"Mr. Osborne, may I be excused? My brain is full."

14-1

1

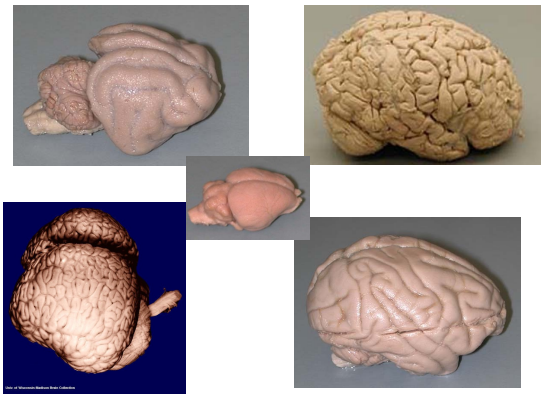
CNS – The Brain

- Structure
- Embryonic development
- Meninges, ventricles, cerebrospinal fluid, blood supply
- Hindbrain: medulla, pons, cerebellum
- Midbrain
- Forebrain: diencephalon, cerebrum
- Higher forebrain functions
- The cranial nerves

14-2

2

3



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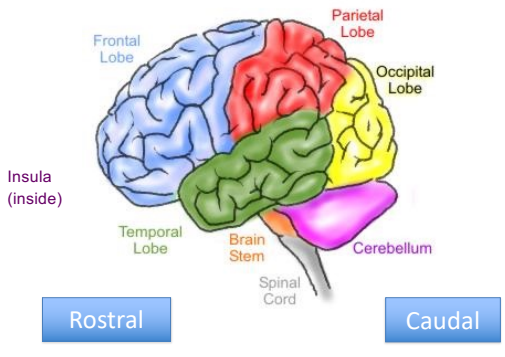

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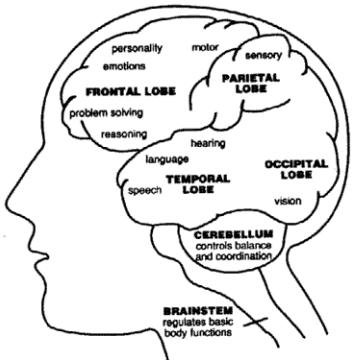
Where do things happen in the brain?



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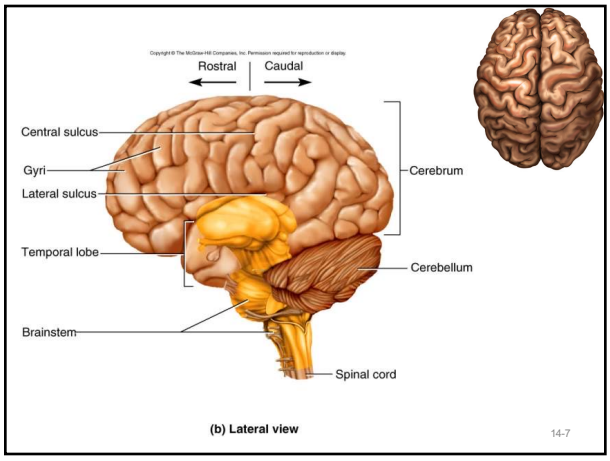

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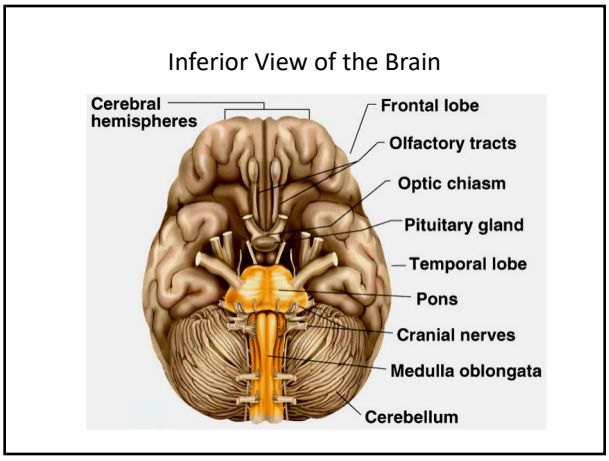

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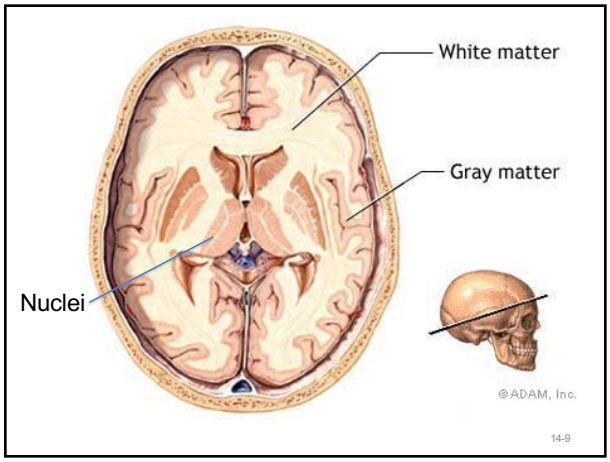

