**Lesson Three: Heredity, Prenatal Development, and Birth**

**Objectives: At the end of this lesson, you will be able to**

**1.    Define gene.**

**2.    Define chromosome.**

**3.    Define gamete.**

**4.    Explain what determines the chromosomal sex of the child.**

**5.    Question the assertion that human traits are genetic.**

**6.    Compare monozygotic and dizygotic twins.**

**7.    Differentiate between genetic disorders and chromosomal abnormalities.**

**8.    Describe Trisomy 21.**

**9.    Differentiate between the germinal, embryonic, and fetal periods of development.**

**10.Describe human development during the germinal, embryonic, and fetal periods.**

**11.Describe a normal delivery and complications of pregnancy and delivery.**

**12.Predict the risks to prenatal development posed by exposure to teratogens.**

**13.Interpret APGAR scores.**

**14.Discover problems of newborns**

**The objectives are indicated in the reading sections below.**

**Heredity: The Epigenetic Framework (Ob5)**

**Nature or Nurture?**

In this lesson, we will look at some of the ways in which heredity helps to shape the way we are. We will look at what happens genetically during conception and take a brief look some genetic abnormalities. Before going into these topics, however, it is important to emphasize the interplay between heredity and the environment. Why are you the way you are? As you consider some of your features (height, weight, personality, being diabetic, etc.), ask yourself whether these features are a result of heredity or environmental factors-or both. Chances are, you can see the ways in which both heredity and environmental factors (such as lifestyle, diet, and so on) have contributed to these features.  For decades, scholars have carried on the "nature/nurture" debate. For any particular feature, those on the "nature" side would argue that heredity plays the most important role in bringing about that feature. Those on the "nurture" side would argue that one's environment is most significant in shaping the way we are. This debate continues in questions about what makes us masculine or feminine (Lippa, 2002), concerns about vision (Mutti, Kadnik and Adams, 1996), and many other developmental issues. (Check out [www.googlescholar.com](http://www.googlescholar.com/) for over 20,000 entries for “current nature/nurture debates”!) Yet most scholars agree that there is a constant interplay between the two forces. It is difficult to isolate the root of any single behavior as a result solely of nature or nurture and most scholars believe that even determining the extent to which nature or nurture impacts a human feature is difficult to answer. In fact, almost all human features are **polygenic** (a result of many genes) and **multifactorial** (a result of many factors, both genetic and environmental). It's as if one's genetic make-up sets up a range of possibilities, which may or may not be realized depending upon one's environmental experiences. For instance, a person might be genetically predisposed to develop diabetes, but the person's lifestyle may help bring about the disease.

**The Epigenetic Framework**

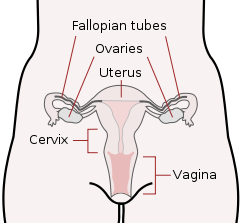
Gottlieb (1998, 2000, 2002) suggests an analytic framework for the nature/nurture debate that recognizes the interplay between the environment, behavior, and genetic expression. This bidirectional interplay suggests that the environment can effect the expression of genes just as genetic predispositions can impact a person’s potentials. And environmental circumstances can trigger symptoms of a genetic disorder.  For example, a person who has sickle cell anemia, a recessive gene linked disorder, can experience a sickle cell crisis under conditions of oxygen deprivation.  Someone predisposed genetically for type two diabetes can trigger the disease through poor diet and little exercise.

**The Human Genome Project (Ob1, Ob2)**

The Human Genome Project is an internationally funded effort to map the locations of human genes and understand the role these genes play in development, health and illness. (Check out recent developments at [www.genome.gov](http://www.genome.gov/))  **Genes** are segments of **chromosomes** (46 strands of a chemical substance called DNA that are contained in the nucleus of each normal human cell) that vary in length.   There are an estimated 25,000 to 30,000 genes on each chromosome; a number far below the estimate of 100,000-150,000 held before the work of the Human Genome Project.

Understanding the role of genes in health and illness can bring about both harm and good (Weitz, 2007). A person who knows that they are at risk for developing a genetic disorder may be able to adopt lifestyle practices that minimize the risk and a person who discovers that they are not at risk may find comfort in knowing that they do not have to fear a particular disease. However, a person who finds out that they are at risk and there is nothing that can be done about it may experience years of fear and anxiety. And the availability of genetic testing may be more widespread than the availability of genetic counseling which can be very expensive.   The possible stigma and discrimination that those with illness or at risk for illness must also be considered.   In light of the high costs of health insurance, many companies are starting to offer benefits contingent on health assessments and lifestyle recommendations; and continued coverage depends on an employee following these recommendations. So a smoker may have to pay a higher premium than a non-smoker or a person who is overweight may be required to engage in a program of exercise and be monitored for improvement. What if a person finds out that they carry the gene for Huntington’s disease (a neurological disorder that is ultimately fatal) which may surface when a person reaches their 40s? The impact this knowledge will have on health care still remains unknown.  Who should know what is on your genome?  Do you think this information should be shared between mates?  What about employers?  What would be the advantages and disadvantages?

