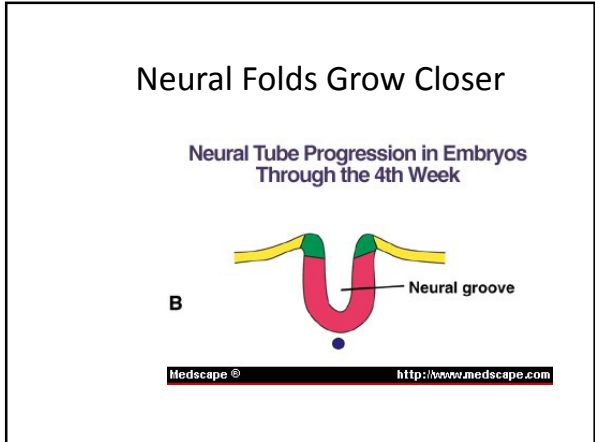
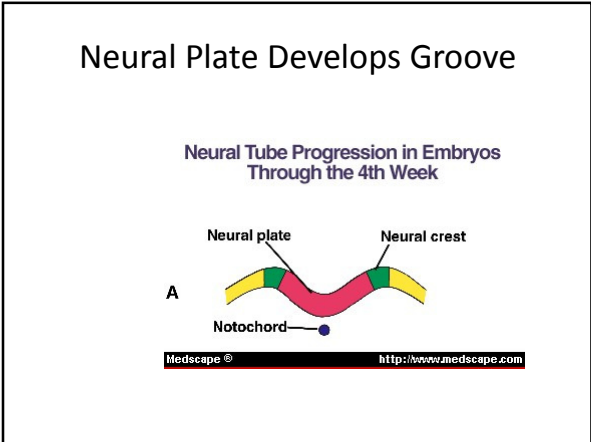
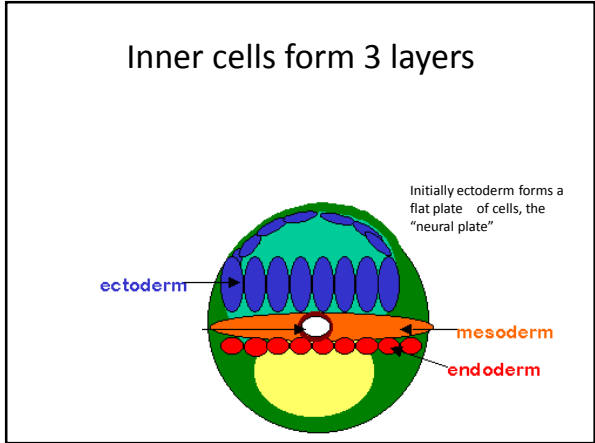
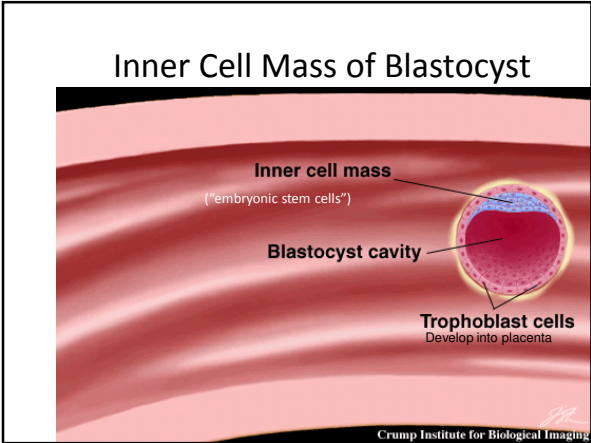
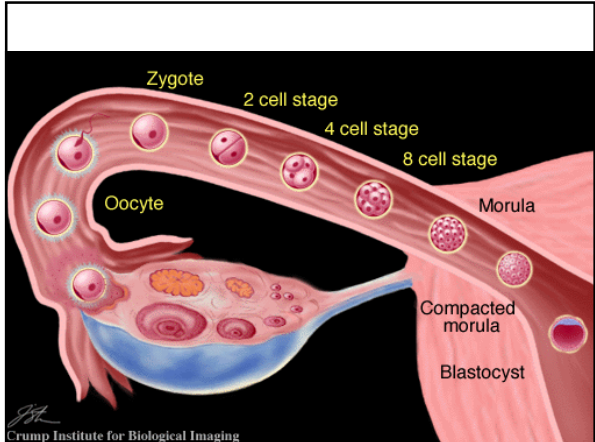
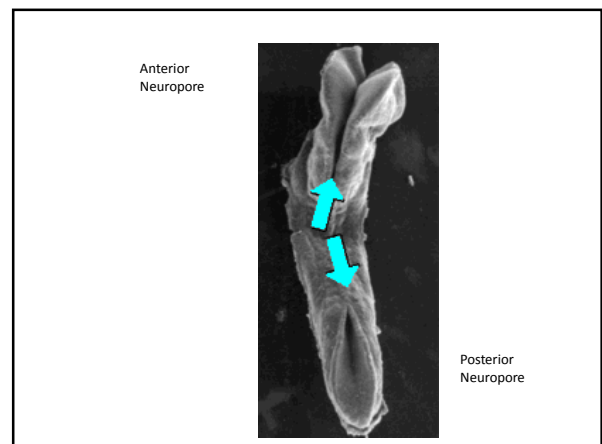
