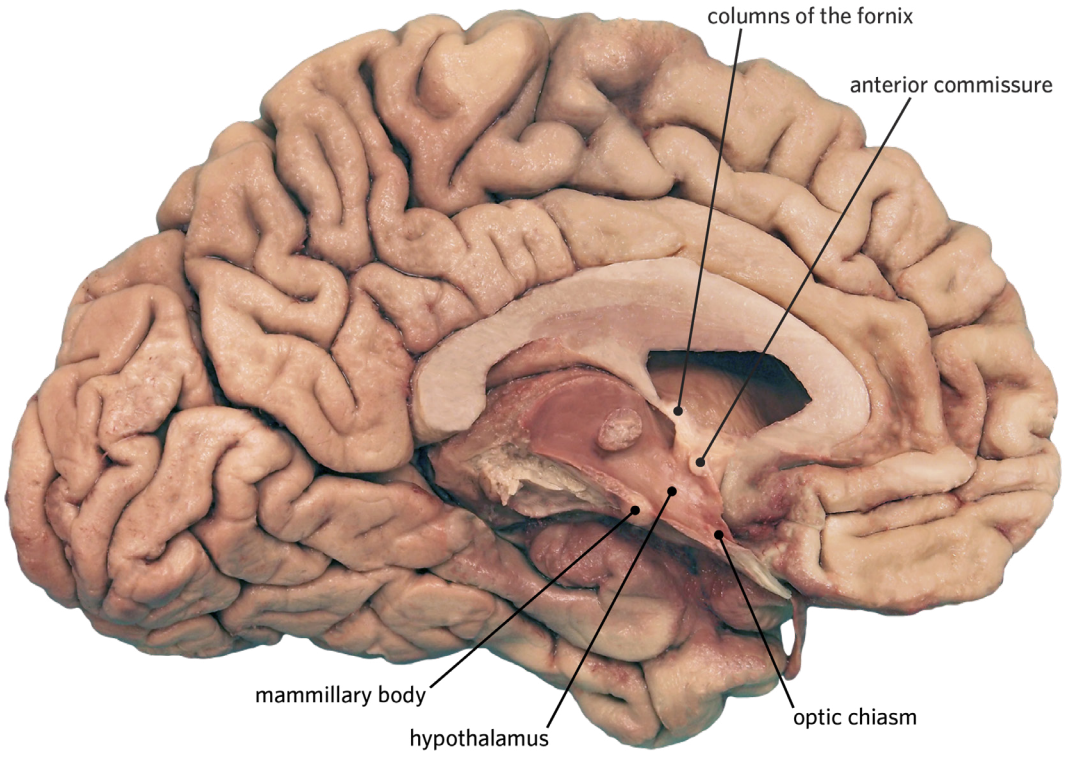
Fornix in Medial View



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Mammillary Body in Medial View

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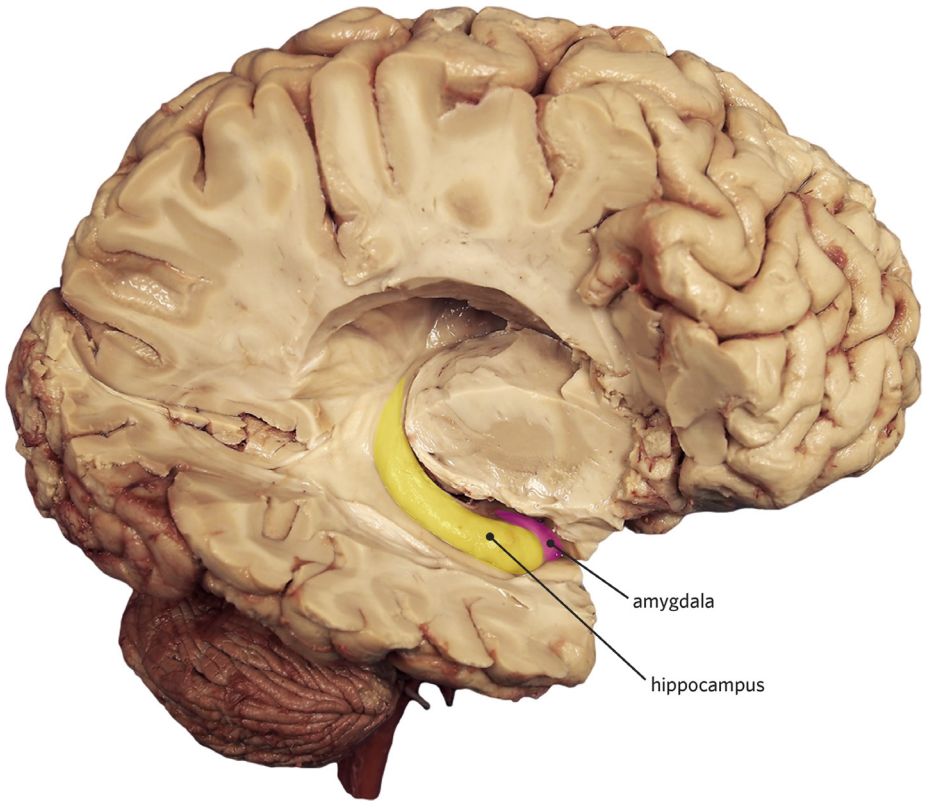
Amygdala and Emotion

