HPS202 Exam Notes – Complete Unit Summary

Week One

MASTERCLASS - TERATOGENS

PRENATAL DEVELOPMENT:

Three Prenatal Periods:

- Germinal --> approximately day 1-14
    - Fertilisation --> a period of rapid cell replication.
    - Placenta --> organ made up of tissue from both embryo and parent. Acts as a filter to allow exchange of nutrients, oxygen and waste products; barrier preventing bloodstreams of parent and embryo coming into contact.
- Embryonic --> week 2-8
    - All organ systems are in place but function is limited.
    - Organogenesis --> important organs are developing. Vulnerable stage.
    - How?
        - Cell differentiation
        - Differential cell proliferation
        - Programmed cell death
        - Folding of the embryo
    - Week 5:
        - Form is more human like
        - Brain and head growth is rapid
        - Forelimbs develop with digital ridges
        - Heart chambers are forming
    - Week 6:
        - Facial features are more distinct.
        - Short webbed fingers appear
        - Heart almost complete
        - The liver is prominent and producing blood cells
    - Week 7-8:
        - The eyes are open (eyelids developing)
        - Mouth, tongue and palate are complete
        - Arms, legs, fingers, toes can be seen
        - Muscular system develops and movements begin
- Foetus --> weeks 9-40

TERATOGENIC INFLUENCES:

Teratogen --> any environmental agent that causes damage during the prenatal period.

- Infections (e.g. herpes, rubella, syphilis)
- Chemicals (e.g. cigarette smoke)
- Radiation
- Drugs (prescribed/illicit)
- Abnormal temperatures

Impact dependent upon time:

- Germinal stage --> generally fatal
- Embryonic stage --> structural abnormalities
- Foetal stage --> functional abnormalities

Other factors influencing impact:

- Tissue-specific effects
- Dose level

- Individual difference
- Effect on mother

ILLICIT DRUGS - NEONATAL ABSTINENCE SYNDROME:

Drugs:

- Amphetamines
- Barbiturates
- Benzodiazepines (diazepam, clonazepam)
- Cocaine
- Marijuana
- Opiates/narcotics (heroin, methadone, codeine)

Complications:

- Birth defects
- Low birth weight
- Premature birth
- Sudden infant death syndrome (SIDS)

Symptoms:

- Diarrhoea
- Excessive crying/high-pitched crying
- Excessive sucking
- Fever
- Irritability
- Poor feeding
- Rapid breathing
- Seizures
- Sleep problems
- Slow weight gain
- Sweating
- Trembling (tremors)
- Vomiting

PRESCRIBED DRUGS:

"Is there any chance that you are pregnant?"
"Not recommended for use during pregnancy"
Does the benefit outweigh the risk?

Examples include:

- Tetracycline
- Lithium (bi-polar disorder)
- Thalidomide

ALCOHOL - FETAL ALCOHOL SYNDROME:

- Alcohol consumed during pregnancy
    - No recommended 'acceptable dose' due to individual differences in tolerance levels
- Outcomes influenced by time and length of alcohol exposure, as well as dose…

Alcohol Exposure - What are the Outcomes?

- General cognitive impairment
    - Mental retardation

    - Impaired motor coordination
    - Attention, memory, language
- Behavioural presentation
    - Irritability
    - Hyperactivity
    - Social difficulties

RISK FACTORS:

- Lack of support
- Mental health issues
- Lack of education
- Not knowing they are pregnant
- Addiction
- Social determinants
- Environmental factors
- Not having access to healthcare
- Pressure from family and partner
- Cultural norms

Regular use of the drug or alcohol prior to pregnancy - 50% more likely to drink when pregnant (HealthCanal, 2013).

Not intending to fall pregnant, or not aware that pregnant (HealthCanal, 2013).

Ages 35-44 years (Marchetta et al., 2012)

Culture and sub-culture.

