Tumors
- Growth of non-functional cells
  - **Benign**: cells grown within their own membrane. Clear boundaries, can usually be removed surgically
  - **Malignant**: No ‘border’ between cell and tissue. Infiltrating tumor, cancerous.
  - **Metastatic tumors**: cells coming from malignant tumors in other organs (e.g. lungs), that reach the brain and develop. Travels through bloodstream to other parts of the body.
    Damage is caused by compression or infiltration.
- Because neurons cannot divide they are not responsible for tumors.
- **Gliomas** (from glial cells): malignant. Can be removed surgically and with radiation.
- **Meningiomas** (from dura mater): benign.
  - Malignant, benign → compression
  - Malignant → take-up space, use-up oxygen/glucose, destroy cells

Seizure Disorders
- Uncontrollable spread of neural activity (excitatory), sometimes leading to convulsions. Recurring seizures = epilepsy
  - Partial (focal+remain local) seizures Vs. Generalized seizures.
  - Partial seizures can be **simple** (no loss of consciousness) or **complex** (loss of consciousness).

**Grand Mal**: generalized seizure with convulsions
  - Aura ~seconds → Tonic Phase (rigid, loss of consciousness) 15 sec → Clonic Phase (convulsion, stop breathing, increase inhibition) 30 sec → sleep min/hours
**Petit Mal**: Absence seizures (generalized, complex). Stop of activity (~few seconds), unconscious.
  - GABA = used to inhibit firing neurons; used to treat seizures

Epilepsy = repeated seizures
- Primary damage in the temporal lobes (hippocampus, amygdala)
  - Status epilepticus = repeated complex seizures without regaining consciousness
    - Temporal Lobe: hippocampus + amygdala + ...
  - Neural Substrate: Hippocampus, among others.
  - Excitotoxicity: neuron death because of too much excitation through NDMA channels
  - Treatments:
    - Anticonvulsants (Be
    - Surgery
    - Vagus nerve stimulation (partial seizures)

Disorders: Cerebrovascular Accidents

Stroke
- 1/2 million strokes per year. Age related.
  - Hemorrhagic: Bleeding in the brain
  - Obstructive: Blood clot → Ischemia (loss of blood flow).
    - Thrombus and embolus → loss of oxygen and glucose, osmolarity variations, bacterial infections
      (Embolus breaks from Thrombus)
Strokes produce permanent brain damage. Can be prevented:
- Medications to reduce blood pressure.
- Brain surgery (on vasculature)
- Antibiotics (embolus and bacterial infection)
-Anticoagulant (prevent blood clot up to 9 hours after stroke. Eg. DSPA)

Causes of Stroke

Plaques – Atherosclerosis: build up of material (cholesterol, calcium deposits) on walls of blood vessels.
-Detected by angiography (X-ray of blood circulation)
-Treated by surgery:
  Stent (parachute + mesh lining)
Rehabilitation after stroke.

-Therapies depend on the type of brain damage (speech, motor impairment....)
-Case of limb movement impairment. Constraint-Induced therapy: inducing brain plasticity by artificially ‘amputating’ / restricting movement in the good limb, and forcing the use of the impaired limb.

-Brain-Machine Interface: linking neural activity to an eternal artificial device.
  -Perception: artificial eye
  -Movement: artificial arm/ legs. (Motor cortex linked to an arm or wheelchair)

Developmental Disorders

-Generally induced by viruses or drugs.
-Result in non-viability or retardation.

-Fetal Alcohol Syndrome: Affects axonal growth and synaptic plasticity (e.g KTP/LTD). Low doses of alcohol during pregnancy are sufficient.
  Distinguishing features: narrow head, small nose, long upper lip with deficient philtrum, eyes far apart

Inherited Metabolic Disorders: deficiency in the production of an enzyme. Genetic bases

-PKU (Phenylketonuria): deficit in phenylalanine → tyrosine conversion
  Lack of myelination
  Mental retardation if untreated
  Detectable at birth. Preventable by appropriate diet (low protein)

-Lack of vitamin B6: damage to thalamus and cerebellum.
-Lack of (milk) glucose metabolism (Galactosemia): damage to cerebellum and cortex.
-Tay-Sachs disease: inability to break down cellular waste products. Accumulation of waste, brain swelling, death. Retinal diagnosis

Down Syndrome: Congenital (born with)

-1/700 children. > 350,000 people in U.S
-Extra chromosome 21 in mother’s ovum. Over-expression of genes. Can be detected before birth

-10% less brain. Less neurons in frontal lobe and Sup. Temp. Gyrus (Wernicke’s area)
-Mild to severe mental retardation. Can learn to have almost normal lives. No cure
-Research: Focused on avoiding associated diseases (heart condition, epilepsy, hearing/vision deficit). Study gene-over expression pattern.