- The amygdala **associates experiences with consequences** and then programs the appropriate behavioral response to those experiences. Specifically, the amygdala plays a role in **emotional learning** and **emotional processing**, with a particular emphasis on the expression of fear and anger.
- Input to the amygdala comes mainly from the **cerebral cortex**.
- After assessing the nature of the input (e.g., friendly, unfriendly, frightening, dangerous), the amygdala sends signals to centers in the **hypothalamus** that elicit the appropriate autonomic and motor responses. Signals are also sent from the basolateral amygdala via the **dorsomedial nucleus of the thalamus** to the **orbitofrontal cortex**.
  - The orbitofrontal cortex is involved in the perception of emotions, whereas the hypothalamus facilitates the expression of emotions.

Hippocampus and Memory

Important role in learning & formation of new memories:

- Hippocampus acts as "encoding area" for translating short-term memories into long-term memories, and is particularly important for declarative memory.
- Often described as the initial storage site for memory. As the process of consolidation occurs, more permanent memories are encoded more diffusely in the cerebral cortex (and connections between the hippocampus and cortex).
- Overlying cortex (e.g., uncus, entorhinal cortex) also plays an important role in memory.
- Bilateral removal of hippocampi typically impairs the ability to form new memories, especially related to facts and events. Deficits are usually less severe if the overlying cortex is not damaged.
- The hippocampus and amygdala are linked to two independent memory systems. They act in concert when '**emotion** meets **memory**'.



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Amygdala and Hippocampus

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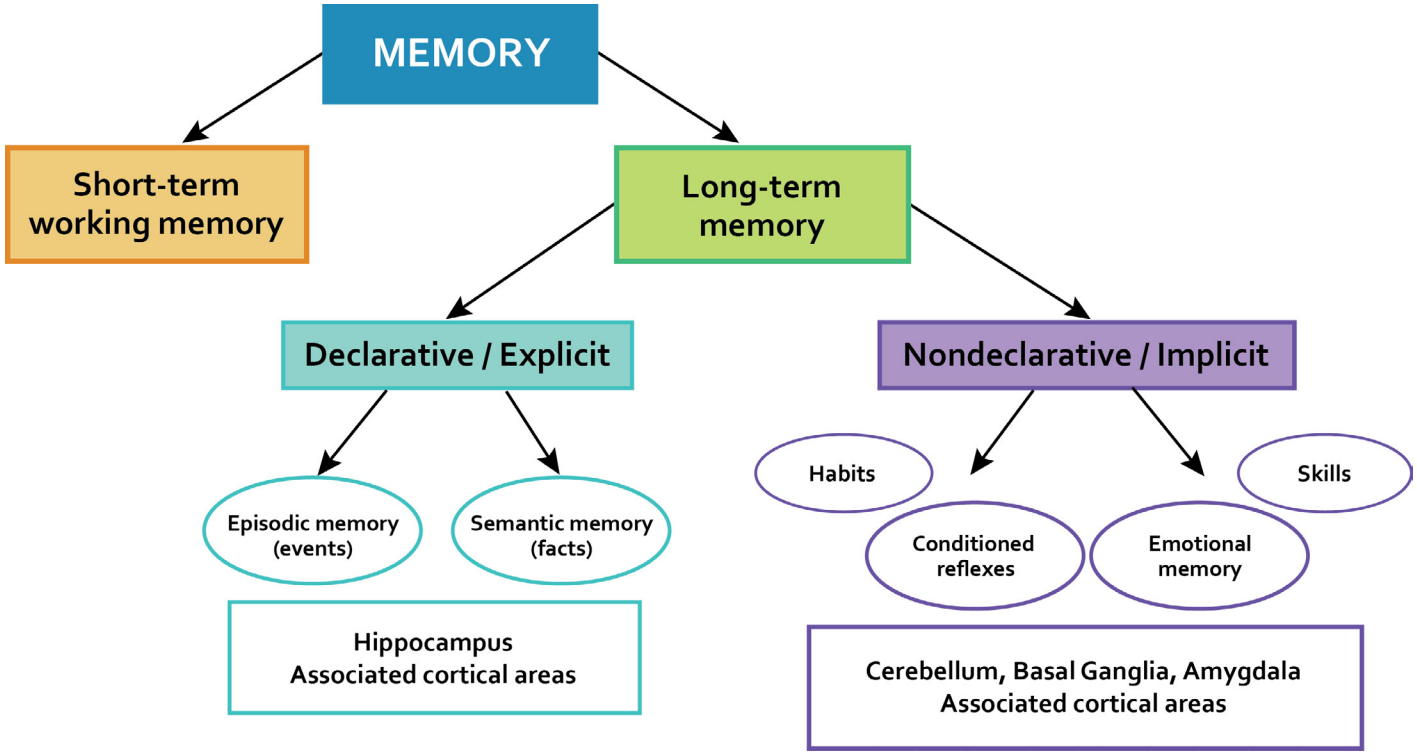
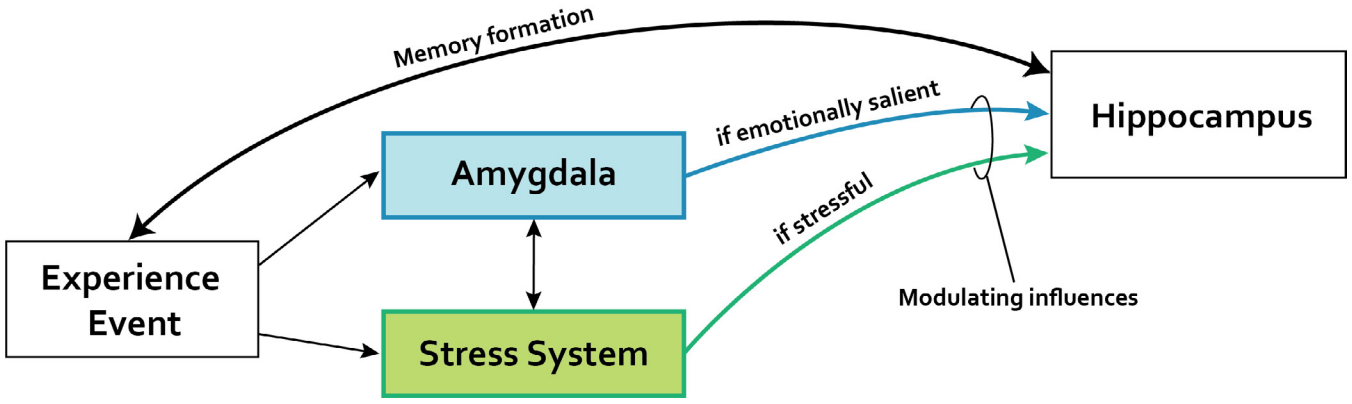
Types of Memory and Their Neural Correlates