RECOMMENDATIONS:

Tennessee's solution: Pregnancy Criminalisation Law

- Criminalises "the illegal use of a narcotic drug while pregnant, if [a woman's] child is born addicted to or harmed by the narcotic drug".
- Local reporting suggests that the woman, Mallory Loyola, was arrested for exposing her child to amphetamine, which is not a narcotic.
- Consequences: up to 12 months jail

SEMINAR

Quizzes:

- End of week 2
- End of week 4
- End of week 7
- End of week 9
- End of week 11

AT1 - ANNOTATED BIBLIOGRAPHY:

- **What is it?**
    - A complication of sources with critical/explanatory information
    - A brief account of the existing research on a topic
- **Why are we doing this?**
    - Allows you to get acquainted with a key developmental topic

    - Allows you to compile and plan some of the sources you will need for AT2: Policy Brief
- **What is an annotated bibliography?**
    - A list of citations/articles
    - Each citation is followed by a brief summary and evaluative paragraph (this is te annotation)
    - The purpose of the annotation
    - Only need 4 articles

NOTES FROM 'GENES AND GENETICS EXPLAINED' READING

SUMMARY:

- Genes are the blueprint for our bodies
- A genetic mutation means that a gene contains a change - like a spelling mistake - that disrupts the gene message (makes the gene faulty)
- Genetic mutations can occur spontaneously
- Sometimes a faulty gene is inherited, which means it is passed on from parent to child
- Genetic changes that make a gene faulty can cause a wide range of conditions
- Although most related parents will have healthy children, they are more likely than unrelated parents to have children with health problems or genetic disorders.

GENES:

Almost every cell in the human body contains a copy of this genetic blueprint, mostly stored inside a special sac within the cell called the nucleus. Genes are part of chromosomes, which are long strands of a chemical substance called deoxyribonucleic acid (DNA). Therefore, genes are made up of DNA.

The genes are copied 'letter for letter' to a similar substance called ribonucleic acid (RNA). The working parts of the cell read the RNA to create the protein or hormone according to the instructions. Each gene codes the instruction for a single protein only, but one protein may have many different roles in the human body.

Sometimes, a gene contains a variation that disrupts the gene's coded message. A variation can occur spontaneously or it can be inherited. Variations in the coding that make a gene not work properly are called mutations and can directly or indirectly lead to a wide range of conditions.

Chromosomes, Sperm and Egg Cells:

Numbered chromosomes are called autosomes.

How We Inherit Characteristics:

One characteristics can have many different forms. Variations in the gene for that characteristics cause these different forms. Each variation of a gene is called an allele. We can inherit different alleles of the gene pair (one from each parent) in different ways.

Dominant and Recessive Genes:

The two copies of the genes contained in each set of chromosomes both send coded messages to influence the way the cell works. The actions of some of these genes, however, appear to be 'dominant' over others. Generally, the coded message from the genes that tells the eyes cells to make brown colour is dominant over blue eye colour. However, a number of different genes together determine eye colour and so blue-eyed parents can have a child with brown eyes.

Dominant and Recessive Blood-Group Inheritance:

Dominant inheritance is when one allele of a gene is dominant within the pair. For blood groups, the A allele is dominant over the O allele, so a person with one A allele and one O allele has the blood group AO. Another way of saying this is that the O group is recessive - a person needs two O alleles to have the blood group O.

If the mother has an A allele and an O allele (AO), her blood group will be A because the A is dominant. The father has two O alleles (OO), so he has the blood group O. Each one of their children has a 50% chance of having blood group A (AO) and a 50% chance of having blood group O (OO), depending on which alleles they inherit.

Co-Dominant Genes:
Not all genes are either dominant or recessive. Sometimes, each allele in the gene pair carries equal weight and will show up as a combined physical characteristic.

Genotype and Phenotype:
A person with the alleles AO will have the blood group A. The observable trait -blood group - is known as the phenotype.
The genotype is the genes that produce the observable trait. So the person with blood group A and AO alleles has the blood group A phenotype but the AO genotype.
Therefore, the genotype produces the phenotype.

Chemical Communication:
Genes communicate with the cell in chemical code, known as the genetic code. The cell carries out its instructions to the letter.

A cell reproduces by copying its genetic information then splitting in half, forming two individual cells. Occasionally, a mistake is made, causing a variation (genetic mutation) and the wrong chemical message is sent to the cell. This spontaneous genetic mutation can cause problems in the way the person's body functions.

Genetic mutations are permanent. Some of the causes of a spontaneous genetic mutation include exposure to radiation, chemicals and cigarette smoke.

Variations in the Genes in the Cells:
Sperm and egg cells are known as 'germ' cells, while every other cell in the body is called 'somatic'. If a variation in the information in a gene happens spontaneously in a person's somatic cells, they may develop the condition related to that gene change, but won't pass it on to their children e.g. skin cancer.

However, if the mutation occurs in a person's germ cells, that person's children each have a 50% chance of inheriting the mutated gene.