**Conception (Ob3)**

[](http://angel.southseattle.edu/AngelUploads/Files/9cc63e02-ff82-4004-a25e-7d194b7ce500/240px-Scheme_female_reproductive_system-en_svg.png)

The Female Reproductive System

**Gametes**

There are two types of sex cells or gametes involved in reproduction: the male gametes or sperm and female gametes or ova. The male gametes are produced in the testes in a process called **spermatogenesis** which begin at about 12 years of age. The female gametes or ova which are stored in the ovaries are present at birth but are immature. Each ovary contains about 250,000 (Rome 1998) but only about 400 of these will become mature eggs (Mackon and Fauser 2000).   Beginning at puberty, one ovum ripens and is released about every 28 days, a process called **oogenesis**.

After the ovum or egg ripens and is released from the ovary, it is drawn into the fallopian tube and in 3 to 4 days, reaches the uterus. It is typically fertilized in the fallopian tube and continues its journey to the uterus. At ejaculation, millions of sperm are released into the vagina, but only a few reach the egg and typically, only one fertilizes the egg. Once a single sperm has entered the wall of the egg, the wall becomes hard and prevents other sperm from entering. After the sperm has entered the egg, the tail of the sperm breaks off and the head of the sperm, containing the genetic information from the father, unites with the nucleus of the egg. As a result, a new cell is formed. This cell, containing the combined genetic information from both parents, is referred to as a **zygote.**

Chromosomes contain genetic information from each parent. While other normal human cells have 46 chromosomes (or 23 pair), gametes contain 23 chromosomes. In a process called **meiosis,** segments of the chromosomes from each parent form pairs and genetic segments are exchanged as determined by chance. Because of the unpredictability of this exchange the likelihood of having offspring that are genetically identical (and not twins) is one in trillions (Gould and Keeton, 1997). 

**Determining the Sex of the Child (Ob4)**

Twenty-two of those chromosomes from each parent are similar in length to a corresponding chromosome from the other parent. However, the remaining chromosome looks like an X or a Y. Half of the male's sperm contain a Y chromosome and half contain an X. All of the ova contain two X chromosomes. If the child receives the combination of XY, the child will be genetically male. If it receives the XX combination, the child will be genetically female.

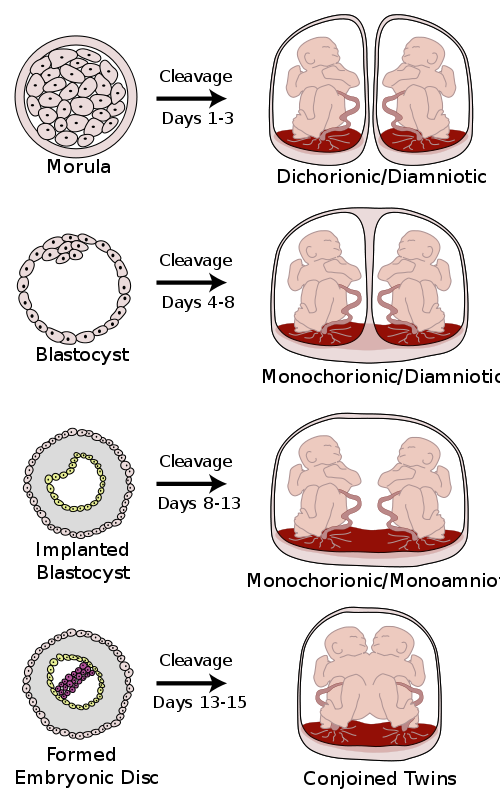
Many potential parents have a clear preference for having a boy or a girl and would like to determine the sex of the child. Through the years, a number of tips have been offered for the potential parents to maximize their chances for having either a son or daughter as they prefer. For example, it has been suggested that sperm which carry a Y chromosome are more fragile than those carrying an X. So, if a couple desires a male child, they can take measures to maximize the chance that the Y sperm reaches the egg. This involves having intercourse 48 hours after ovulation, which helps the Y sperm have a shorter journey to reach the egg, douching to create a more alkaline environment in the vagina, and having the female reach orgasm first so that sperm are not pushed out of the vagina during orgasm. Today, however, there is new technology available that makes it possible to isolate sperm containing either an X or a Y, depending on the preference, and use that sperm to fertilize a mother's egg.

**Monozygotic and Dizygotic Twins (Ob6)**

Monozygotic twins occur when a single zygote or fertilized egg splits apart in the first two weeks of development. The result is the creation of two separate but genetically identical offspring. About one-third of twins are monozygotic twins. Are you an identical twin?

Sometimes, however, two eggs or ova are released and fertilized by two separate sperm. The result is dizygotic or fraternal twins. About two-thirds of twins are dizygotic. These two individuals share the same amount of genetic material as would any two children from the same mother and father.  Older mothers are more likely to have dizygotic twins than are younger mothers and couples who use fertility drugs are also more likely to give birth to dizygotic twins. Consequently, there has been in increase in the number of fraternal twins in recent years (Bortolus et. al., 1999).

What are the other possibilities?  Various degrees of sharing the placenta can occur depending on the timing of the separation and duplication of cells.  This is known as placentiation.  Here is a diagram that illustrates various types of twins.