Modified from Lippincott's Illustrated Reviews: Neuroscience by C. Krebs, J. Weinberg, E.J. Akesson, and E. Dilli.

The Role of the Amygdala in Memory



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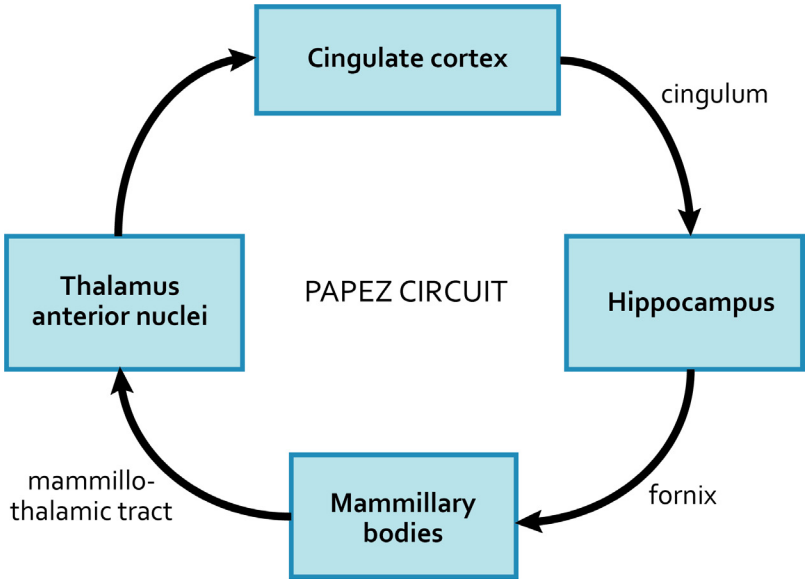
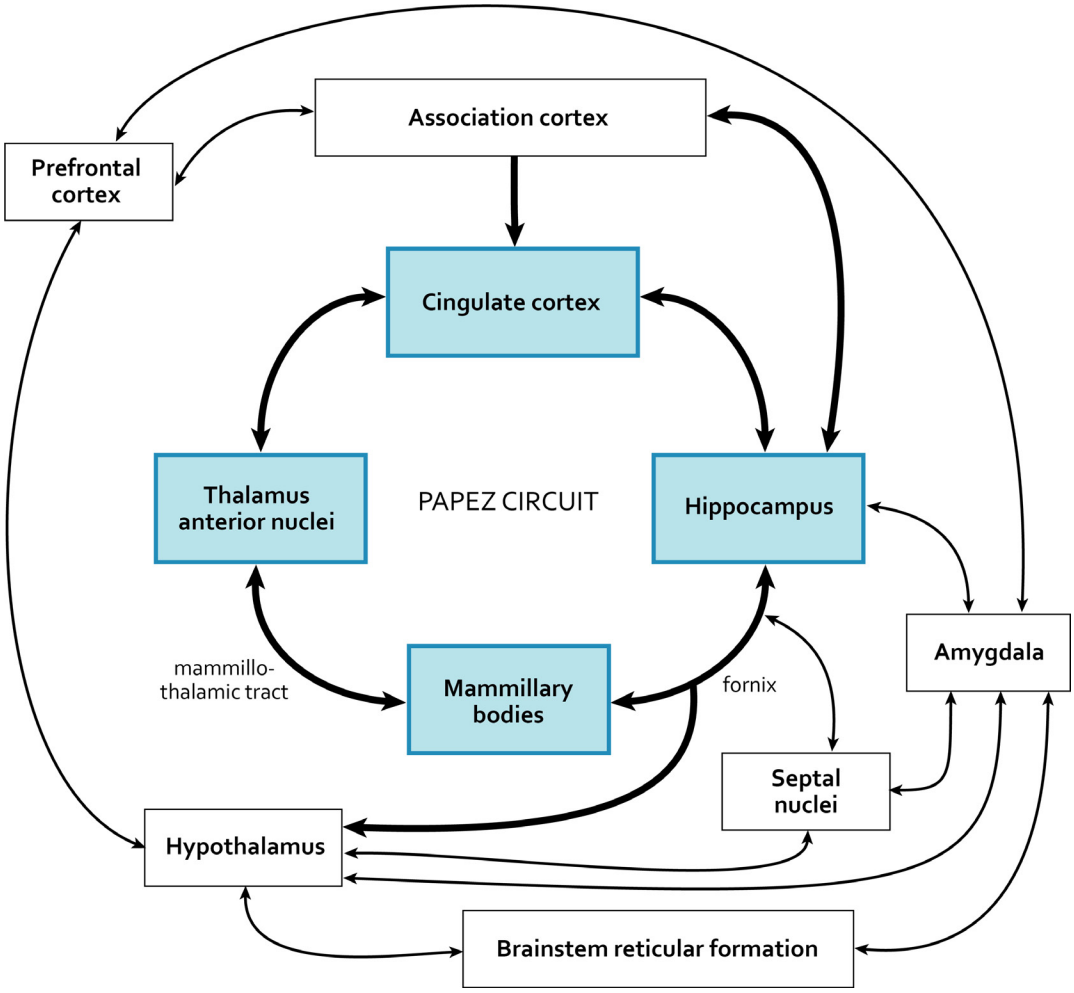
Classic Papez Circuit