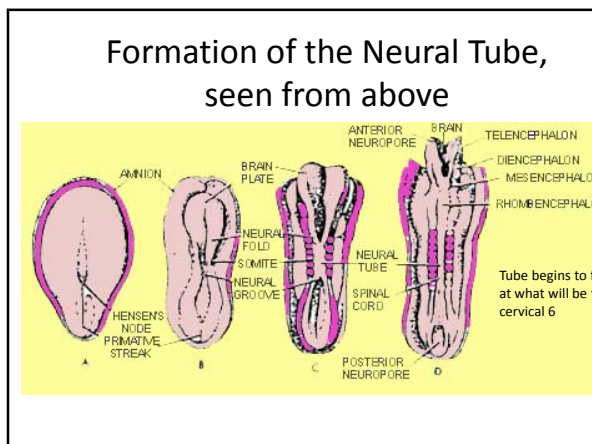
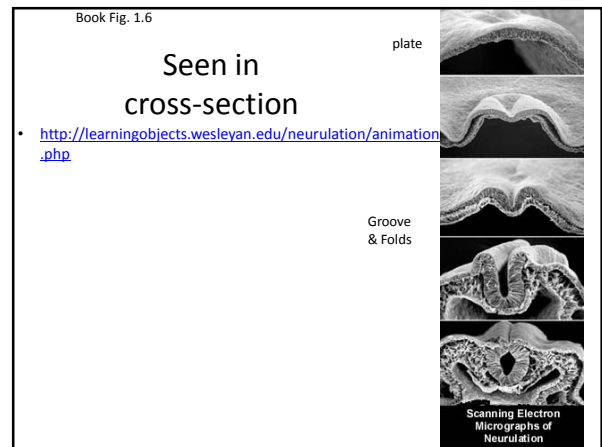
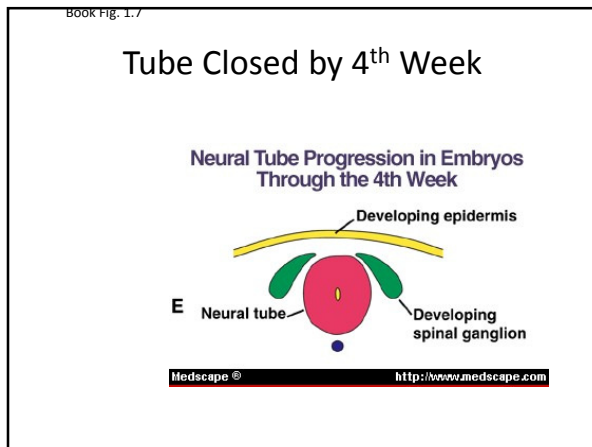
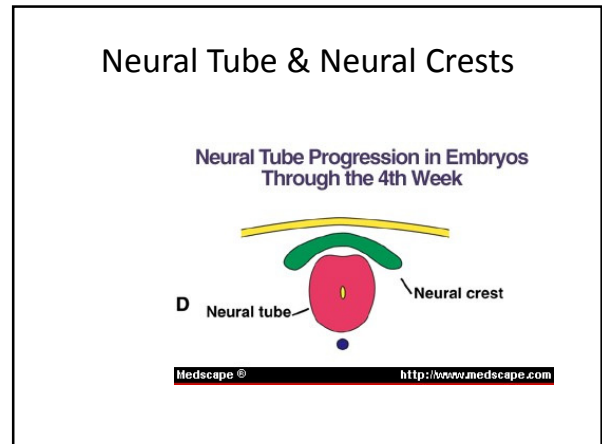
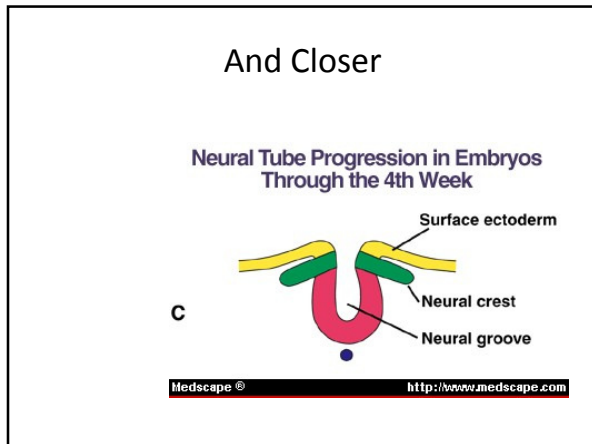