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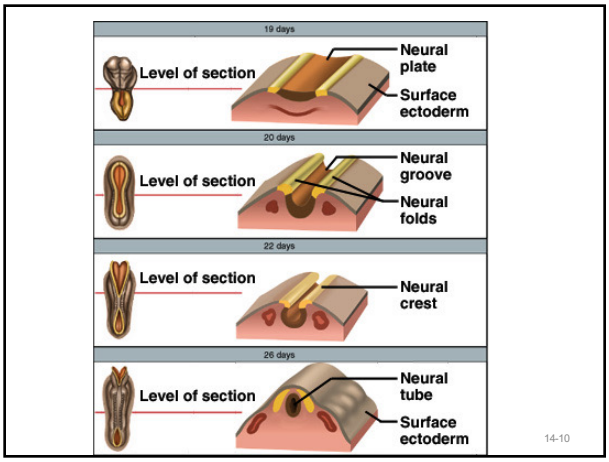

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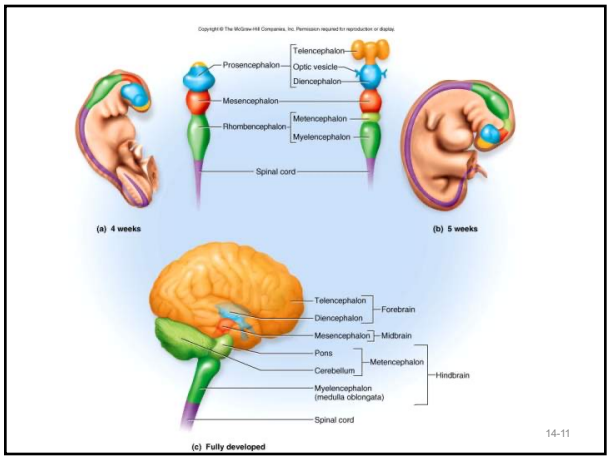

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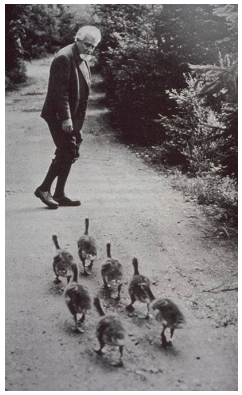


Brain development: are their critical periods?

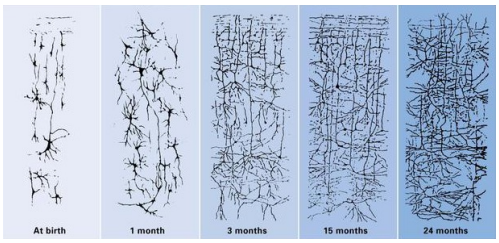
Ducklings raised by Konrad Lorenz imprinted on first moving object – him!

Imprinting must occur during sensitive period

14-12

12

Neuron connections in early development
Neurons that don't connect, die



14-13

13

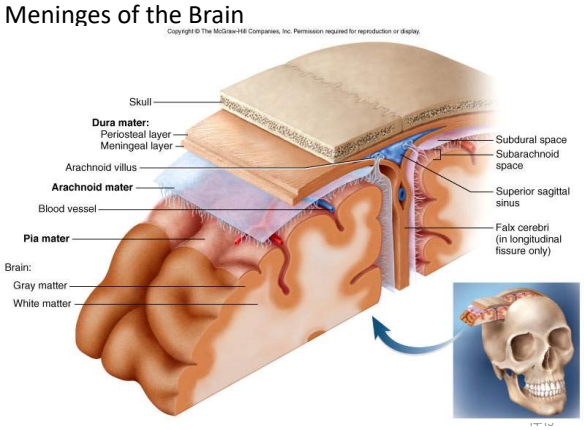
Environment & brain development

- Enriched environments lead to more synapses
- Our brain evolved under pressure of natural selection to have some abilities: basic vision, first language learning, categorization, number sense, time sense, deception, social relations
- Early childhood experiences important.
- Our brains didn't evolve to manifest: writing, algebra, astronomical understanding, breeding of animals, etc. We can always learn these.

14-14

14

Meninges of the Brain



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Meningitis

14-16

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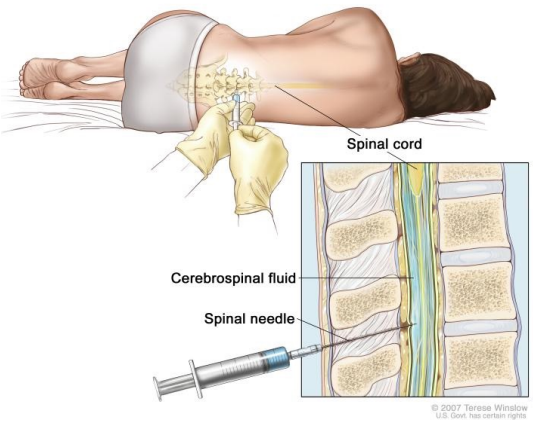

