Protection of CNS

both brain and spinal cord are heavily protected:

1. bone: skull and vertebral column
2. meninges: tough flexible covering
3. liquid cushion: cerebrospinal fluid
4. adipose cushion around spinal cord

Meninges

composed of 3 layers:

1. dura mater

   strong fibrous connective tissue

   outer layer in skull is periosteum of cranial bones

   3 extensions of the dura mater form partitions between various parts of the brain:

   falx cerebri
   largest partition
   between cerebral hemispheres

   falx cerebelli
   separates cerebellar hemispheres
   not in sheep brain

   tentorium cerebelli
   separates cerebrum from cerebellum

2. arachnoid layer
   delicate cobwebby layer

   subdural space = between dura mater and arachnoid membrane

   subarachnoid space = between arachnoid layer and pia mater

3. pia mater

   transparent

   adheres to outer surface of brain and cord

   contains blood vessels
space between vertebrae and dura mater = **epidural space**
  is occupied by blood vessels, adipose tissue and loose connective tissue

meninges continues around spinal cord and extends beyond the end of the spinal cord
  → safer site for lumbar puncture to get CSF

**Meningitis** = inflammation of arachnoid, pia and CSF
  usually bacterial or viral
  may lead to encephalitis

**Encephalitis** = inflammation of brain tissue itself

**Cerebro Spinal Fluid**

as further protection against damage the brain and spinal cord have a cushion of fluid around and within
  → brain actually “floats” in CSF (~140 ml of CSF)

CSF provides buoyancy and protection to delicate brain tissues
  also produces chemical stability

CSF mainly in:
  a. space between arachnoid layer and pia mater of meninges
  b. brain ventricles and ducts
  c. central canal of spinal cord

ventricles are cavities inside brain:
  1st & 2nd : in side cerebral hemispheres
  = lateral ventricles
  3rd : small slit at base of brain
  inside diencephalon (thalamus)
  4th : diamond shaped expansion of central spinal canal in brainstem

capillary beds in pia mater of meninges extend into the 4 ventricles of the brain where they form **choroid plexi**

surrounded by **astrocytes** (blood brain barrier)

each choroid plexus secretes CSF into ventricles

produces ~500ml of CSF/day
  → only 100-160ml at a time in circulation
isolated by “**Blood Brain Barrier**”
capillaries are much less leaky than normal capillaries
→ astrocytes help regulate flow into CSF
difficulty getting drugs to brain tissue
any trauma to head may damage BBB

**Circulation of CSF**
- Choroid plexus in each ventricle
- fluid moves from lateral ventricles through duct to 3rd ventricle
- another duct moves fluid to 4th ventricle
- fluid moves to central canal of spinal cord
- fluid moves out to subarachnoid space around cord and brain
- reabsorbed from subarachnoid space into **arachnoid granulations**

if circulation is blocked by tumor or other means during fetal development may cause **hydrocephalus**
→ fluid is still produced but can’t circulate and be reabsorbed