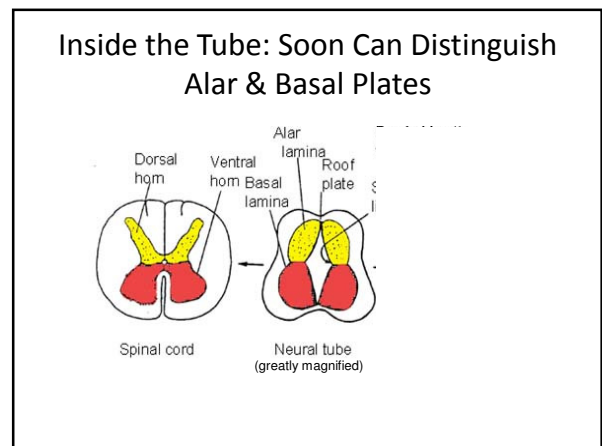
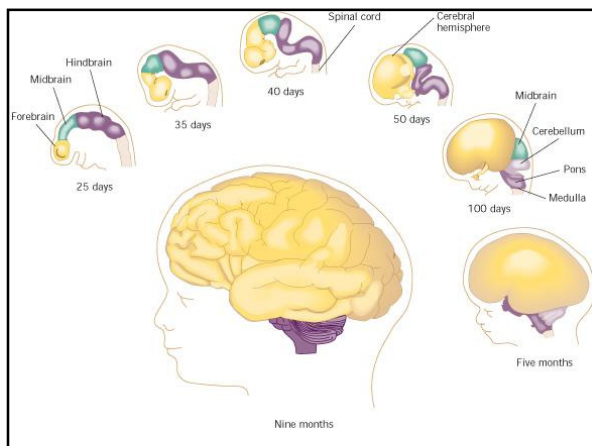
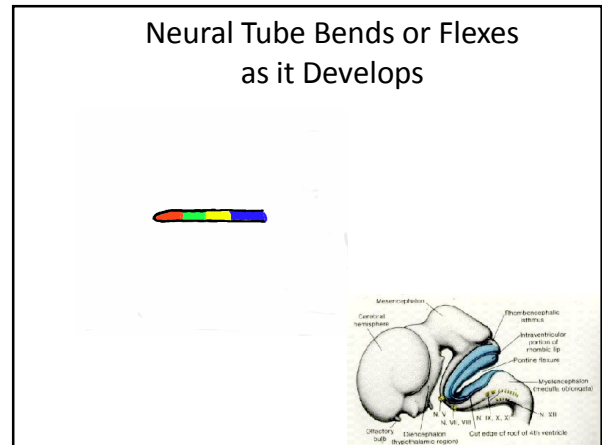
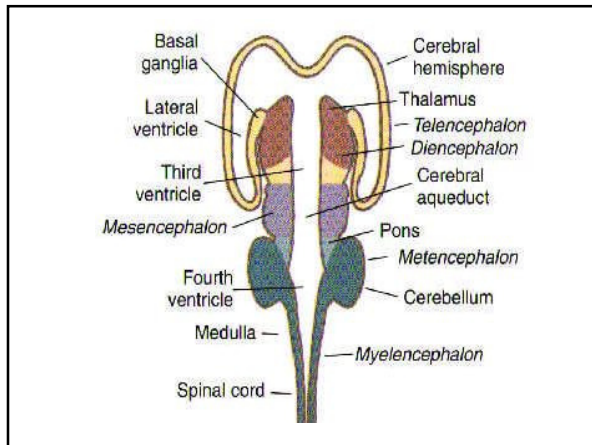
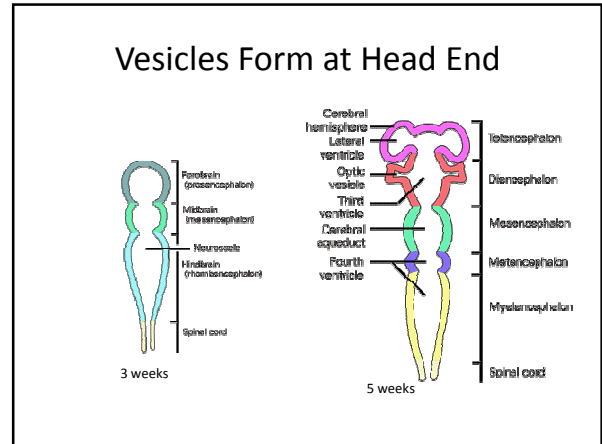
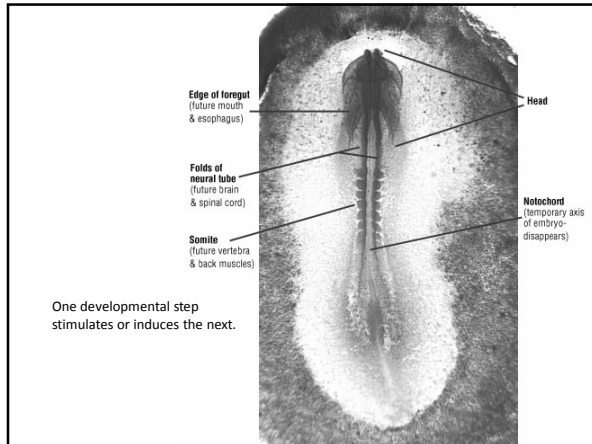