[](http://angel.southseattle.edu/AngelUploads/Files/9cc63e02-ff82-4004-a25e-7d194b7ce500/500px-Placentation_svg.png)

Author Kevin Dufenbach

**Genotypes and Phenotypes (or why what you get is not always what you see) (Ob5)**

The word **genotype** refers to the sum total of all the genes a person inherits. The word **phenotype** refers to the features that are actually expressed. Look in the mirror. What do you see, your genotype or your phenotype? What determines whether or not genes are expressed? Actually, this is quite complicated (Berger, 2005). Some features follow the **additive pattern** which means that many different genes contribute to a final outcome. Height and skin tone are examples. In other cases, a gene might either be turned on or off depending on the gene with which it is paired. Some genes are considered dominant because they will be expressed. Others, termed recessive, are only expressed in the absence of a dominant gene. Some characteristics which were once thought of as **dominant-recessive**, such as eye color, are now believed to be a result of the interaction between several genes (McKusick, 1998). Dominant traits include curly hair, facial dimples, normal vision, and dark hair. Recessive characteristics include red hair, pattern baldness, and nearsightedness.   Sickle cell anemia is a recessive disease; Huntington disease is a dominant disease. Other traits are a result of **partial dominance** or **co-dominance** in which both genes are influential. For example, if a person inherits both recessive genes for sickle cell anemia, the disease will occur. But if a person has only one recessive gene for the disease, the person may experience effects of the disease only under circumstances of oxygen deprivation such as high altitudes or physical exertion (Berk, 2004).

**Chromosomal Abnormalities and Genetic Disorders (Ob7, Ob8)**

A **chromosomal abnormality** occurs when there a child inherits too many or two few chromosomes. The most common cause of chromosomal abnormalities is the age of the mother. A 20 year old woman has a 1 in 800 chance of having a child with a common chromosomal abnormality. A woman of 44, however, has a one in 16 chance. It is believed that the problem occurs when the ovum is ripening prior to ovulation each month. As the mother ages, the ovum is more likely to suffer abnormalities at this time.

Some gametes do not divide evenly when they are forming. Therefore, some cells have more than 46 chromosomes. In fact, it is believed that close to half of all zygotes have an odd number of chromosomes. Most of these zygotes fail to develop and are spontaneously aborted by the body. If the abnormal number occurs on pair #21 or # 23, however, the individual may have certain physical or other abnormalities.

One of the most common chromosomal abnormalities is on pair 21. **Trisomy 21** occurs when there are three rather than two chromosomes on #21.   A person with Down syndrome experiences problems such as mental retardation and certain physical features such as having short fingers and toes, having folds of skin over the eyes, and a protruding tongue. Life expectancy of persons with Down syndrome has increased in recent years. Keep in mind that there is as much variation in people with Down Syndrome as in most populations and those differences need to be recognized and appreciated.

Watch the following video clip about Down Syndrome from the National Down Syndrome Society <http://www.youtube.com/watch?v=TIcbFrt4F_c>

When the abnormality is on pair #23, the result is a **sex-linked chromosomal abnormality**. A person might have XXY, XYY, XXX, XO, or 45 or 47 chromosomes as a result. Two of the more common sex-linked chromosomal disorders are **Turner’s syndrome** and Klinefelter’s syndrome. Turner’s syndrome occurs in 1 of every 2,500 live female births (Carroll, 2007) when an ovum which lacks a chromosome is fertilized by a sperm with an X chromosome. The resulting zygote has an XO composition. Fertilization by a Y sperm is not viable. Turner syndrome affects cognitive functioning and sexual maturation. The external genitalia appear normal, but breasts and ovaries do not develop fully and the woman does not menstruate. Turner’s syndrome also results in short stature and other physical characteristics.  Learn more at [**http://www.turnersyndrome.org/**](http://www.turnersyndrome.org/)**Klinefelter's syndrome (XXY)** occurs in 1 out of 700 live male births and results when an ovum containing an extra X chromosome is fertilized by a Y sperm. The Y chromosome stimulates the growth of male genitalia, but the additional X chromosome inhibits this development. An individual with Klinefelter’s syndrome has some breast development, infertility (this is the most common cause of infertility in males), and has low levels of testosterone.

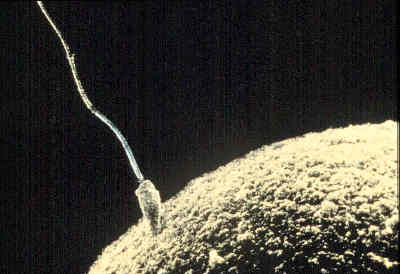
Most of the known **genetic disorders** are dominant gene-linked; however, the vast majority of dominant gene linked disorders are not serious disorders, or if they are, they may still not be debilitating. For example, the majority of those with Tourette's Syndrome suffer only minor tics from time to time and can easily control or cover up their symptoms. Huntington's Disease is a dominant gene linked disorder that affects the nervous system and is fatal but does not appear until midlife.  Recessive gene disorders, such as cystic fibrosis and sickel-cell anemia, are less common but may actually claim more lives because they are less likely to be detected as people are unaware that they are carriers of the disease. If the genes inherited from each parent are the same, the child is **homozygous** for a particular trait and will inherit the trait. If, however, the child inherits a gene from one parent but not the other, the child is **heterozygous**, and interaction between the genes will in part determine whether or not that trait is expressed (Berk, 2004).

**Prenatal Development (Ob9, Ob10)**

**Periods of Prenatal Development**

Now we turn our attention to prenatal development which is divided into three periods: the germinal period, the embryonic period, and the fetal period. Here is an overview of some of the changes that take place during each period.