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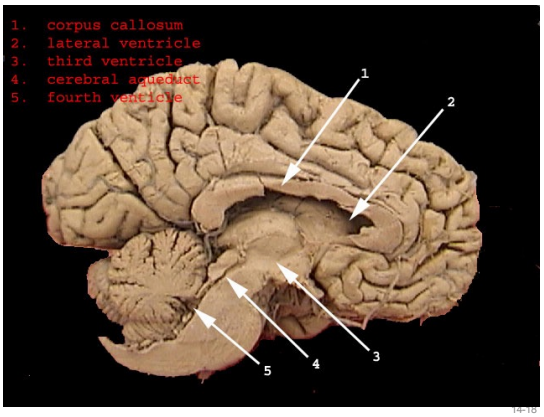

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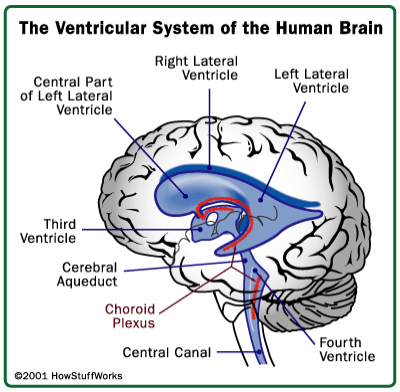

14-19

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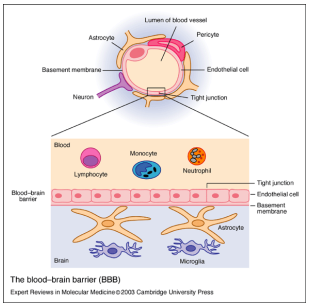
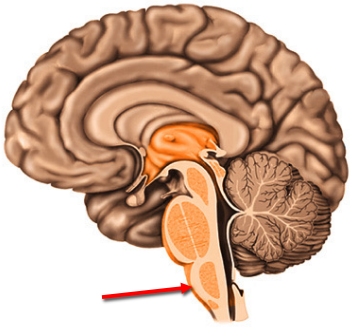
Blood-Brain and Blood-CSF Barriers



14-20

20

Hindbrain - Medulla Oblongata



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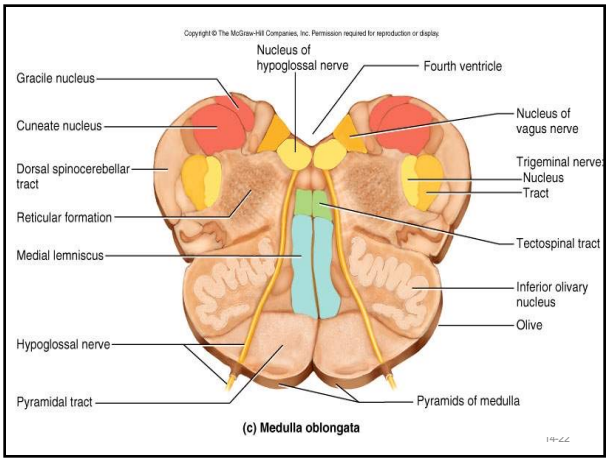
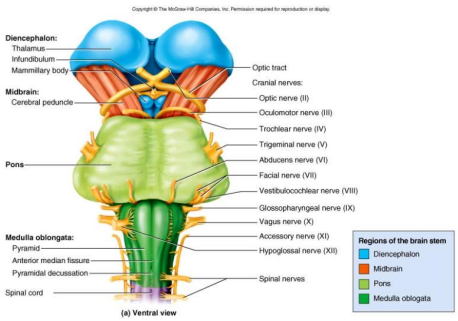


22

Medulla and Pons



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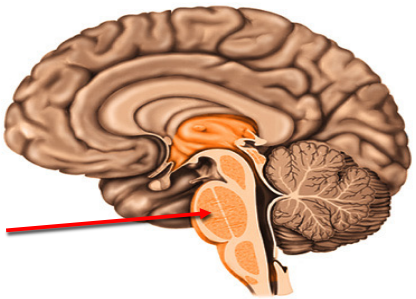
Pons



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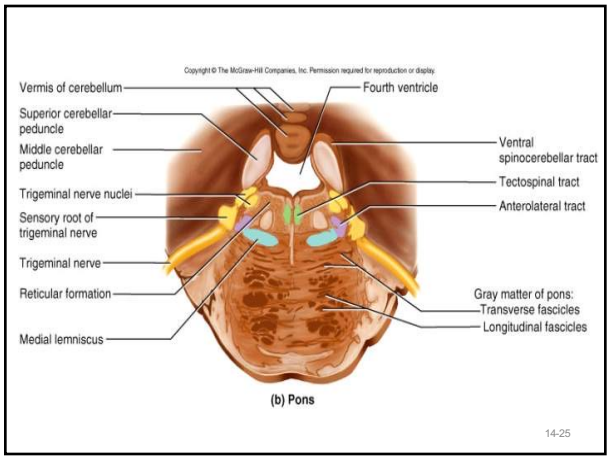