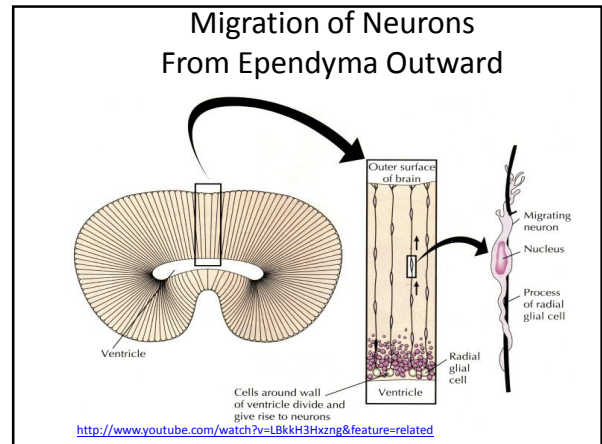
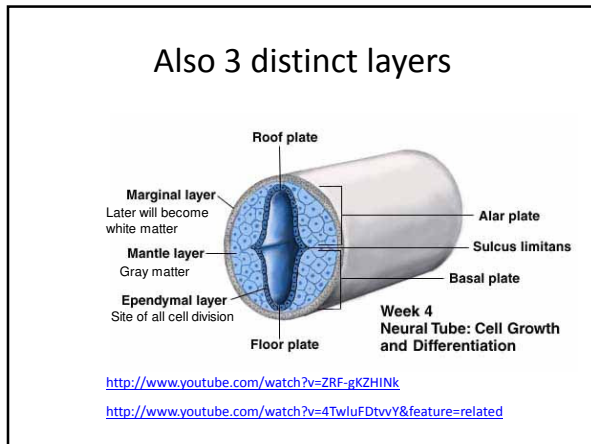
Nervous System Development