**The Germinal Period**

**[](http://angel.southseattle.edu/AngelUploads/Files/9cc63e02-ff82-4004-a25e-7d194b7ce500/Sperm-egg.jpg)**

**Sperm and Ovum at Conception**

The germinal period (about 14 days in length) lasts from conception to implantation of the zygote (fertilized egg) in the lining of the uterus. During this time, the organism begins cell division and growth. After the fourth doubling, differentiation of the cells begins to occur as well. It's estimated that about 60 percent of natural conceptions fail to implant in the uterus.  The rate is higher for in vitro conceptions.

**The Embryonic Period**

**[](http://angel.southseattle.edu/AngelUploads/Files/9cc63e02-ff82-4004-a25e-7d194b7ce500/800px-Human_Embryo_-_Approximately_8_weeks_estimated_gestational_age.jpg)**

**Photo by Lunar Caustic**

 This period begins once the organism is implanted in the uterine wall. It lasts from the third through the eighth week after conception.  During this period, cells continue to differentiate and at 22 days after conception the neural tube forms which will become the brain and spinal column. Growth during prenatal development occurs in two major directions: from head to tail (**cephalocaudal development**) and from the midline outward (**proximodistal development**). This means that those structures nearest the head develop before those nearest the feet and those structures nearest the torso develop before those away from the center of the body (such as hands and fingers). The head develops in the fourth week and the precursor to the heart begins to pulse.  In the early stages of the embryonic period, gills and a tail are apparent. But by the end of this stage, they disappear and the organism takes on a more human appearance.  About 20 percent of organisms fail during the embryonic period, usually due to gross chromosomal abnormalities. As in the case of the germinal period, often the mother does not yet know that she is pregnant. It is during this stage that the major structures of the body are taking form making the embryonic period the time when the organism is most vulnerable to the greatest amount of damage if exposed to harmful substances. (We will look at this in the section on teratology below.) Potential mothers are not often aware of the risks they introduce to the developing child during this time. The embryo is approximately 1 inch in length and weighs about 4 grams at the end of this period. The embryo can move and respond to touch at this time.

**The Fetal Period**

From the ninth week until birth, the organism is referred to as a fetus. During this stage, the major structures are continuing to develop. By the 12th week, the fetus has all its body parts including external genitalia. In the following weeks, the fetus will develop hair, nails, teeth and the excretory and digestive systems will continue to develop.  At the end of the 12th week, the fetus is about 3 inches long and weighs about 28 grams.

**During the 4-6th months**, the eyes become more sensitive to light and hearing de, hearing develops. Respiratory system continues to develop. Reflexes such as sucking, swallowing and hiccupping develop during the 5th month. Cycles of sleep and wakefulness are present at that time as well. The first chance of survival outside the womb, known as the **age of viability** is reached at about 22 and 26 weeks (Moore & Persaud, 1998). Many practitioners hesitate to resuscitation before 24 weeks. The majority of the neurons in the brain have developed by 24 weeks although they are still rudimentary and the glial or nurse cells that support neurons continue to grow. At 24 weeks the fetus can feel pain (Royal College of Obstetricians and Gynecologists, 1997).

**Between the 7th and 9th** months the fetus is primarily preparing for birth. It is exercising its muscles, its lungs begin to expand and contract. It is developing fat layers under the skin. The fetus gains about 5 pounds and 7 inches during this last trimester of pregnancy which includes a layer of fat gained during the 8th month. This layer of fat serves as insulation and helps the baby regulate body temperature after birth.

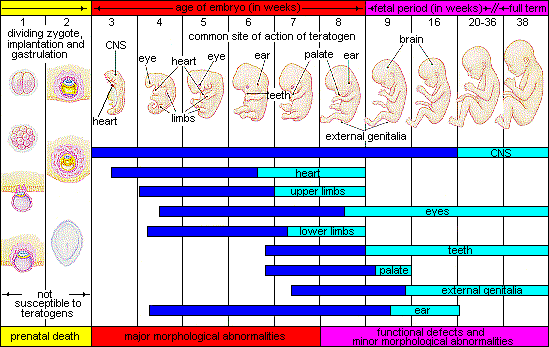
**Environmental Risks during Prenatal Development (Ob12)**

**Teratology**

Good prenatal care is essential. The developing child is most at risk for some of the most severe problems during the first three months of development. Unfortunately, this is a time at which most mothers are unaware that they are pregnant. Today, we know many of the factors that can jeopardize the health of the developing child. The study of factors that contribute to birth defects is called teratology. Teratogens are factors that can contribute to birth defects which include some maternal diseases, pollutants, drugs and alcohol.

**Factors influencing prenatal risks:**There are several considerations in determining the type and amount of damage that might result from exposure to a particular teratogen (Berger, 2004).  These include:

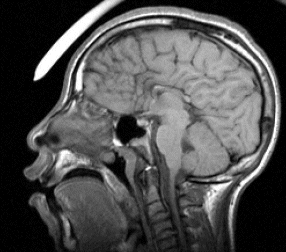
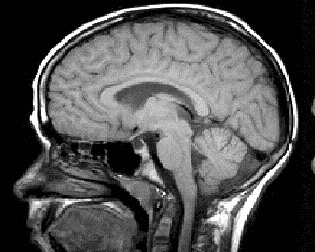
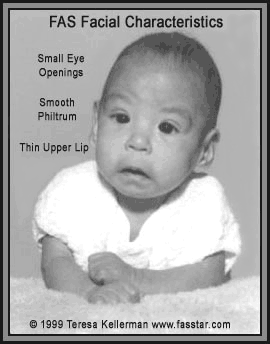
* **The timing of the exposure**: Structures in the body are vulnerable to the most severe damage when they are forming. If a substance is introduced during a particular structure's critical period (time of development), the damage to that structure may be greater. For example, the ears and arms reach their critical periods at about 6 weeks after conception. If a mother exposes the embryo to certain substances during this period, the arms and ears may be malformed.
* **The amount of exposure**: Some substances are not harmful unless the amounts reach a certain level. The critical level depends in part on the size and metabolism of the mother.
* **Genetics:** Genetic make-up also plays a role on the impact a particular teratogen might have on the child. This is suggested by fraternal twin studies who are exposed to the same prenatal environment, yet do not experience the same teratogenic effects. The genetic make-up of the mother can also have an effect; some mothers may be more resistant to teratogenic effects than others.
* **Being male or female**: Males are more likely to experience damage due to teratogens than are females. It is believed that the Y chromosome, which contains fewer genes than the X, may have an impact.

[](http://angel.southseattle.edu/AngelUploads/Files/9cc63e02-ff82-4004-a25e-7d194b7ce500/hcriticaldev.gif)

Critical Periods of Prenatal Development

**A look at some teratogens**

One of the most commonly used teratogens is alcohol and because half of all pregnancies in the United States are unplanned, it is recommended that women of child-bearing age take great caution against drinking alcohol when not using birth control or when pregnant (Surgeon General’s Advisory on Alcohol Use During Pregnancy, 2005). Alcohol consumption, particularly during the second month of prenatal development but at any point during pregnancy may lead to neurocognitive and behavioral difficulties that can last a lifetime. Binge drinking (5 or more on a single occasion) or 7 or more drinks during a single week place a child at risk. In extreme cases, alcohol consumption can lead to fetal death but more frequently it can result in **fetal alcohol spectrum disorders** (FASD),  (This terminology is now used when looking at the effects of exposure and replaces the term fetal alcohol syndrome.  It is preferred because it recognizes that symptoms occur on a spectrum and that all individuals do not have the same characteristics.)  Children with FASD share certain physical features such as flattened noses, small eye holes, and small heads, intellectual developmental delay, and behavioral problems. Those with FASD are more at risk for lifelong problems such as criminal behavior, psychiatric problems, and unemployment (CDC, 2006). The terms alcohol-related neurological disorder (ARND) and alcohol-related birth defects (ARBD) have replaced the term Fetal Alcohol Effects to refer to those with less extreme symptoms of FASD. ARBD include kidney, bone and heart problems.

[[](http://angel.southseattle.edu/AngelUploads/Files/9cc63e02-ff82-4004-a25e-7d194b7ce500/normalbrain.gif)](http://angel.southseattle.edu/AngelUploads/Files/9cc63e02-ff82-4004-a25e-7d194b7ce500/normalbrain.gif)[](http://angel.southseattle.edu/AngelUploads/Files/9cc63e02-ff82-4004-a25e-7d194b7ce500/fasfacejohn.gif)

**Tobacco** is the second most widely used teratogen and the number of adolescent females who smoke is increasing. In fact, among adolescents, females are just as likely to smoke as are males. Tobacco use during pregnancy has been associated with low birth weight, placenta previa, preterm delivery, fetal growth restriction and sudden infant death syndrome (Center for Disease Control, 2004).

**Illicit drugs** as well as prescribed medications can have serious teratogenic effects. It is difficult to completely determine the effects of a particular illicit drug on a developing child because most mothers, who use, use more than one substance. However, several problems seem clear. The use of cocaine is connected with low birth weight, stillbirths and spontaneous abortion. Heavy marijuana use is associated with brain damage and mothers addicted to heroin often pass that addiction to their child. And many medications do not include adequate information on risks posed if taken during pregnancy (Center for Disease Control, 2004).

**Pollutants**

Some environmental pollutants of major concern include lead poisoning, which is connected with low birth weight and slowed neurological development. Children who live in older housing in which lead based paints have been used have been known to eat peeling paint chips thus being exposed to lead. The chemicals in certain herbicides are also potentially damaging. Radiation is another environmental hazard. If a mother is exposed to radiation, particularly during the first 3 months of pregnancy, the child may suffer some congenital deformities. There is also an increased risk of miscarriage and stillbirth. Mercury leads to physical deformities and mental retardation (Dietrich, 1999).

**HIV**

One of the most potentially devastating teratogens is HIV. In the United States, the fastest growing group of people with AIDS is women; globally half of all people infected with HIV are women (UNAIDS, 2005). It is estimated that between 630,000 to 820,000 children were newly infected with HIV worldwide in 2005. Most of this infection is from mother-to-child through the placenta or birth canal (Newell, 2005). There are some measures that can be taken to lower the chance the child will contract the disease (such as the use of antiretroviral drugs from 14 weeks after conception until birth, avoiding breastfeeding, and delivering the child by c-section), many women do not know they are HIV positive during pregnancy. Still others cannot afford the costly drugs used for treating AIDS.  The transmission rate of HIV from mother to child has been reduced in the United States to between 100-200 infants annually.  Go to <http://www.cdc.gov/hiv/topics/perinatal/resources/factsheets/perinatal.htm> to learn more.