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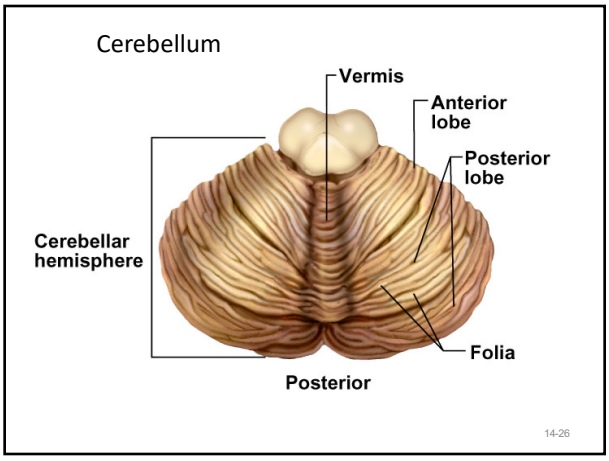

26

Cerebellar Functions

- Evaluation of sensory input
  - coordination and locomotor ability
  - spatial perception
- Timekeeping center
  - predicting movement of objects
- Distinguish pitch and similar sounding words
- Planning and scheduling tasks

14-27

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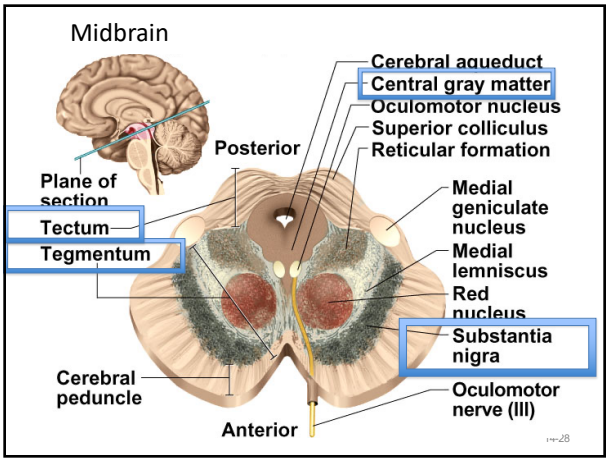

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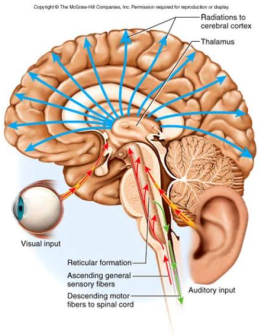
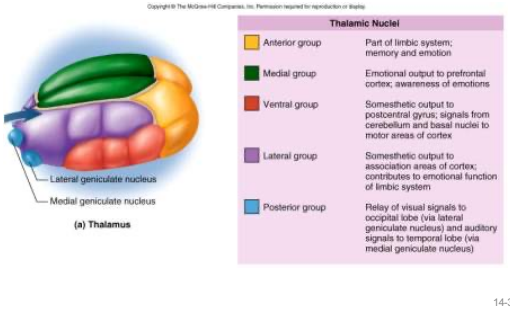
Reticular Formation



29

Diencephalon: Thalamus



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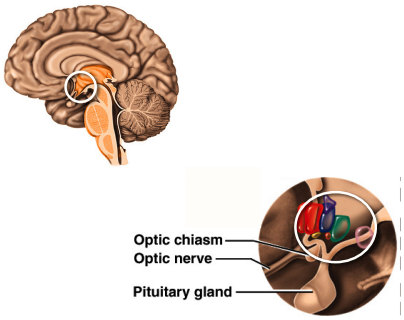
Diencephalon: Hypothalamus



14-31

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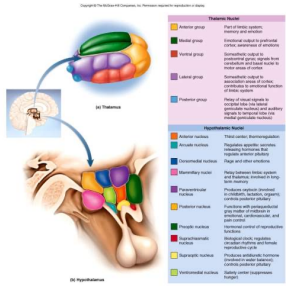
Diencephalon: Hypothalamus

- Mammillary bodies contain 3 to 4 nuclei that relay signals from limbic system to thalamus



14-32

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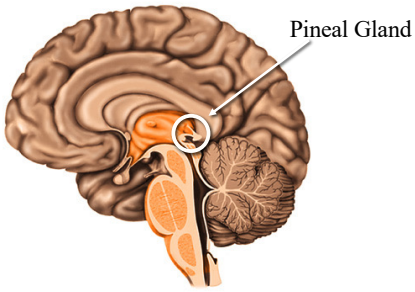
Diencephalon: Epithalamus



Epithalamus consists of pineal gland (endocrine) and the habenula (connects limbic system to midbrain)

14-33

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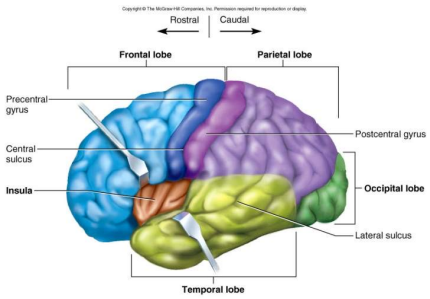
Cerebrum -- Gross Anatomy



- Cerebral cortex - 3mm layer of gray matter
  - extensive folds increase surface area - divided into lobes

