

### Cephalization = Brain Evolution

**Cephalization** = clustering of neurons in "brain" at front (anterior) end of bilaterally symmetrical animals → where sense organs are

 Cnidarian Simplest nervous system no control of complex actions	 Echinoderm More organization but still based on nerve nets; supports more complex movement	 Flatworm Platyhelminthes Simplest, defined central nervous system more complex muscle control
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### Cephalization = Brain Evolution

▪ increase in interneurons in brain region

 Earthworm More complex brains connected to all other parts of body by peripheral nerves	 Mollusk More complex brains in predators most sophisticated invertebrate nervous system	 Arthropod Further brain development ganglia = neuron clusters along CNS
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### Evolution of Vertebrate Brain

↑↑↑forebrain dominant cerebrum

hindbrain

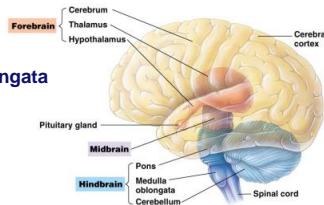
↑↑forebrain

↑↑forebrain

- Spinal cord
- Hind: Medulla oblongata
- Hind: Cerebellum
- Optic tectum
- Midbrain
- Fore: Cerebrum
- Olfactory tract

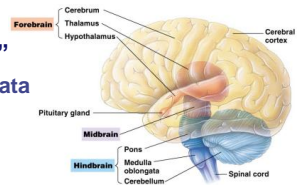
## Functional Divisions of Brain

- **Hindbrain**
  - ◆ evolutionary older structures of the brain
    - regulate essential autonomic & integrative functions
  - ◆ brainstem
    - pons
    - medulla oblongata
    - midbrain
  - ◆ cerebellum



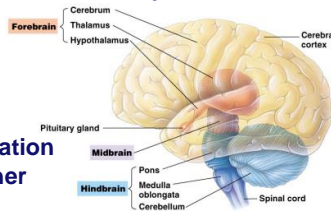
## Brainstem

- **The "lower brain"**
  - ◆ medulla oblongata
  - ◆ pons
  - ◆ midbrain
- **Functions**
  - ◆ homeostasis
  - ◆ coordination of movement
  - ◆ conduction of impulses to higher brain centers



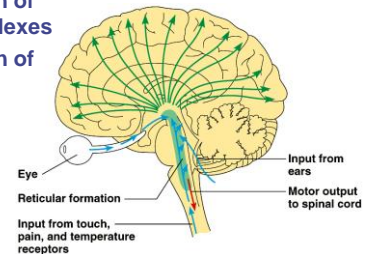
## Medulla Oblongata & Pons

- **Controls autonomic homeostatic functions**
  - ◆ heart & blood vessel activity
  - ◆ breathing
  - ◆ swallowing
  - ◆ vomiting
  - ◆ digestion
- **Relays information to & from higher brain centers**



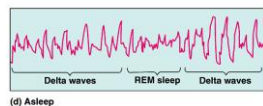
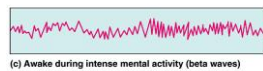
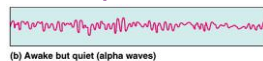
## Midbrain

- **Involved in the integration of sensory information**
  - ◆ regulation of visual reflexes
  - ◆ regulation of auditory reflexes



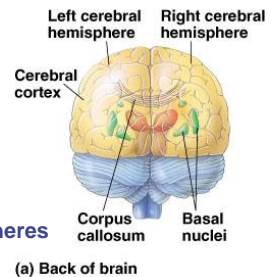
## Reticular Formation (of Midbrain)

- **Sleep & wakefulness produces patterns of electrical activity in the brain**
  - ◆ recorded as an **ElectroEncephaloGram (EEG)**
  - ◆ most dreaming during **REM** (rapid eye movement) sleep



## Cerebrum

- **Most highly evolved structure of mammalian brain**
- **Cerebrum divided**
  - ◆ hemispheres
  - ◆ left = right side of body
  - ◆ right = left side of body
- **Corpus callosum**
  - ◆ major connection between 2 hemispheres



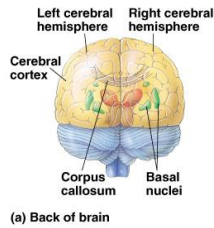
### Lateralization of Brain Function

#### Left hemisphere

- language, math, logic operations, processing of serial sequences of information, visual & auditory details
- detailed activities required for motor control

#### Right hemisphere

- pattern recognition, spatial relationships, non-verbal ideation, emotional processing, parallel processing of information

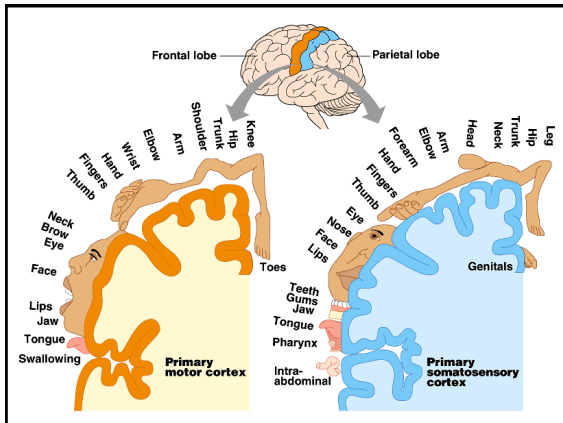
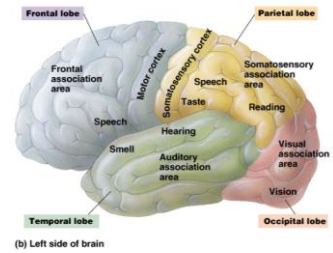


### Cerebrum Specialization

- Regions of the cerebrum are specialized for different functions

#### Lobes

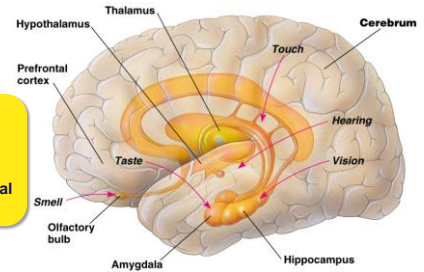
- frontal
- temporal
- occipital
- parietal



### Limbic System

Mediates **basic emotions** (fear, anger), involved in emotional bonding, establishes emotional memory

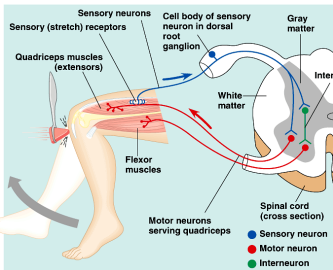
**Amygdala** involved in recognizing emotional content of facial expression



### Simplest Nerve Circuit

#### Reflex, or automatic response

- rapid response
- automated
- signal only goes to spinal cord
- no higher level processing
- adaptive value
- essential actions
- don't need to think or make decisions about
  - blinking
  - balance
  - pupil dilation
  - startle



### Eye Blink or Pain Withdrawal Reflex