**Maternal Diseases**

German measles (or rubella) have been associated with a number of maladies. If the mother contracts the disease during the first three months of pregnancy, damage can occur in the eyes, ears, heart or brain of the unborn child. Deafness is almost certain if the mother has German measles before the 11th week of prenatal development and can also cause brain damage. Gonorrhea, syphilis, and Chlamydia are sexually transmitted infections that can be passed to the fetus by an infected mother; mothers should be tested as early as possible to minimize the risk of spreading these infections (Center for Disease Control, 2006).

**Pregnancy and Childbirth (Ob11)**

**Complications of Pregnancy**

**Minor complications:**  There are a number of common side effects of pregnancy. Not everyone experiences all of these nor to the same degree. And although they are considered "minor" this is not to say that these problems are potentially very uncomfortable. These side effects include nausea (particularly during the first 3-4 months of pregnancy as a result of higher levels of estrogen in the system), heartburn, gas, hemorrhoids, backache, leg cramps, insomnia, constipation, shortness of breath or varicose veins (as a result of carrying a heavy load on the abdomen). What is the cure? Delivery!

**Major Complications:**The following are some serious complications of pregnancy which can pose health risks to mother and child and that often require hospitalization. **Ectopic pregnancy** occurs when the zygote becomes attached to the fallopian tube before reaching the uterus. About 1 in 50 pregnancies in the United States are tubal pregnancies and this number has been increasing because of the higher rates of pelvic inflammatory disease and Chlamydia (Carroll, 2007). Abdominal pain, vaginal bleeding, nausea and fainting are symptoms of ectopic pregnancy. **Toxemia** or blood poisoning due to kidney malfunction is experienced by 6 to 7 percent of women during their last months of pregnancy. If untreated toxemia can lead to **preeclampsia** or swelling and hypertension or progress to **eclampsia** which is can involve coma or death.

**Maternal Mortality:** Approximately 1000 women die in childbirth around the world each day (World Health Organization, 2010).  Rates are highest in Subsaharan Africa and South Asia although there has been a substantial decrease in these rates.   The campaign to make childbirth safe for everyone has led to the development of clinics accessible to those living in more isolated areas and training more midwives to assist in childbirth.  Listen to this story about a midwife's experience in a remote region of Afghanistan.

<http://www.npr.org/blogs/thetwo-way/2010/09/28/130180983/afghan-midwives-save-lives>

**Spontaneous abortion** is experienced in an estimated 20-40 percent of undiagnosed pregnancies and in another 10 percent of diagnosed pregnancy. Usually the body aborts due to chromosomal abnormalities and this typically happened before the 12th week of pregnancy. Cramping and bleeding result and normal periods return after several months. Some women are more likely to have repeated miscarriages due to chromosomal, amniotic, or hormonal problems; but miscarriage can also be a result of defective sperm (Carroll et. al., 2003).

**Problems of the Newborn (Ob14)**

**Low Birth weight**

We have been discussing a number of teratogens associated with low birth weight such as cocaine, tobacco, etc. A child is considered low birth weight if he or she weighs less than 5.8 pounds (2500 grams).  About 8.2 percent of babies born in the United States are of low birth weight (Center for Disease Control, 2010).  A low birth weight baby has difficulty maintaining adequate body temperature because it lacks the fat that would otherwise provide insulation. Such a baby is also at more risk for infection. And 67 percent of these babies are also preterm which can make them more at risk for respiratory infection.  Very low birth weight babies (2 pounds or less) have an increased risk of developing cerebral palsy. Many causes of low birth weight are preventable with proper prenatal care, however.

**Premature Birth**

A child might also have a low birth weight if it is born at less than 37 weeks gestation (which qualifies it as a preterm baby). Early birth can be triggered by anything that disrupts the mother's system. For instance, vaginal infections or gum disease can actually lead to premature birth because such infection causes the mother to release anti-inflammatory chemicals which, in turn, can trigger contractions. Smoking and the use of other teratogens can lead to preterm birth.

**Anoxia**

Anoxia is a temporary lack of oxygen to the brain. Difficulty during delivery may lead to anoxia which can result in brain damage or in severe cases, death.

Babies who suffer both low birth weight and anoxia are more likely to suffer learning disabilities later in life as well.

**Childbirth**

**Approaches to Childbirth**

Prepared childbirth refers to being not only physically in good condition to help provide a healthy environment for the baby to develop, but also helping a couple to prepare to accept their new roles as parents and to get information and training that will assist them for delivery and life with the baby as much as possible. The more a couple can learn about childbirth and the newborn, the better prepared they will be for the adjustment they must make to a new life. (Nothing can prepare a couple for this completely). Once a couple finds that they are to have a child, they begin to conjure up images of what they think the experience will involve. Once the child is born, they must reconcile those images with reality (Galinsky, 1987). Knowing more of what to expect does help them in forming more realistic images thus making the adjustment easier.

Let's explore some of the methods of prepared childbirth.

**The Dick-Read Method of Natural Childbirth**

Grantley Dick-Read was an English obstetrician and pioneer of prepared childbirth in the 1930s. In his book Childbirth Without Fear, he suggests that the fear of childbirth increases tension and make the process of childbearing more painful. He believed that if mothers were educated, the fear and tension would be reduced and the need for medication could frequently be eliminated. The Dick-Read method emphasized the use of relaxation and proper breathing with contractions as well as family support and education. (For more current information on this method go to [www.hypnobirthing.com](http://www.hypnobirthing.com/)) This method influenced the most commonly taught method in the U.S. today, the Lamaze Method.