14-34

34

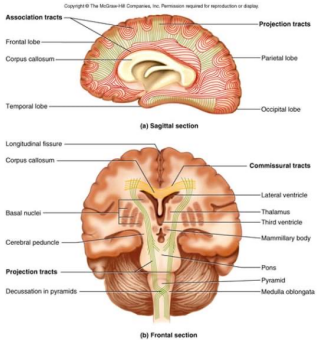
Functions of Cerebrum - Lobes

- Frontal
  - voluntary motor functions
  - planning, mood, smell and social judgement
- Parietal
  - receives and integrates sensory information
- Occipital
  - visual center of brain
- Temporal
  - areas for hearing, smell, learning, memory, emotional behavior

14-35

35

Tracts of Cerebral White Matter



14-36

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Tracts of Cerebral White Matter

- Most of cerebrum is white matter
- Types of tracts
  - projection tracts
    - from brain to spinal cord, forms internal capsule
  - commissural tracts
    - cross to opposite hemisphere
      - corpus callosum
      - anterior and posterior commissures
  - association tracts
    - connect lobes and gyri within a hemisphere

14-37

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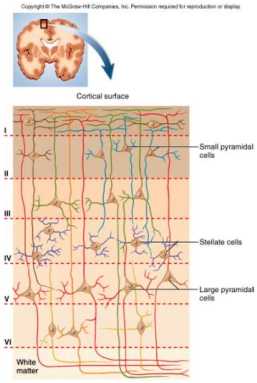
Cerebral Cortex



14-38

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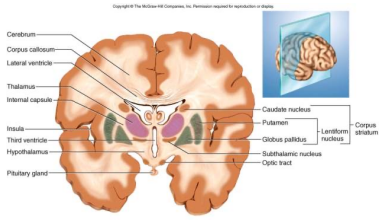
Basal Nuclei



- Masses of gray matter deep to cortex
  - corpus striatum (lentiform nucleus) = caudate nucleus, putamen, and globus pallidus
- Motor control
  - substantia nigra and motor cortex

14-39

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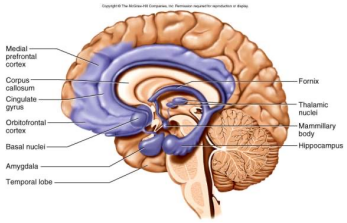
Limbic System



- Loop of cortical structures
  - amygdala, hippocampus and cingulate gyrus
- Role in emotion and memory
  - pleasure and aversion centers

14-40

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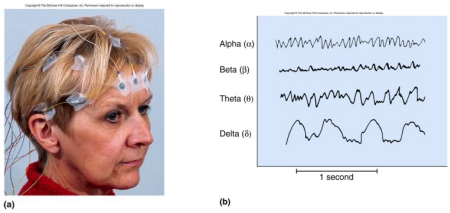
EEG and Brain Waves



- Electroencephalogram
  - records voltage changes from postsynaptic potentials in cerebral cortex
- Brain waves
  - 4 types distinguished by amplitude and frequency

14-41

41

Brain Waves

- alpha
  - occur when awake; resting with eyes closed
- beta
  - eyes open; performing mental tasks
- theta
  - sleep or emotional stress
- delta
  - deep sleep

14-42

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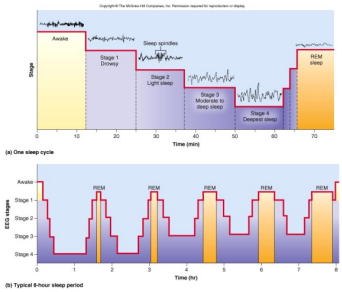
Sleep Stages



- Brain waves change during sleep phases and cycles

14-43

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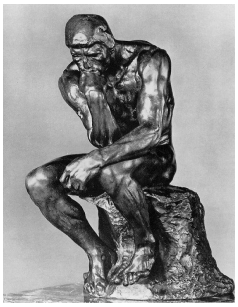
Cognition



14-44

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Accidental Lobotomy of Phineas Gage

- Accidental destruction of ventromedial region of both frontal lobes
- Personality change to an irreverent, profane and fitful person
- Neuroscientists believe planning, moral judgement, and emotional control are functions of the prefrontal cortex

14-45

45

Memory

- Information management
  - requires learning, memory and forgetting
- Amnesia
  - anterograde amnesia - no new memories
  - retrograde amnesia – can't remember old ones
- Hippocampus
  - organizes sensory and cognitive information into a new memory
- Cerebellum – helps learn motor skills
- Amygdala - emotional memory

14-46

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Emotion

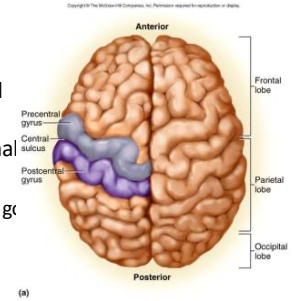
- Prefrontal cortex
  - controls expression of emotions (seat of judgement)
- Form in hypothalamus and amygdala
  - fear, anger, pleasure, love, etc.
- Behaviour
  - often learned by rewards and punishments or responses of others to them