Genetic Conditions:
The three ways in which genetic conditions can happen are:

- The variation in the gene that makes it faulty (a mutation) happens spontaneously in the formation of the egg or sperm, or at conception.
- The faulty gene is passed from parent to child and may directly cause a problem that affects the child at birth or later in life.
- The faulty gene is passed from parent to child and may cause a genetic susceptibility. Environmental factors, such as diet and exposure to chemicals, combine with this susceptibility to trigger the onset of the disorder.

Autosomal Recessive Genetic Disorders:
If two parents have a copy of the same altered gene, they may both pass their copy of this altered gene on to a child, so the child receives both altered copies as the child then does not have a normal, functioning copy of the gene, the child will develop the disorder. This is called autosomal recessive inheritance. The parents are 'carriers' of the genetic condition but are unaffected themselves. Examples include cystic fibrosis and phenylketonuria (PKU).

A child with only one copy of the altered gene will not be affected, as that child also has a normal copy of that gene - the same as the healthy parents.

NOTES FROM GENETICS MINI LECTURE VIDEO

Gene is a location on the DNA that provides instructions for making an enzyme or protein, which in turn, makes a characteristic.
Gene comprises instructions for synthesising proteins and enzymes. These are then used to create all of our characteristics.

CHROMOSOMES:

- Humans have 46 which geneticist typically group into pairs
- Thus it is said we have 23 pairs of chromosomes
- Numbered from largest to smallest.
- One set of genes from mother and the other from father.
- ASPM gene is located on chromosome 1 which plays a role in determining brain size.

Phenotype = the expression of a gene (or genotype)
Genotype = genetic make up of the individual
Allele = alternative forms of a gene e.g. three forms of a gene (allele) for hair = brown, black, blonde.
Homozygous = alleles are the same
Heterozygous = alleles are different
Recessive = need two copies of the gene for the trait to be expressed (one from biological father and the other from biological mother).
Dominant = need only one copy of the gene for the trait to be expressed (can be from either parent).
Co-dominant inheritance = both traits of the parent are expressed in the offspring.

NOTES FROM PRENATAL DEVELOPMENT READING

THE GERMINAL PERIOD:

The germinal period or period of the zygote is a period of rapid cell replication (multiplication) so that by the time the zygote reaches the uterus it consists of hundreds of cells. By this time it is a ball of cells known as a blastocyst, consisting of two cell layers, an outer cell mass (the trophoblast layer) which encloses a fluid-filled cavity, and an inter cell mass called the developing embryonic disk. The trophoblast layer will develop into tissues that support, protect and nourish the developing embryo, while the embryonic disk contains the cells that will become the embryo. When the blastocyst reaches the uterus, trophoblast cells put out tiny branches that burrow into the spongy wall of the uterus until they come into contact with the maternal blood vessels. This is called implantation.

Immediately after implantation, membranes grow rapidly from the trophoblast layer to ensure that the developing embryo is provided with nutrients and protection from environmental trauma. An inner membrane, the amnion, forms as a watertight sac that fills with fluid from the mother's tissues (amniotic fluid). This cushions the developing organism from holts as the mother moves around,

helps to maintain constant temperature and provides support and a medium in which it can move. Within the amniotic fluid a yolk sac forms, and this produces blood cells until the embryo is capable of producing its own.

An outer membrane, the chorion, forms around the amnion by the end of the second week. This becomes the foetal part of the placenta, a complex organ made up of tissue from both the mother and the embryo. The placenta and embryo become linked by the umbilical cord, which is formed by another membrane, the allantois.

Until birth the placenta acts simultaneously as a barrier that prevents the bloodstreams of the mother and embryo/foetus from coming into direct contact and as a filter that allows nutrients, oxygen and waste products to be exchanged.

EMBRYONIC PERIOD:

The period of the embryo lasts from implantation until about the end of the eighth week of gestation. It is a period when all the basic organs of the body are formed and the embryo begins to respond to direct stimulation.

By the third week after conception the embryonic disk is rapidly differentiation into three cell layers that will give rise to all parts of the body. The ectoderm will form the nervous system, skin and hair. The mesoderm will form the muscles, bones, circulatory system and other internal organs. The endoderm will form the digestive system, lungs, urinary tract and glands.

The first tissue to form is the neural tube, or primitive spinal cord, and by the end of the first month the brain has begun to develop, the heart has formed and begun to beat, muscles are forming and the backbone, ribs and digestive system have begun to form. Limb buds, the beginnings of arms and legs, have also appeared. Eyes, ears, nose, mouth and neck develop soon after and limbs rapidly form from the limb buds.