**The Lamaze Method**

This method originated in Russia and was brought to the United States in the 1950s by Fernand Lamaze. The emphasis of this method is on teaching the woman to be in control in the process of delivery. It includes learning muscle relaxation, breathing though contractions, having a focal point (usually a picture to look at) during contractions and having a support person who goes through the training process with the mother and serves as a coach during delivery.

**Birthing Centers/Birthing Rooms**

The trend now is to have birthing rooms that are hospital rooms that look more like a suite in a hotel equipped with a bed that can be converted for delivery. These rooms are also equipped with a bed and monitoring systems for the newborn. However, many hospitals have only one or two of these rooms and availability can be a problem.

**The LeBoyer Method**

Other birthing options include the use of birthing chairs, which make use of gravity in assisting the woman giving birth and the Leboyer Method of "Gentle Birthing". This method involves giving birth in a quiet, dimly lit room and allowing the newborn to lie on the mother's stomach with the umbilical cord intact for sever minutes while being given a warm bath.

**Home Birth and Nurse-Midwives**

Historically in the United States, most babies were born under the care of lay midwives. In the 1920s, middle class women were increasingly using doctors to assist with childbirth but rural women were still being assisted by lay midwives. The nursing profession began educating nurse-midwives to assist these women. Nurse-midwives continued to assist most rural women with delivery until the 1970s and 1980s when their growth is thought to have posed a threat to the medical profession (Weitz, 2007). Since that time, nurse-midwives have found it more difficult to sustain practices with the high costs of malpractice insurance. (Many physicians have changed areas of specialization in response to these costs as well.) Women who are at low risk for birth complications can successfully deliver under the care of nurse-midwives but only 1 percent of births occur at home. Because one out of every 20 births involves a complication, most medical professionals recommend that delivery take place in a hospital. However, some couples choose to have their baby at home. About 1 percent of births occur out of a hospital in the United States.  Two-thirds of these are homebirths and more than half of these are assisted by midwives.  Midwives are trained and licensed to assist in delivery and are far less expensive than the cost of a hospital delivery. One-third of out-of-hospital births occur in freestanding clinics, birthing centers, or in physicians offices or other locations.  In the United States, women who have had previous children, who are over 25 and who are white are more likely to have out-of-hospital births (MacDorman, et. als., 2010).

**The Process of Delivery (Ob11)**

**The First Stage** of labor begins with uterine contractions that may initially last about 30 seconds and be spaced 15 to 20 minutes apart. These increase in duration and frequency to more than a minute in length and about 3 to 4 minutes apart. Typically, doctors advise that they be called when contractions are coming about every 5 minutes. Some women experience false labor or **Braxton-Hicks** contractions, especially with the first child. These may come and go. They tend to diminish when the mother begins walking around. Real labor pains tend to increase with walking. Labor may also be signaled by a bloody discharge being expelled from the cervix. In one out of 8 pregnancies, the amniotic sac or water in which the fetus is suspended may break before labor begins. In such cases, the physician may induce labor with the use of medication if it does not begin in order to reduce the risk of infection.  Normally this sac does not rupture until the later stages of labor.

The first stage of labor is typically the longest. During this stage the cervix or opening to the uterus dilates to 10 centimeters or just under 4 inches. This may take around 12-16 hours for first children or about 6-9 hours for women who have previously given birth. It takes one woman in 9 over 24 hours to dilate completely.  Labor may also begin with a discharge of blood or amniotic fluid.  If the amniotic sack breaks, labor will be induced if necessary to reduce the risk of infection.

**The Second Stage** involves the passage of the baby through the birth canal. This stage takes about 10-40 minutes. Contractions usually come about every 2-3 minutes. The mother pushes and relaxes as directed by the medical staff. Normally the head is delivered first. The baby is then rotated so that one shoulder can come through and then the other shoulder. The rest of the baby quickly passes through.   At this stage, an **episiotomy** may be performed to avoid tearing the tissue of the back of the vaginal opening. The baby's mouth and nose are suctioned out. The umbilical cord is clamped and cut.

**The Third Stage** is relatively painless. During this stage, the placenta or afterbirth is delivered. This typically within 20 minutes after delivery

If an episiotomy was performed it is stitched up during this stage.

**Assessing the Neonate (Ob13)**

There are several ways to assess the condition of the newborn. The most widely used tool is the **Neonatal Behavioral Assessment Scale** (NBAS) developed by T. Berry Brazelton. This tool has been used around the world to help parents get to know their infants and to make comparisons of infants in different cultures (Brazelton & Nugent, 1995). The baby's motor development, muscle tone, and stress response is assessed.  The **Apgar** is conducted one minute and five minutes after birth. This is a very quick way to assess the newborn's overall condition. Five measures are assessed: the heart rate, respiration, muscle tone (quickly assessed by a skilled nurse when the baby is handed to them or by touching the baby's palm), reflex response (the Babinski reflex is tested), and color. A score of 0 to 2 is given on each feature examined. An Apgar of 5 or less is cause for concern. The second Apgar should indicate improvement with a higher score.