Extended Papez Circuit



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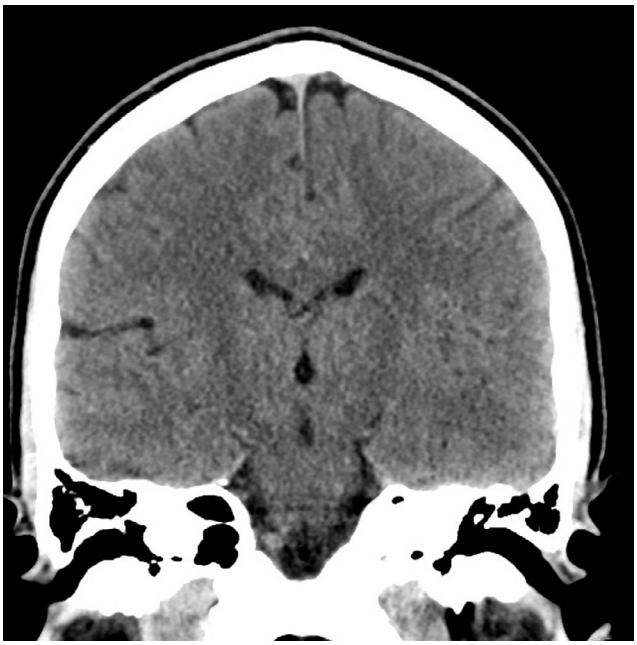
Neuroimaging

Normals For Reference

CT Scans



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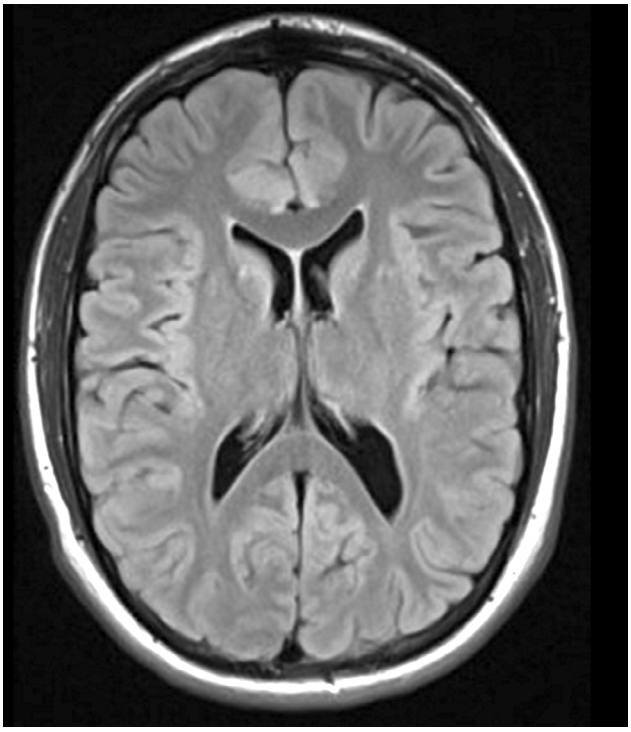
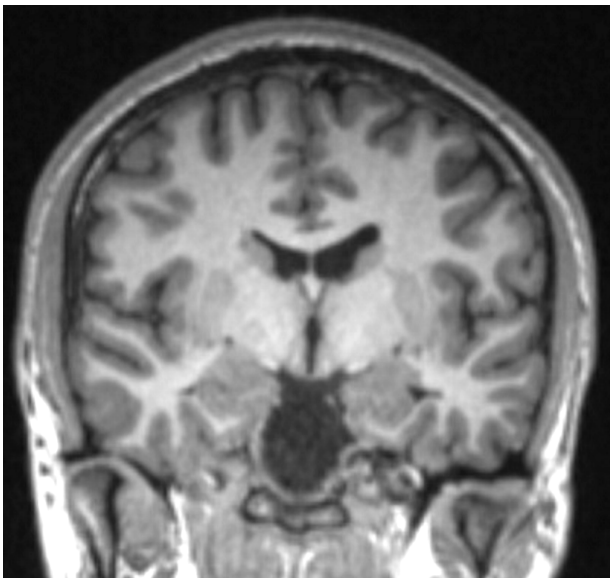
Neuroimaging

