Book Fig. 1.1 Review the parts of a neuron.

**Parts of the Neuron**

Although blue in this figure, the myelin sheath is actually a white, fatty insulating coating on many axons. Any part of the CNS with lots of axons looks white as a result, in contrast to areas with lots of cell bodies which have no myelin sheath, so are darker.

**Gray & White Matter**

- Brain areas with lots of neuron cell bodies/dendrites look darker ("gray matter") and function like information processors — receiving & combining input
- Areas with lots of myelinated axons appear lighter ("white matter") and function like cables connecting regions
- A group of neuron cell bodies = “nucleus” (in CNS) or “ganglion” (in PNS)
- A group of axons = “tract” or “pathway” (in CNS) or “nerve” (in PNS)

Figure 1.20 Cortex is Gray Matter

Cross Section of Cord

Afferent (Sensory)

Efferent (Motor)

Become familiar with these terms and different views.

**Directional Terms**
5 levels of spinal cord & column with 31 pairs spinal nerves (8, 12, 5, 5, 1 in the 5 divisions, respectively)

Side view

View from belly side

5 Chunks of Brain

Telencephalon – outer part of forebrain
Cerebral hemispheres

Diencephalon – inner part of forebrain
Thalamus & Hypothalamus

Mesencephalon - midbrain

Metencephalon – upper part of hindbrain
Pons & Cerebellum

Myelencephalon – lower part of hindbrain
Medulla oblongata

5 Vesicles that will develop into the 5 chunks of the adult brain are visible very early in the Embryonic Brain

Brain stem & Cerebellum

Our authors use the term brain stem to refer to the last 3 divisions (midbrain, pons, medulla) but you may find other sources that include the diencephalon (hypothalamus & thalamus) in their definition of the stalk-like brain stem

These evolutionarily ancient regions are sometimes called our reptilian brain

The Brain is Like a Tootsie Pop

Part of the 'middle layer' wraps around the brainstem core.
Basal Ganglia
Also part of the ‘middle layer’

Protection of the CNS
Chap 5
Bones, Meninges & Cerebrospinal Fluid (CSF) do a good job under normal everyday conditions.

The Meninges (Greek for “membranes”)
- 3 layers of connective tissue enclosing brain & spinal cord
- Starting from the outside, the layers are:
  - dura mater
  - arachnoid mater
  - pia mater
- Meninges mnemonic (from the inside ◀ out) = PAD (the meninges PAD the outside of the brain)
Dura Mater ("tough matter")

- Actually has 2 layers which run close together in most locations
  - outer layer is anchored to skull bones in certain places
  - inner layer forms folds (or "dural septa") that partition skull cavity into compartments
    - one between R & L hemispheres: falx cerebri
    - one between occipital lobes & cerebellum: tentorium cerebelli
    - Because of these folds your cranium is like a sub-divided tupperware container with different spaces for different things
  *singular = septum – a "wall" that separates 2 areas

Falx is Latin for "sickle"

- A sickle
- Falx cerebri – sickle shaped membrane of the cerebrum between R and L hemispheres

These folds of dura serve another function as well:

- The spaces between the 2 dural layers at those folds form "dural venous sinuses" acting like giant veins for blood leaving brain
Blood in Dural Sinuses Dumps Into Jugular Veins to Head Back to Heart

Layer 2 – The Arachnoid Mater
Left hemisphere here has arachnoid layer in place. Not as thick as dura. Notice blood vessels supplying the brain are located under the arachnoid.

Arachnoid Mater (“spiderlike”)  
- Thinner layer loosely enclosing CNS  
- Space beneath arachnoid is filled with cerebrospinal fluid (CSF)  
- Spider-like filaments cross this “subarachnoid space” to the inner most layer of meninges, the pia mater

Pia Mater (“tender matter”)  
- Microscopically thin layer that tightly follows brain surface  
- Forms the waterproof floor of the subarachnoid space  
- Contains lots of small capillaries supplying blood to the CNS
Clinical Applications

- Dural partitions (Falx cerebri & tentorium cerebelli) can play a significant role in brain damage related to head injuries as well as that resulting from increased intracranial pressure. Although partitions normally hold the brain in place, they become a firm barrier soft brain tissue rams up against in sudden stops.
- Meningioma- "brain tumors" arising from the meninges ("oma" ending means tumor)
- Meningitis – infection/inflammation of the meninges ("itis" ending means inflammation). Meningitis is the most common acute infection of the CNS.