14-47

47

Somesthetic Sensation

- Receptors in body
  - for touch, pressure, stretch, temperature, and pain
- Signals travel up gracile and cuneate fasciculi and spinothalamic tracts of spinal cord
  - ascending signals decussate, g to thalamus, to cortex
- Somatosensory area in postcentral gyrus



14-48

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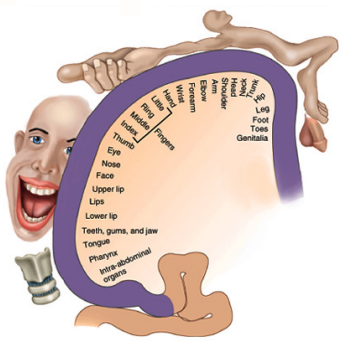
Sensory Homunculus

- Demonstrates that the area of the cortex dedicated to the sensations of various body parts is proportional to how sensitive that part of the body is.



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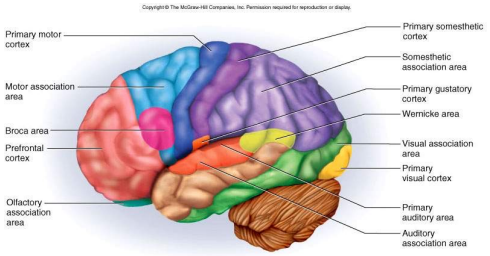
Functional Regions of Cerebral Cortex



14-50

50

Special Senses

14-51

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Sensory Association Areas

- Interpret sensory information
- Somesthetic association area (parietal lobe)
  - position of limbs; location of touch or pain; shape, weight and texture of an object
- Visual association area (occipital lobe)
  - identify things we see
  - faces recognized in temporal lobe
- Auditory association area (temporal lobe)
  - recall the name of a piece of music or identify a person by his voice

14-52

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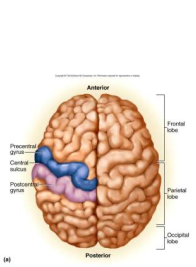
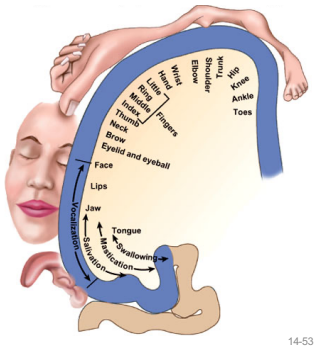
Motor Homunculus





14-53

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Basal Nuclei and Cerebellum

- Basal nuclei in feedback circuit with cerebral cortex
  - highly practised movements
  - starting and stopping movements
  - walking
  - dyskinesias and unwanted movements
- Cerebellum
  - learned motor skills, muscle tone, posture, and smooth muscle contractions
  - compares intention to actual movement and sends signal to adjust

14-54

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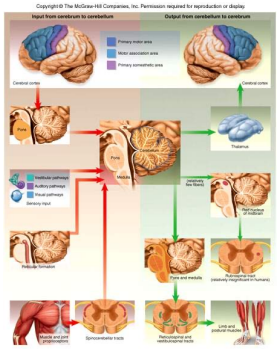
Input and Output to Cerebellum



Afferent Efferent

14-55

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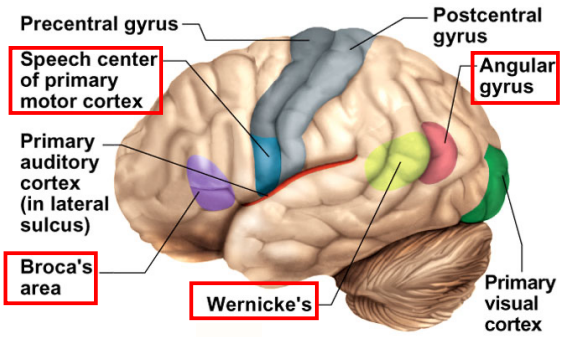
Language Centers



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Aphasia

- Language deficit from lesions in same hemisphere as Wernicke and Broca areas
- Lesion to Broca = nonfluent aphasia
  - slow speech, difficulty in choosing words
- Lesion to Wernicke = fluent aphasia
  - speech normal and excessive, but makes little sense
- Anomic aphasia
  - speech and understanding are normal but text and pictures make no sense

14-57

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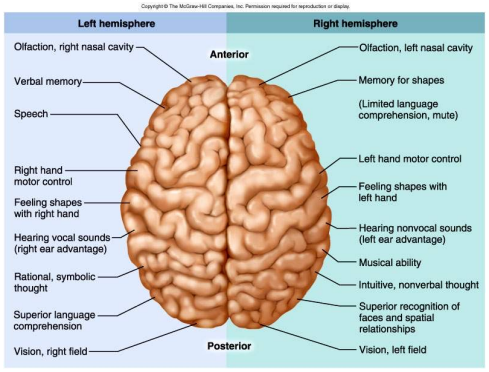
Lateralization of Cerebral Functions