Normals For Reference

MRIs





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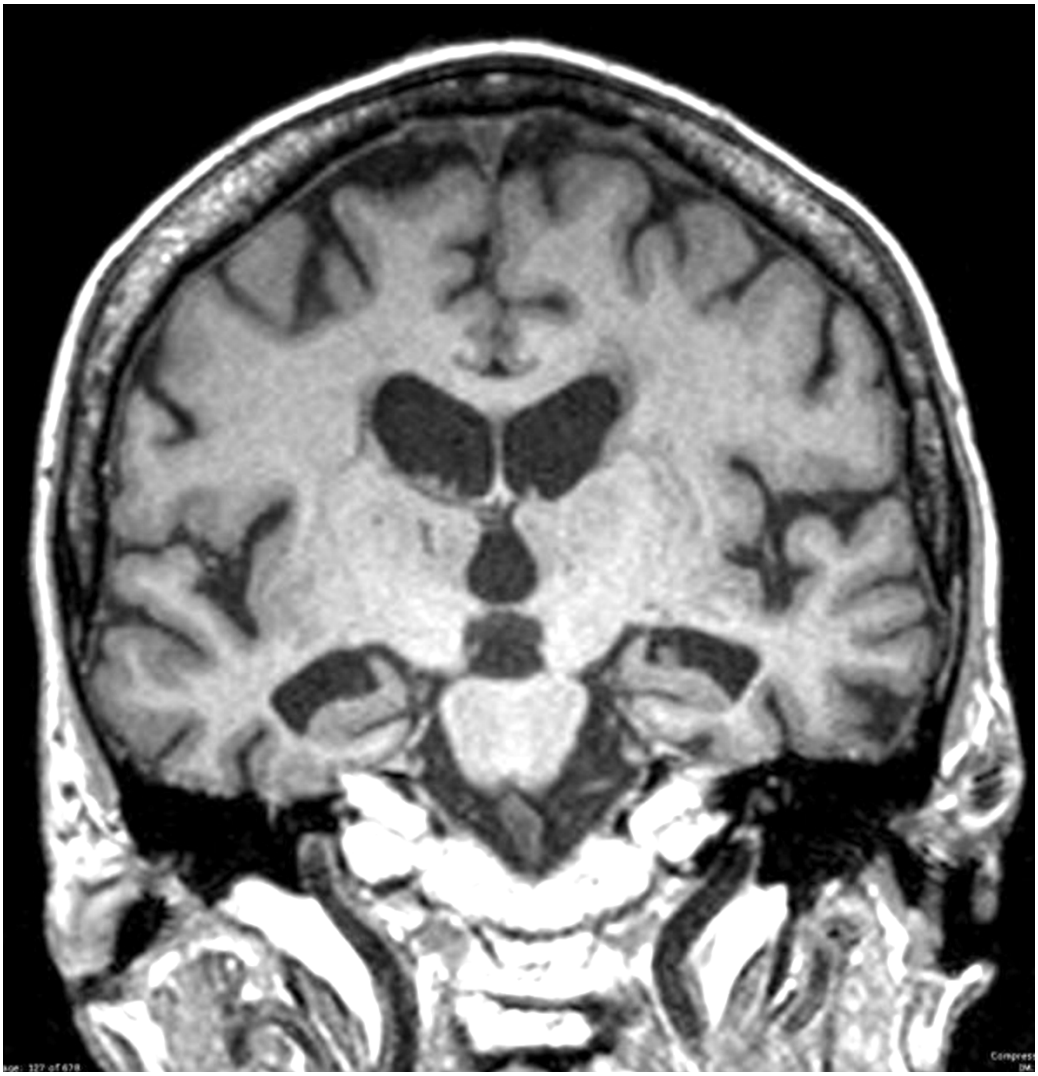
Case 1

This 76-year-old man had become increasingly forgetful and confused over the past five years. He locked himself out of the house on several occasions and could not find his way home. He became unable to care for himself and had to be institutionalized. He died of pneumonia. At autopsy, the brain weighed 1080 gms.