By the seventh week the embryo has a rudimentary skeleton and in the 8th week movement begins and bones begin to harden. By the end of the second month all the basic tissues and organs exist in rudimentary form. The brain can direct primitive muscle contractions, sexual development has begun, and the embryo's circulatory system is functioning on its own as the liver and spleen have begun producing blood cells.

FOETAL PERIOD:

In this period the organs take on their final form and begin to function. The period of the foetus begins two-thirds of the way through the first trimester. By the end of the first trimester (13 weeks) the spinal cord is recognisable, the kidneys are able to secrete, the sexes are eternally different and the foetus responds reflexively to a touch on the face.

By the end of the second trimester (26 weeks) the mother's abdomen is distended and she can feel the foetus move, reporting kicks. Suck and swallow reflexes are present, the brain is differentiating and the sheathing of nerve fibres has begun. The foetus can now hear sounds and the eyes open and shut regularly and appear to shift their gaze. The internal genitals are formed and hair is forming on the body and head. At the end of this period the lungs are beginning to produce surfactin, a substance that enables the lungs to inflate.

The third trimester is a period of rapid weight gain as a layer of brown fat is deposited beneath the skin. This will keep the newborn warm. The nervous system is now functioning well enough to support life outside the womb, the lungs are able to extract oxygen from air and the eyes have

become responsive to light. Electrical activity in the brain indicates periods of sleep and wakefulness. The reflexes are now highly responsive. Normal birth occurs at about week 38/39.

TERATOGENIC INFLUENCES:

During the course of prenatal development, teratogens may cause malformations in the foetus. They include maternal diseases and blood disorders, diet, irradiation, drugs of many kinds and abnormal temperature and oxygen levels. In addition, maternal characteristics such as age, emotional state and the number of children previously born can influence prenatal development. The adverse effects of these agents include congenital anomalies, embryonic or foetal death, intrauterine growth retardation and mental dysfunction.

Effects of Teratogenic Agents on Prenatal Development:

- Sensitive periods for action of teratogens --> the gravest danger to life is during the first two weeks, well before cell differentiation. Teratogens present during this stage will either completely destroy the zygote or have no lasting effect. The embryonic period is the most vulnerable in terms of teratogens producing structural abnormality, as this is the time when all the structures are being laid down. Teratogens acting in the foetal period are more likely to affect function than structure, as this is the period when the various systems are becoming functional.
- Tissue-specific effect --> each teratogen acts in a specific way on specific developing tissue, and thus causes a particular pattern of abnormal development.
- Dose-response relationship --> in general, the greater concentration of the teratogenic agent to which the organism is exposed, the greater the risk of abnormal development.
- Individual differences in effect --> not every child will be equally affected by a given amount of exposure to a particular teratogen. The way in which the developing organism responds to the teratogenic agent depends to some degree on its genotype and that of its mother. The mother's age, nutrition, uterine condition and hormonal balance can all affect the action of teratogens.
- Effects on mother --> mothers may suffer no adverse effects from teratogens that can produce defects in the developing embryo. In fact, some of the agents are taken by the mother because they have a beneficial effect on her.

Maternal Diseases and Disorders:

Maternal Disease Groups	Individual Diseases	Possible Effects on Child
Maternal Disorders	Anaemia (iron deficiency)	Death; brain impairment
	Scarlet Fever	Early death
	Diabetes Mellitus	Death; stillbirth; respiratory problems; metabolic disorders
Viral Infections	Chicken Pox	Physical malformation; mental retardation
	Cytomegalovirus* (most frequent prenatal source of infection)	Stillbirth; death; CNS damage; mental retardation; blood disorders; microcephaly
	Genital herpes*	Miscarriage; physical malformation; blindness; death
	HIV/AIDS*	Brain damage; repeated illness; death
	Rubella	Heart defects; blindness; deafness; genital, urinary, and

		intestinal abnormalities; mental retardation
Bacterial Infections	Syphilis*	Death; blindness; deafness; mental retardation
	Tuberculosis	Death; lowered resistance to tuberculosis
Parasitic Infections	Malaria	Miscarriage; low birthweight/prematurity
	Toxoplasmosis	Brain defects; mental retardation; heart defects; death

*Sexually transmitted diseases

Prescription and Non-Prescription Drugs:
Any drug that has a molecule small enough to cross the 'placental barrier' is capable of entering the bloodstream of the developing embryo or foetus. Prescription drugs that have been identified as causing problems include thalidomide, quinine which can cause congenital deafness, reserpine (a tranquiliser) which can cause respiratory problems, tetracyclines which can depress skeletal growth, and certain anticonvulsant drugs that might result in cleft lip and palate.