See pages 4-7

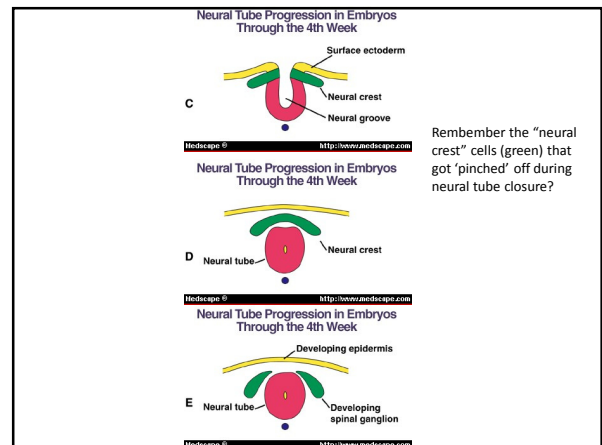








- ### Each step must occur properly for normal development
- Formation of the neural tube
 - Cell proliferation
 - Cell migration & differentiation
 - Growing of neural connections
 - Apoptosis or selective cell death or “pruning” of unsuccessful connections
 - Myelination of axons and continued formation of synapses
- http://www.youtube.com/watch?v=n_9YTeEHp1E&feature=related



- ### Neural Crest Cells Become:
- Sensory ganglia & incoming sensory nerves
 - Autonomic ganglia & nerves to organs
 - Parts of endocrine system related to NS (e.g. adrenal medulla)
 - Parts of eye and ear; some smooth muscles
 - Peripheral glial cells; pigmented cells

- ### Neural Tube Defects (NTD) ~1 per 1000 live births
- Closure of the neural tube normal induces the normal development of spinal column, skull & overlying skin. If closure does not occur normally, nervous system may remain exposed (“open NTD”).
 - In other cases the neural tube may not be exposed to the surface (“closed NTD”), but the spinal vertebrae and skin surrounding the spine may not be completely normal.

Open NTD



Causes

- Has been linked to maternal diet (insufficient folic acid (one of the B vitamins), zinc)
- E-W Geography, anti-seizure meds or alcohol use, fever and illness during pregnancy, age of mom, diabetes, and ethnicity & genetics also play a role.

Improper Closing of the Anterior Neuropore (~ 25 days)

- Anencephaly – forebrain & its coverings fail to develop. Baby has a flattened, open skull. With only hindbrain & midbrain structures intact, survival is brief
- (hours-days).
- <http://www.youtube.com/watch?v=vl>



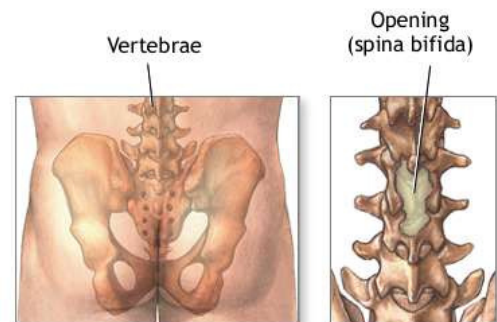
Anterior Neuropore Fails to Close Properly