1. *What is the most likely diagnosis?*

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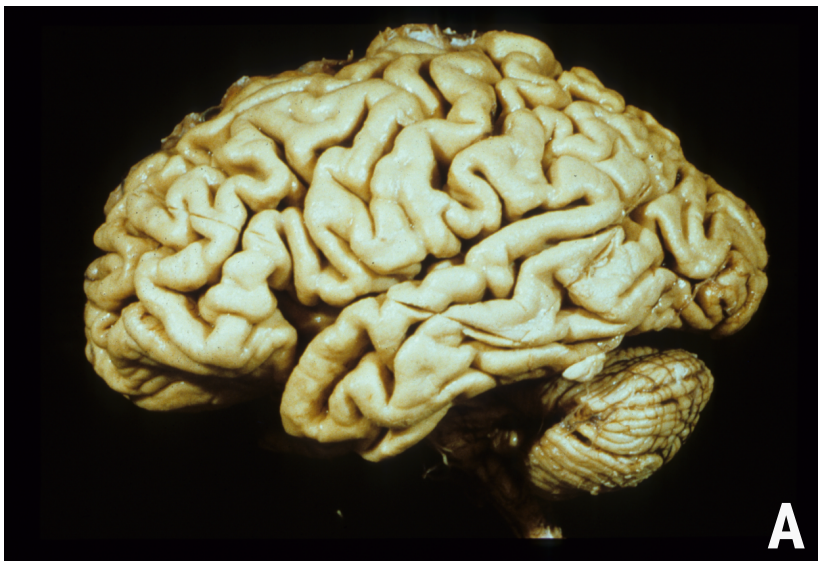
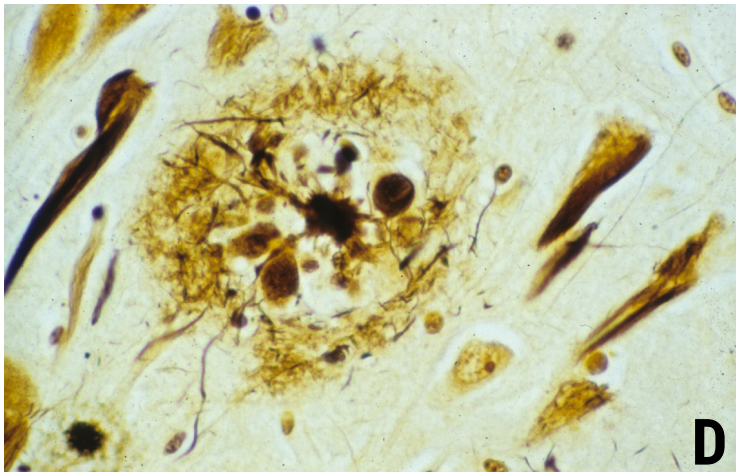
Case 1 (cont'd)





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Case 1 (cont'd)

2. *What gross abnormalities are seen in Figures A and B?*
   (Figure A = lateral view of fixed brain, Figure B = coronal section through the frontal lobes)

3. *What microscopic abnormalities are illustrated in Figures C and D?*
   (Figure C = hippocampus, low power, Figure D = high power. Bielschowsky silver stain)

4. *What inherited factor might predispose to this condition?*

5. *When do patients usually present with this disease?*

6. *What cerebral lobes are atrophied? How might this explain the clinical presentation?*

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Case 2

This 66-year-old woman presented with antisocial behaviour and changes in her personality that became so severe she had to be institutionalized. She subsequently developed a progressive language disorder, eventually resulting in mutism. Her memory remained intact until the late stages of her disease.

1. *What is the general term for this neurologic syndrome?*

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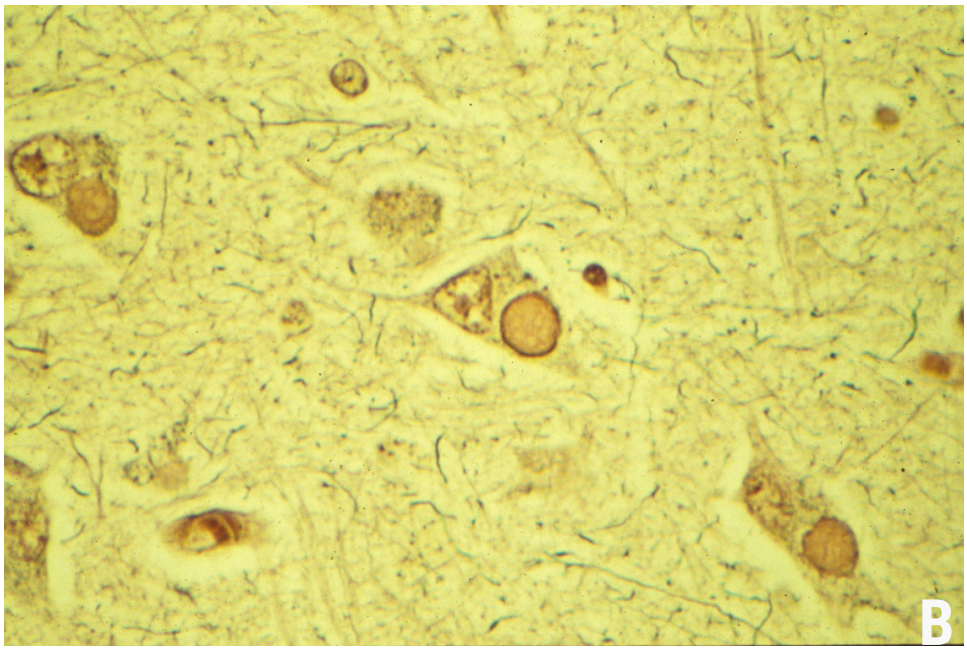
Case 2 (cont'd)