Foetal Alcohol Syndrome:
The most noticeable characteristics of FAS are defects such as microcephaly (small head) and malformations of the heart, limbs, joints and face. The facial abnormalities are the most noticeable external anomalies, including a smooth upper lip, short nose and narrow, widely spaced eyes. The brains of FAS children are typically smaller and show a lack of cortical convolutions (tend to be smoother). An affected baby is likely to exhibit abnormal behaviours such as excessive irritability, hyperactivity, seizures and tremors. At birth FAS children are smaller and lighter than normal and their physical growth lags behind that of normal age mates.

NOTES FROM PRENATAL DEVELOPMENT AND TERATOGENIC MINI LECTURE VIDEOS

PRENATAL DEVELOPMENT:

- **Germinal period**
  - Rapid cell division and creation of a blastocyst
  - Implanted into the uterus
  - Creation of embryonic disc.
- **Embryonic period**
  - Three layers of cells created from the embryonic disc which later become different body parts
  - Structural development = CNS, heart, lungs etc.
  - Duration = implantation of the blastocyst to the 8th week
- **Foetal period**
  - Maturation of body parts and organs
  - Duration = 8th week to birth

TERATOGENIC INFLUENCES:

- Typically, prenatal development is guided by genes
- Environmental influences can also assert influences
- Teratogens are agents from the environment that has adverse effects on the developing embryo or foetus.
- E.g. thalidomide
  - Drug used to treat nausea in pregnant women in 1950s

    - Drug has adverse effects on embryo
    - Caused problems to limbs
- E.g. alcohol and FAS
    - Mother consumes large amounts of alcohol during pregnancy
    - Outcomes influenced by time and length of alcohol exposure
    - Can cause general cognitive impairment
        - Mental retardation
        - Impaired motor coordination
        - Attention
        - Memory
        - Language
        - Physical abnormalities
    - Can also cause facial abnormalities
        - Widely spaced eyes
        - Small head
        - Short small nose
        - Thin upper lip
- Effects of teratogens on prenatal development
    - Sensitive periods
    - Tissue specific effects
    - Dose-response relationships
    - Individual differences

NOTES FROM NEUROLOGICAL DEVELOPMENT READING

EARLY BRAIN DEVELOPMENT:

The raw material of the brain is the nerve cell called the neuron. During foetal development, neurons are created and migrate to form the various parts of the brain. As neurons migrate, they also differentiate, or specialise, to govern specific functions in the body in response to chemical signals. This process of development occurs sequentially from the "bottom up". That is, from areas of the brain controlling the most primitive functions of the body (e.g. heart rate, breathing) to the most sophisticated functions (e.g. complex thought).

The first areas of the brain to full develop are the brainstem and midbrain; they govern the bodily functions necessary for life, called the autonomic functions. At birth, these lower portions of the nervous system are very well developed, whereas the higher regions (the limbic system and cerebral cortex) are still rather primitive. Higher function brain regions involved in regulating emotions, language, and abstract thought grow rapidly in the first 3 years of life.

THE GROWING CHILD'S BRAIN:

Synapses organise the brain by forming pathways that connect the parts of the brain governing everything we do. This is the essence of postnatal brain development, because at birth, very few synapses have been formed. The synapses present at birth are primarily those that govern our bodily functions such as heart rate, breathing, eating, and sleeping.

Based on the child's experiences, some synapses are strengthened and remain intact, but many are gradually discarded. This process of synapse pruning is a normal part of development. By the time children reach adolescence, about half of their synapses have been pruned, leaving the number they will have for most of the rest of their lives.

Another important process that takes place in the developing brain is myelination. Myelin is the white fatty tissue that forms a sheath to insulate mature brain cells, thus ensuring clear transmission

of neurotransmitters across synapses. Young children process information slowly because their brain cells lack the myelin necessary for fast, clear nerve impulse transmission.

ADOLESCENT BRAIN DEVELOPMENT:

Right before puberty, adolescent brains experience a growth spurt that occurs mainly in the frontal lobe, which is the area that governs planning, impulse control, and reasoning. During the teenage years, the brain goes through a process of pruning synapses and also sees an increase in white matter and changes to neurotransmitter systems. As the teenager grows into young adulthood, the brain develops more myelin to insulate the nerve fibres and speed neural processing, and this myelination occurs last in the frontal lobe. Another change that happens during adolescence is the growth and transformation of the limbic system, which is responsible for our emotions.