Bacterial Meningitis (update based on Bamberger(2010))

- **Medical Emergency**- progression to permanent brain injury or death (21%) can occur in hours – should start treatment right away even before lab results
- Symptoms: severe headache, fever, stiff neck, altered mental state (confused, irritable)(95% of adults show at least 2 of these; 63% have rash), photophobia, nausea, vomiting, possible seizures
- Several common bacteria can infect meninges – if they gain access to the CNS –
  - Neisseria meningitidis ("meningococcal meningitis" most common in college students & infants, may be epidemic)
  - Haemophilus influenzae B (Hib)* (mostly in young but almost eliminated here by Hib vaccine)
  - Streptococcus pneumoniae (mostly in adults – 25% had recent otitis or sinusitis)

*Weak stomach warning

Bacterial Meningitis continued

- Infection may get to CNS 1) via blood, 2) spread from nearby ear or sinus infections, or 3) thru acquired (head injury or brain surgery) or congenital defects in protective coverings of CNS
- Bacteria release toxins damaging capillaries & causing dangerous cerebral edema (swelling) and increased intracranial pressure. Can also trigger hydrocephalus, increasing the rapid rise in pressure. Antibiotics do not decrease edema but corticosteroids like dexamethasone help.
- Causes lasting deficits in 20-30% (impaired hearing (14% adults, 22% kids), vision or movement (4%), retardation, epilepsy, hydrocephalus) of survivors, especially in neonatal cases or if treatment is delayed.


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http://www.pbs.org/wgbh/nova/meningitis/

(Click on news minute on right)
The Glass Test – “rash” doesn’t disappear when pressed on.

Viral Meningitis  ~4X more common & less serious

- Initial symptoms similar but mental status and brain usually unaffected. Excellent prognosis – treatment usually not necessary. Again, a variety of viruses possible (Herpes, varicella, Lyme disease, many others)
- More serious risks if a virus affects the brain itself (“viral encephalitis”).
- Fungal infection of meninges can occur in those with compromised immune systems (like in AIDS, lupus)
- Sometimes allergy-like drug reactions can cause a similar irritation of meninges (ibuprofen, naproxen, trimethoprim, carbamazepine, lamotrigine(Lamictal, contrast agents used in CT scans), spec. If you have lupus or autoimmune disease)
- All these non-bacterial forms are called “aseptic meningitis”

Tests

- Lumbar puncture (spinal tap) to identify specific infection
- Kernig’s sign
- Brudzinki’s sign
- CT scan if person shows signs of ICP or localized signs

- Now vaccines for 2 different meningitis varieties available: Hib and Meningococcal (Menomune and Menactra for Neisseria strains A,C,Y)) No vaccine for the strain B. Menomune lasts 3-5 yrs, Menactra up to 10 years.

Meningococcal Vaccination

States with Meningococcal Precaution Mandates for Colleges and Universities (2011)

About 39 states now have legislation

Fungal infection of meninges can occur in those with compromised immune systems (like in AIDS, lupus)

Extending leg pulls on meninges and causes pain & resistance.

Flexing neck causes pain & involuntary bending of legs to relieve tension on meninges.
Actually caused by blood leaking out of vessels

**Fever**

(+101° F)

**Severe Sudden Headache**

ACCOMPANIED BY ANY OF THESE:

**Neck/Back Stiffness**

**Mental Changes**

(Agitation, confusion, coma)

**Rashes**

* *The rashes appear in about 76% of patients and may be quite variable. They can be as small as 1-2 mm and appear as tiny red, purple-black spots; or they may be much larger, resembling bruises. They are usually found on the arms, groin, ankles, and areas where pressure may be applied (e.g., underwear and soaks).*

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**MENINGITIS SYMPTOMS IN BABIES**

- Fever
- Hands & feet may feel cold
- Refusing feeds or vomiting
- Diarrhoea
- High pitched moaning cry or whimpering
- Delirious of being handled, tailful
- Neck retraction with arching of back
- Blank & staring expression
- Lying lethargic
- Difficult to wake, lethargic
- Faint, bitty, deep sleep
- Fatigue, complications