14-58

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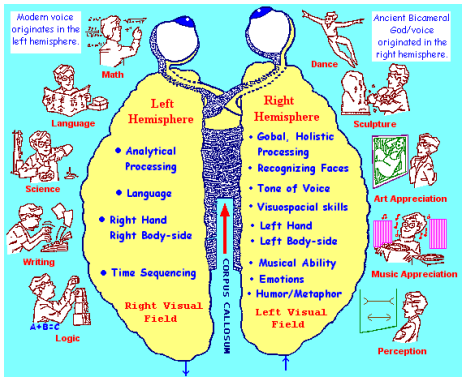
Cerebral Lateralization



14-59

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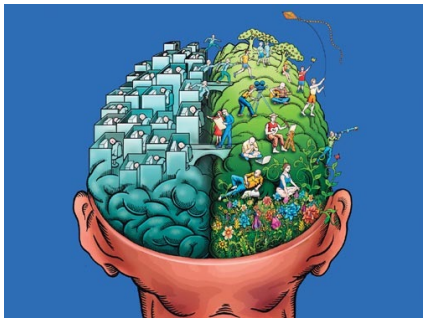

14-60

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Unravelling the mysteries of Alzheimer's disease

[redacted]

14-61

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Cranial Nerves

- 12 pair of nerves
  - arise from brain
  - exit through foramina leading to muscles, glands and sense organs in head and neck
- Input and output ipsilateral except CN II and IV

14-62

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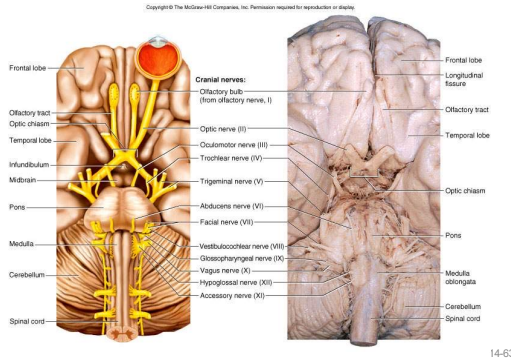
Cranial Nerves



14-63

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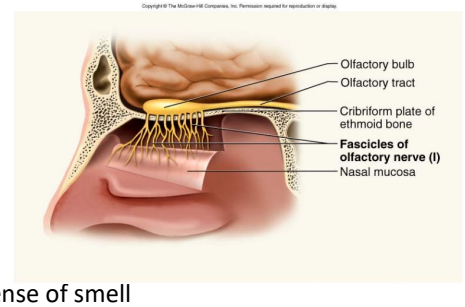
Olfactory Nerve

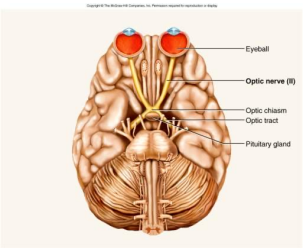


- Sense of smell
- Damage causes impaired sense of smell

14-64

64

Optic Nerve

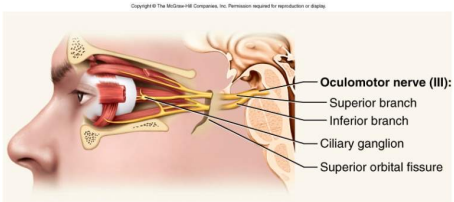


- Provides vision
- Damage causes blindness in visual field

14-65

65

Oculomotor Nerve

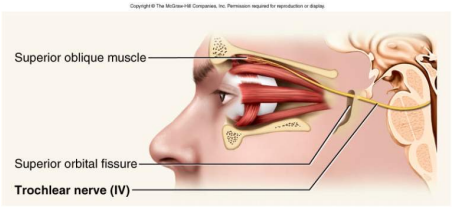


- Eye movement, opening of eyelid, constriction of pupil, focusing
- Damage causes drooping eyelid, dilated pupil, double vision, difficulty focusing and inability to move eye in certain directions

14-66

66

Trochlear Nerve



- Eye movement (superior oblique muscle)
- Damage causes double vision and inability to rotate eye inferolaterally

14-67

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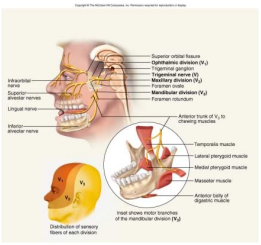
Trigeminal Nerve



- Sensory to face (touch, pain and temperature) and muscles of mastication
- Damage produces loss of sensation and impaired chewing

14-68

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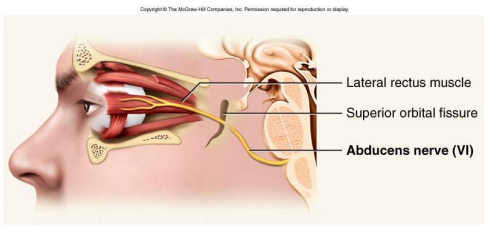
Abducens Nerve



- Provides eye movement (lateral rectus m.)
- Damage results in inability to rotate eye laterally and at rest eye rotates medially

14-69

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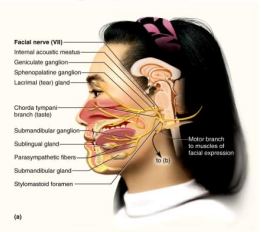
Facial Nerve