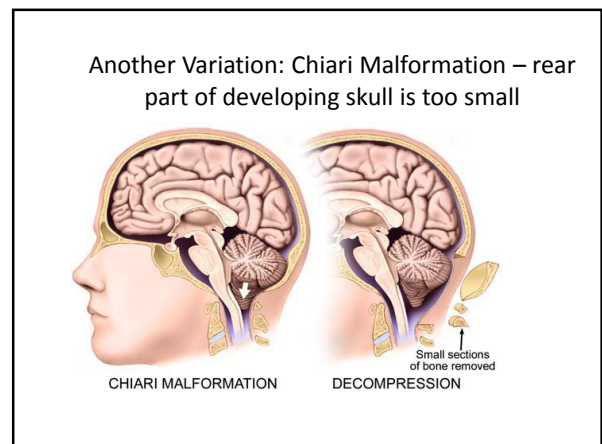
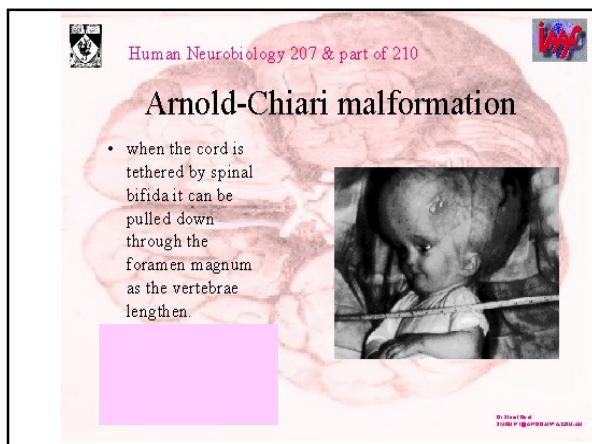
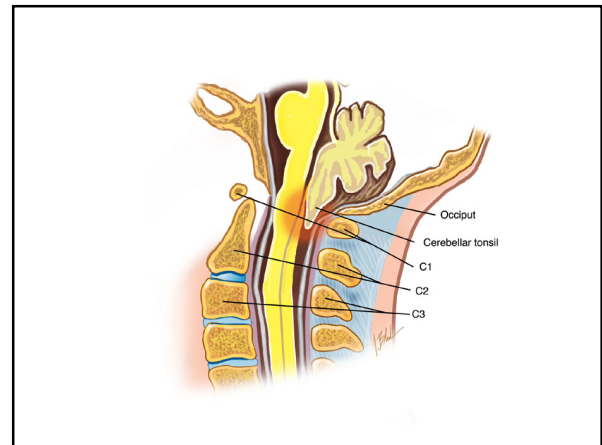
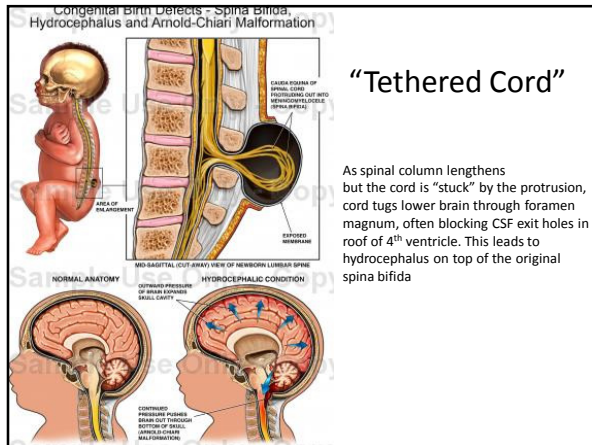
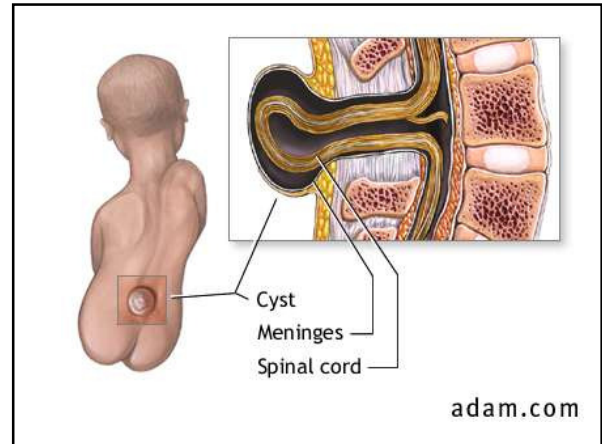
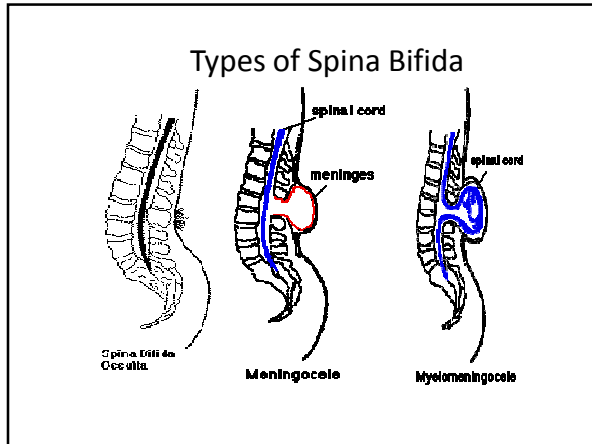
- Sometimes the forebrain develops but the skull does not fuse completely.
- As a result meninges and/or part of the brain (often the occipital region) may bulge out of the opening. This is an encephalocele.