2. *What is the corresponding gross pathologic change illustrated in Figure A?*

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Case 2 (cont'd)

3. *What specific diagnosis is characterized by the microscopic changes shown in Figure B?*
   (Figure B = Bodian silver stain)

4. *What cerebral lobes are atrophied? How might this explain the clinical presentation?*

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Case 3

This 77-year-old woman with a history of diabetes mellitus and hypertension died of myocardial infarction. She had suffered repeated neurologic events resulting in a visual field defect, focal weakness, and memory impairment.

1. *What gross abnormalities are seen in this post-mortem brain specimen?*

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Case 3 (cont'd)

2. *How might this process result in dementia?*

3. *With what other type of pathology may this process combine to produce dementia?*

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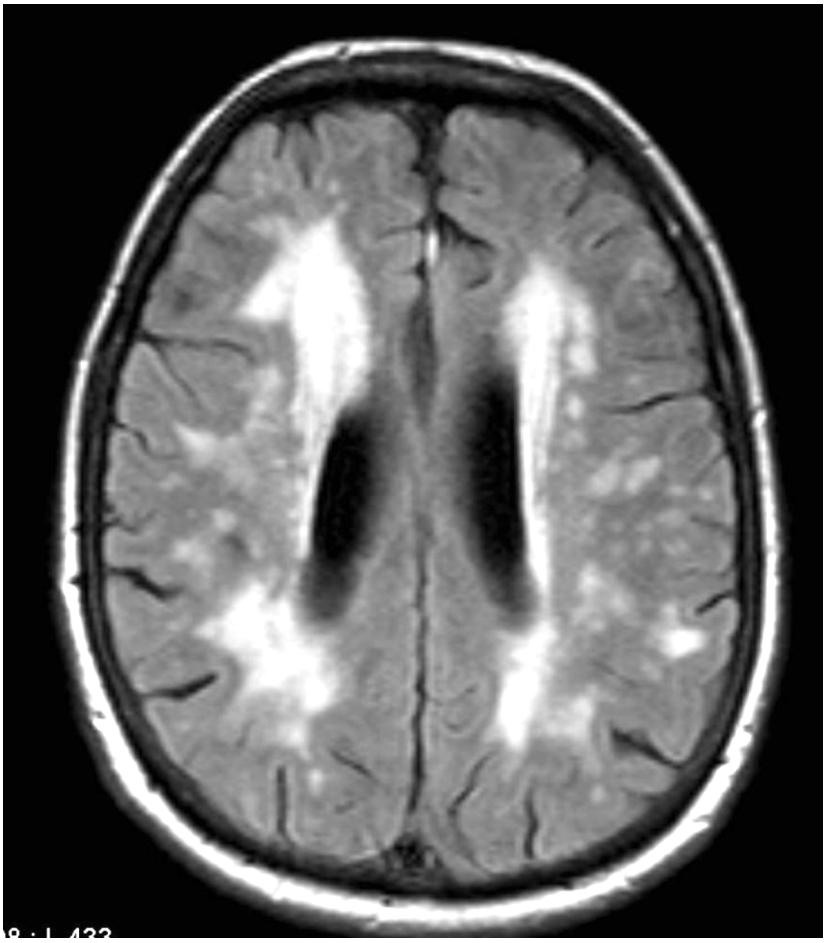
Case 4

A 65-year-old male presents with stepwise, progressive cognitive decline with slow cognitive processing, executive dysfunction, and slow gait. He has a history of hypertension.