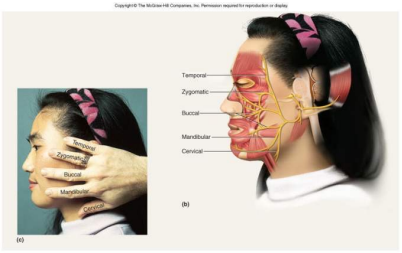


- Motor - facial expressions; salivary glands and tear, nasal and palatine glands
- Sensory - taste on anterior 2/3's of tongue
- Damage produces sagging facial muscles and disturbed sense of taste (no sweet and salty)

14-70

70

Branches of Facial Nerve



Clinical test: Test anterior 2/3's of tongue with substances such as sugar, salt, vinegar, and quinine; test response of tear glands to ammonia fumes; test motor functions by asking subject to close eyes, smile, whistle, frown, raise eyebrows, etc.

14-71

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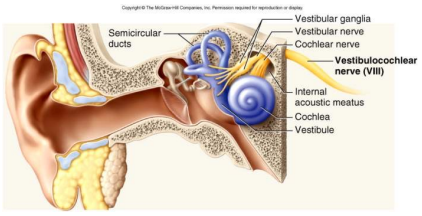
Vestibulocochlear Nerve



- Provides hearing and sense of balance
- Damage produces deafness, dizziness, nausea, loss of balance and nystagmus

14-72

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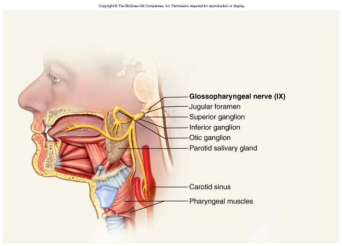
Glossopharyngeal Nerve



- Swallowing, salivation, gagging, control of BP and respiration
- Sensations from posterior 1/3 of tongue
- Damage results in loss of bitter and sour taste and impaired swallowing

14-73

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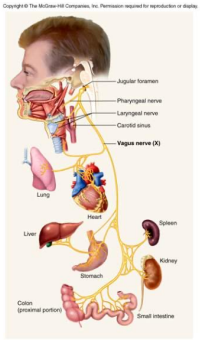
Vagus Nerve

- Swallowing, speech, regulation of viscera
- Damage causes hoarseness or loss of voice, impaired swallowing and fatal if both are cut



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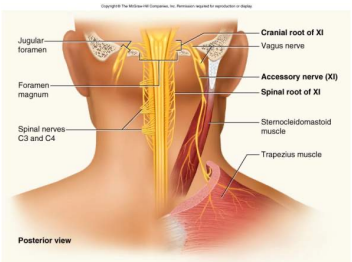
Accessory Nerve



- Swallowing, head, neck and shoulder movement
  - damage causes impaired head, neck, shoulder movement; head turns towards injured side

14-75

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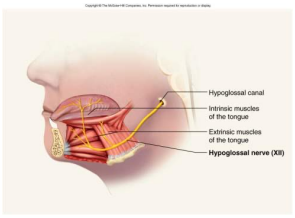
Hypoglossal Nerve



- Tongue movements for speech, food manipulation and swallowing
  - if both are damaged – can't protrude tongue
  - if one side is damaged – tongue deviates towards injured side; see ipsilateral atrophy

14-76

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Cranial Nerve Disorders

- Trigeminal neuralgia (tic douloureux)
  - recurring episodes of intense stabbing pain in trigeminal nerve area (near mouth or nose)
  - pain triggered by touch, drinking, washing face
  - treatment may require cutting nerve
- Bell's palsy
  - disorder of facial nerve causes paralysis of facial muscles on one side
  - may appear abruptly with full recovery within 3-5 weeks

14-77

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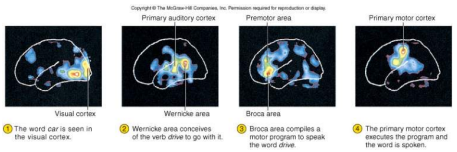
PET Scans and Language Task



14-78

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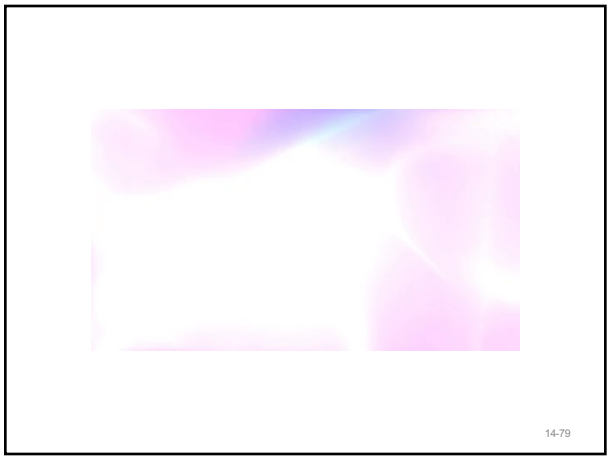

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