PLASTICITY - THE INFLUENCE OF ENVIRONMENT:

The extent of a brain's plasticity is dependent on the stage of development and the particular brain system or region affected. For instance, the lower parts of the brain, which control basic functions such as breathing and heart rate, are less flexible, or plastic, than the higher functioning cortex, which controls thoughts and feelings. While cortex plasticity decreases as a child gets older, some degree of plasticity remains.

SENSITIVE PERIODS:

There are sensitive periods for development of certain capabilities. These refer to windows of time in the developmental process when certain parts of the brain may be most susceptible to particular experiences.

If certain synapses and neuronal pathways are not repeatedly activated, they may be discarded, and their capabilities may diminish. For example, infants have a genetic predisposition to form strong attachments to their primary caregivers, but they may not be able to achieve strong attachments, or trusting, durable bonds if they are in a severely neglectful situation with little one-on-one caregiver contact.

MEMORIES:

When repeated experiences strengthen a neuronal pathway, the pathway becomes encoded, and it eventually becomes a memory. Babies are born with the capacity for implicit memory, which means that they can perceive their environment and recall it in certain unconscious ways.

In contrast, explicit memory, which develops around age 2, refers to conscious memories and is tied to language development. Explicit memory allows children to talk about themselves in the past and future or in different places or circumstances through the process of conscious recollection.

Sometimes, children who have been abused or suffered other trauma may not retain or be able to access explicit memories of their experiences; however, they may retain implicit memories of the physical or emotional sensations, and these implicit memories may produce flashbacks, nightmares, or other uncontrollable reactions.

RESPONDING TO STRESS:

The type of stress and the timing of that stress determine whether and how there is an impact on the brain. The National Scientific Council on the Developing Child (2014) outlines three classifications of stress:

- Positive stress is moderate, brief, and generally a normal part of life (e.g. entering a new child care setting). Learning to adjust to this type of stress is an essential component of healthy development.

- Tolerable stress includes events that have the potential to alter the developing brain negatively, but which occur infrequently and give the brain time to recover (e.g. the death of a loved one).
- Toxic stress includes strong, frequent, and prolonged activation of the body's stress response system (e.g. chronic neglect).

Healthy responses to typical life stressors are very complex and may change depending on individual and environmental characteristics, such as genetics, the presence of a sensitive and responsive caregiver, and past experiences. A healthy stress response involves a variety of hormone and neurochemical systems throughout the body, including the SAM system which produces adrenaline, and the HPA system which produces cortisol. Increases in adrenaline help the body engage energy stores and alter blood flow. Increases in cortisol also help the body engage energy stores and also can enhance certain types of memory and activate immune responses. In a healthy stress response, the hormonal levels will return to normal after the stressful experience has passed.

NOTES FROM NEUROLOGICAL MINI LECTURE VIDEO

- **Cell/Neuronal Proliferation**
  - Process for creating cells (includes neurons)
  - At the end of this process more cells are created than required. Cells that are not used die during this process
- **Cell Migration**
  - Once the cells are created how do they end up in the right place?
  - Passive migration = new cells push up old ones into their correct position.
  - Active migration = new cells, using the position of the old/developed cells, go past them and take their rightful position.
- **Neuronal Differentiation**
  - Once cells are in place, the process of differentiation begins
  - At the start of the process cell serves no specific function. At the end of the process we end up with a neuron or a cell that can now complete some specific function
- **Post-Natal Brain Development**
  - Brain continues to develop after birth (continue until early 20's)
  - Environmental influences play a larger role
  - Two processes
    - Synaptogenesis
      - Synapse is the point between two neurons. Allows information to travel between different parts of the brain
      - When we are born we have more connections than we need. The creation of these synapses is called synaptogenesis. Our experiences with the world influence which synapses we keep and which ones we lose.
    - Myelination (also occurs prenatally)
      - Process whereby axon is covered by a fatty substance
      - Acts as insulation
      - Electrical signals can travel faster in the brain.
- **Implications**
  - Parts of the brain which support basic function (e.g. regulation of heart, motor and perceptual skills) develop early in development.
  - Parts of the brain which we use for higher order functions (planning, organisation) develop much later in development (early 20's).
  - In order to understand the impact or disruptions to brain development, WHEN it happens is very important.