Much More Common: Improper Closing of Posterior Neuropore (~27 days)

- Spina bifida (“open spine”)
- May be so minor you don’t know you have it (“spina bifida occulta”), or may be so severe it causes death or disability



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Prenatal Diagnosis

- Open NTDs are associated with elevated levels of alpha-fetoprotein in mother's blood and amniotic fluid (~16-18 weeks)
- Some NTDs are visible on ultrasound
- Some experimental surgeries to repair spinal abnormalities in utero

Healthy Sonogram



Signs of Anencephaly



Signs of Spina Bifida

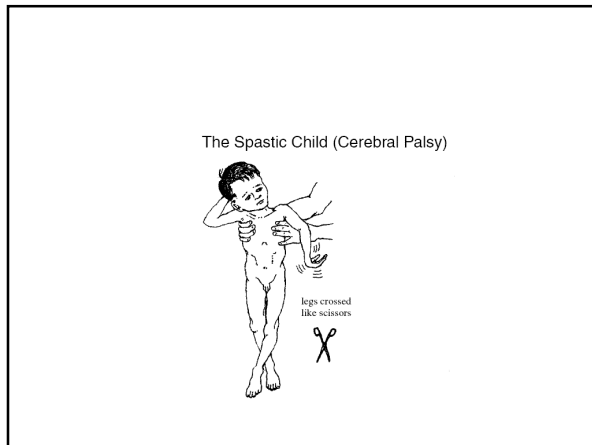
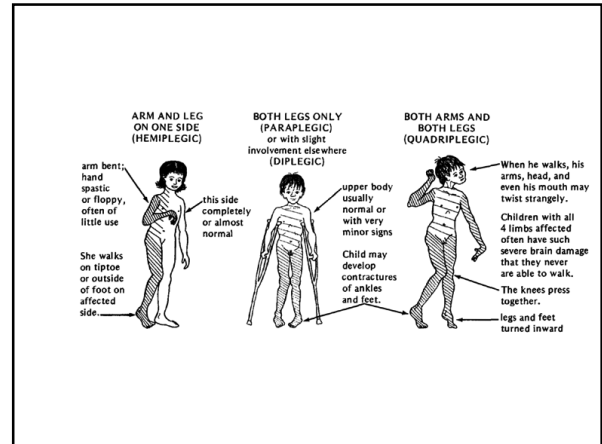
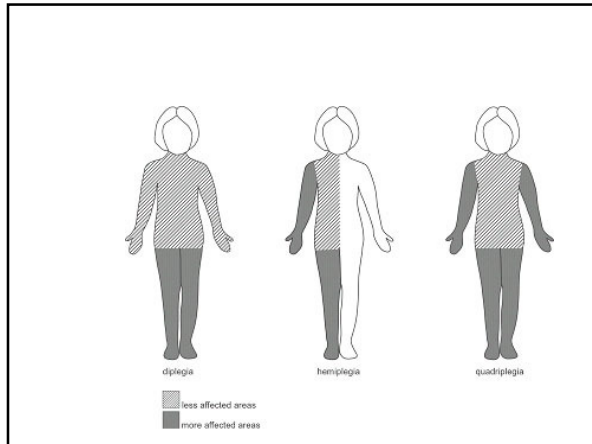


Cerebral Palsy (~6/1000 live births; 500,000 in US) aka Static Encephalopathy

- Not a single disease or disorder but a category of nonprogressive motor impairments that result from faulty brain development or early brain damage.
- Specific motor symptoms **vary**, as does severity and presence of other disabilities.
- Once thought to be due to difficult labors/birth injuries but majority of cases due to genetic, developmental malformations, intrauterine factors like infection during pregnancy or premature birth.

Categories of Motor Problems

- 50% Spastic CP – limbs resist movement
 - Spastic hemiplegia (arm & leg) usually due to dev. malformation or early stroke; IQ ok; seizure risk
 - Spastic diplegia- (legs) usually related to prematurity; IQ ok
 - Spastic quadriplegia – usually due to severe diffuse damage; severe seizures, retardation
- Physical therapy & medications to deal with spasticity



- 25% Athetoid CP – involuntary movements; slurring, grimacing – usually due to hypoxia, basal ganglia lesions
- <http://www.youtube.com/watch?v=IFMLL6A7KOU&feature=related>
- 10% Ataxic CP – uncoordinated, wide based gait, can't walk straight line, falls
- http://www.youtube.com/watch?v=p5VNd7_nIM&feature=related

- ### Fetal Alcohol Syndrome
- Most common variety of drug-related faulty development, causing underdevelopment, distinctive physical features as well as nervous system abnormalities.

