Nervous system

- **Central** - brain and spinal cord
- **Peripheral** - spinal nerves, motor and sensory nerves

Neuroglia

- Most CNS cells are glial cells
- They provide structure and maintain interneurons in the CNS
- Are capable of dividing, even in adulthood

Astrocytes:
- Hold neurons together
- Establish a blood-brain barrier with capillaries
- Repair brain injuries

Oligodendrocytes form myelin sheaths around axons
- Ependymal cells line the internal cavities of the CNS.
Meninges
- Spinal and cranial meninges
  - fish - one layer
  - tetrapods 2 or 3 (mammals)

Cranial meninges
- Scalp
- Skull
- Arachnoid mater
- Subarachnoid space of brain
- Brain

Neurocoel and ventricles
- CNS develops from DHNC neural tube of embryo has neurocoel

Cerebral spinal fluid
- provides almost neutral balance for brain (it "floats")
- cushions and nourishes brain

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Cerebral spinal fluid
- CSF produced by choroid plexus in ventricles

Blood brain barrier
- Exists at choroid plexus and capillaries in brain
- Capillaries have tight junctions

Brain development
- olfaction
- visual, auditory
- inner ear, lat. line
Brain development

Basic plan for vertebrate brains

Comparing vertebrate brains

- Cerebrum and cerebellum vary among vertebrates – the brainstem is conserved throughout phylogeny.
Brain stem and cerebellum

- **Brain stem** - Controls basic functions: breathing, heart rate, digestion, etc.
- **Cerebellum** maintains balance, enhances muscle tone, and coordinates skilled muscle activity

General trends for comparison

- **Cerebrum** gets larger in later verts - increased sensory input
- **Cerebellum** - largest in birds, mammals, some fish. Receives lateral line input.
Brain regions

Going up the brain:

- **Myelencephalon** - primarily medulla oblongata grades into the spinal cord.

Spinal cord arrangement of neurons is maintained into medulla

Dorsal nerves vs. Ventral nerves
Cranial nerves

- Nerves 5, 7, 9, 10 - "Dorsal nerves"
  - 5 – Trigeminal - Mandibular arch
  - 7 – Facial - Hyoid arch
  - 9 – Glossopharyngeal – Pharynx, tongue
  - 10 – Vagus – Pharynx, tongue, viscera

Branchiomeric nerves

- Somitomeres

Metencephalon -
- Cerebellum and pons

Mesencephalon -
- Optic lobe -
- Auditory lobe - (amniotes) impulses from the cochlea
**Optic and auditory pathways**

- **Optic lobe** - functions as an integrating center in fish (similar to cerebrum in amniotes)
  - Receives: visual, auditory, somatosensory, electroreception

**Diencephalon**

- Thalamus, epithalamus, hypothalamus, optic chiasma and pituitary.

**Diencephalon**

- **Thalamus**

**Diencephalon - Pineal & parietal eye**

- Photoreceptor in many fishes, amphibians, and reptiles - close to skin

(p.481)

(p.515)
Diencephalon - Pineal & parietal eye
- Tetrapods – pineal secretes melatonin
  - indicator of day length for daily or seasonal synchronization
  - Stimulated by light at eye & internal clock

Telencephalon
- Cerebrum and rhinencephalon
  - Rhinencephalon = olfactory bulbs, tracts, and lobes.
  - prominent in fish

Telencephalon
- Cerebrum: control motor movements; receive sensory info., “higher” functions.
- Flexibility in circuitry. Not as “hard wired”
Gray matter regions

- "Subpallium" = striatum and septum

Telencephalon

- Cortex (pallium)
- Striatum

Striatum

- Inhibits muscle tone
- Selects and maintains purposeful muscle activity while inhibiting useless movement

Amygdala

In tetrapods striatum includes portions of amygdala

Amygdala is associated with fear, arousal, emotional memory, basic drives.
- Pallium in mammals - cortex extends over striatum & midbrain
  - Medial pallium
  - Lateral pallium
  - Dorsal pallium

Pallium
- Medial pallium – a major part of limbic system. hippocampus in mammals.
- Dorsal pallium – In amniotes, integrates visual, auditory, somatosensory input. Small in fish, larger in amniotes.
- Lateral pallium – olfactory center. In fish, lateral p. integrates olfaction & motor responses

Hippocampus
- Short-term memory is converted to long-term memory by passing through the hippocampus

Telencephalon
- Comparing cortex of mammals, humans have greatly increased association areas