**Now watch this video entitled Life's Greatest Miracle**

[www.pbs.org/wgbh/nova/miracle/program.html](http://www.pbs.org/wgbh/nova/miracle/program.html)

**References**

Berger, K. S. (2005). *The developing person through the life span* (6th ed.). New York: Worth.

Berk, L. (2004). *Development through the life span* (3rd ed.). Boston: Allyn and Bacon.

Bortolus, R., Parazzini, F., Chatenoud, L., Benzi, G., Bianchi, M. M., & Marini, A. (1999). The epidemiology of multiple births. *Human Reproduction Update*, *5*, 179-187.

Brazelton, T. B., & Nugent, J. K. (1995). *Neonatal behavioral assessment scale*. London: Mac Keith Press.

Carrell, D. T., Wilcox, A. L., Lowry, L., Peterson, C. M., Jones, K. P., & Erikson, L. (2003). Elevated sperm chromosome aneuploidy and apoptosis in patients with unexplained recurrent pregnancy loss. *Obstetrics and Gynecology*, *101*(6), 1229-1235.

Carroll, J. L. (2007). *Sexuality now: Embracing diversity* (2nd ed.). Belmont, CA: Thomson.

Dietrich, K. N. (1999). Environmental toxicants and child development. In Tager-Flusberg (Ed.), *Neurodevelopmental disorders* (pp. 469-490). Boston: MIT Press.

FASD, NCBDDD, CDC. (2006, July/August). *Centers for Disease Control and Prevention*. Retrieved May 03, 2011, from http://www.cdc.gov/ncbddd/fas/fasask.htm

Galinsky, E. (1987). *The six stages of parenthood*. Reading, MA: Addison-Wesley Pub.

Gottlieb, G. (1998). Normally occurring environmental and behavioral influences on gene activity: From central dogma to probabilistic epigenesis. *Psychological Review*, *105*, 792-802.

Gottlieb, G. (2000). Environmental and behavioral influences on gene activity. *Current Directions in Psychological Science*, *9*, 93-97.

Gottlieb, G. (2002). *Individual development and evolution: The genesis of novel behavior*. New York: Oxford University Press.

Gould, J. L. (1997). *Biological science*. New York: Norton.

Lippa, R. A. (2002). *Gender, nature, and nurture*. Mahwah, NJ: L. Erlbaum.

MacDorman, M., Menacker, F., & Declercq, E. (2010, August 30). *Trends and Characteristics of Home and Other out of Hospital Births in the United States, 1990-2006* (United States, Center for Disease Control). Retrieved December 22, 2010, from http://www.cdc.gov/nchs/data/nvsr/nvsr58;nvsr58\_11.PDF

Mackon, N., & Fauser, B. (2000). Aspects of ovarian follicle development throughout life. *Hormone Research*, *52*, 161-170.

McKusick, V. A. (1998). *Mendelian inheritance in man: A catalog of human genes and genetic disorders.* Baltimore, MD: Johns Hopkins University Press.

Moore, K. L., & Persaud, T. V. (1998). *Before we are born* (5th ed.). Philadelphia, PA: Saunders.

Mutti, D. O., Zadnik, K., & Adams, A. J. (n.d.). Myopia. The nature versus nurture debate goes on. *Investigative Ophthalmology & Visual Science*. Retrieved May 03, 2011, from http://www.iovs.org/cgi/reprint/37/6/952

Newell, M. (2005). Current issues in the prevention of mother-to-child transmission of HIV-1 infection. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *100*(1), 1-5. doi: 10.1016/j.trstmh.2005.05.012

Rome, E. (1998). Anatomy and physiology of sexuality and reproduction. In *The New Our Bodies, Ourselves* (pp. 241-258). Carmichael, CA: Touchstone Books.

UNAIDS, World Health Organization. (2005). *Adults and Children Estimated to Be Living with HIV as of the End of 2005*. Retrieved August 13, 2006, from http://www.unaids.org?NetTools/Misc/DocInfo.aspx?LANG=en&href http://GVA-DOC-OWL/WEBcontent/Documents/pub/Topics/Epidemiology/Slides02/12-05/EpiCoreDec05Slide004\_en.ppt

United States, Center for Disease Control. (n.d.). *The Health Consequences of Smoking: 2004 Report of the Surgeon General*. Retrieved August 14, 2004, from http://www.cdc.gov/tobacco/sqr/sqr\_2004

United States, Center for Disease Control. (2006, July/August). *Sexually Transmitted Diseases Treatment Guidelines*. Retrieved August 14, 2006, from http://www.cdc.gov/std/treatment/2006/rr5511.pdf

United States, Center for Disease Control, Health and Human Services. (2010, October 5). *Centers for Disease Control and Prevention*. Retrieved May 03, 2011, from http://www.cdc.gov/nchs/faststats/birthwt.htm

United States, Center for Disease Control, National Center on Birth Defects and Developmental Disabilities. (2004, October 29). *Fast Facts about Medication Use during Pregnancy and While Breastfeeding.* Retrieved August 10, 2006, from http://www.cdc.gov/ncbddd/fas/fasask.htm

World Health Organization. (2010, September 15). *Maternal Deaths Worldwide Drop by a Third, WHO*. Retrieved December 22, 2010, from http://www.who.int/mediacentre/news/releases/2010/maternal\_mortality\_20100915/en/index.html