1. *What is the definition of mild cognitive impairment?*

2. *Which patients with mild cognitive impairment receive imaging?*

3. *What is the recommended management for this patient?*

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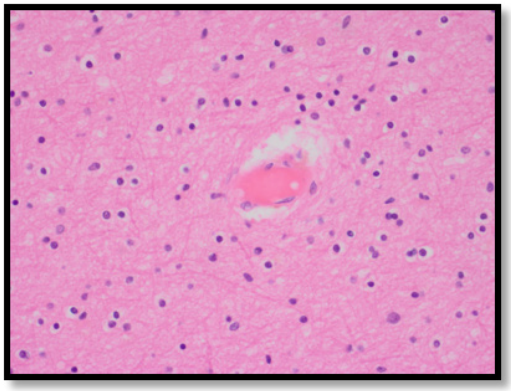
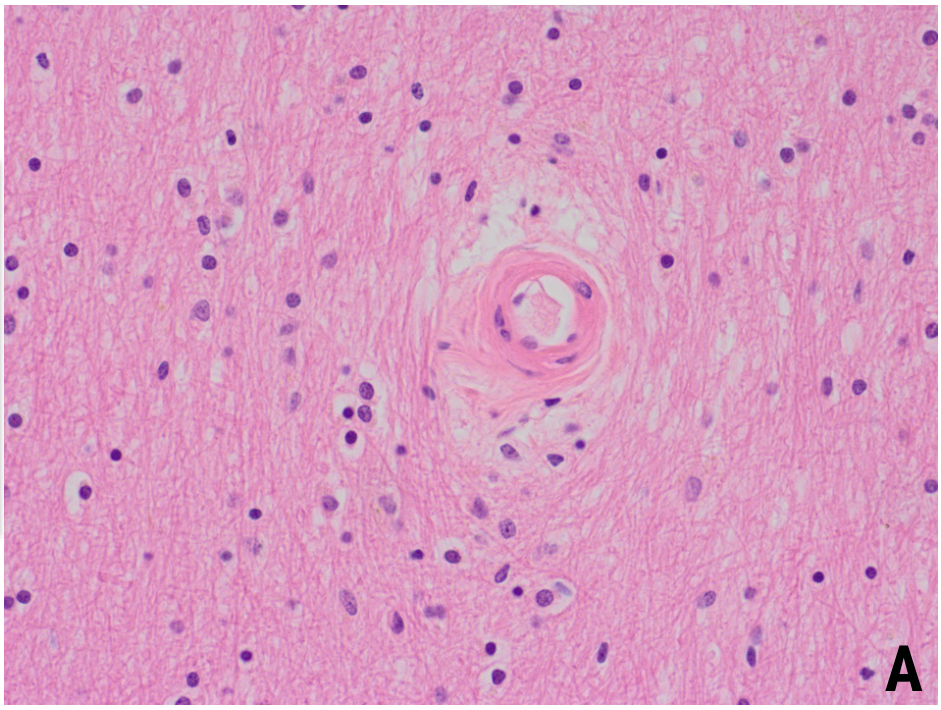
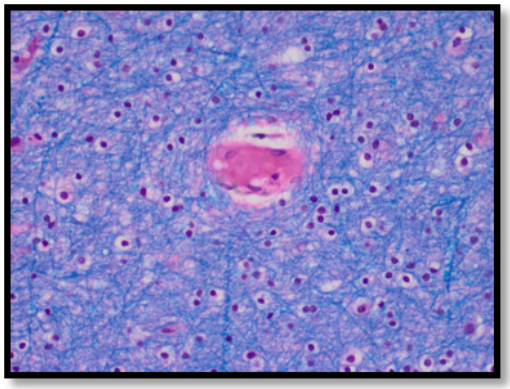
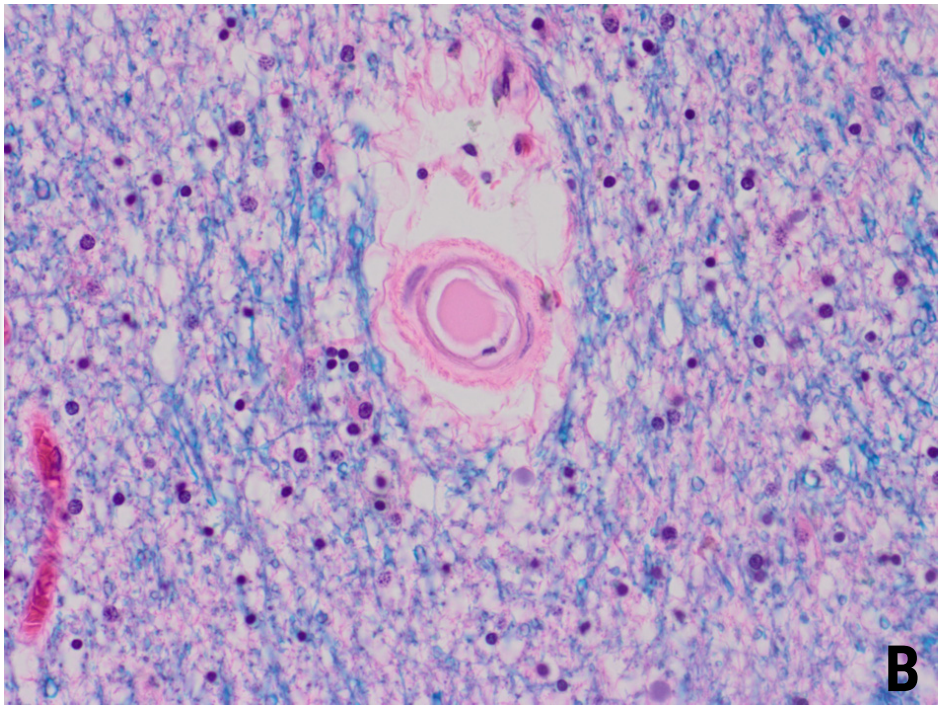
Case 4 (cont'd)









4. What abnormalities are depicted in Figures A (H&E) and B (Luxol Fast Blue)? ('normal' histological findings shown on left)