Now we are going to begin the story of the lifespan. In this lesson, we explore the role of heredity and the environment in human development, prenatal development, and childbirth.  
  
  
First, let’s examine the role that heredity and the environment play in shaping development.  
  
  
What makes us who we are? Look closely at this picture of two girls. In what ways are they similar? How do they differ? List the genetic and environmental forces you see here.  
  
  
The epigenetic framework is an important tool for helping us understand the interplay between nature (or heredity) and nurture (or the environment). The terms suggest that the environment can trigger genetic potential.  
  
Most human features are the product of several genes or are polygenic. And if you consult the causes of many diseases, you will find that they are caused by many factors or are multifactorial. Some examples include diabetes and heart disease. Some people are genetically more at risk, but lifestyle increases risk.  
  
  
The basic building blocks of development are chromosomes and genes.   
Chromosomes are long strands of DNA (deoxyribonucleic acid) which contains the blueprint or genetic code for our construction. Normal human cells (other than reproductive cells) have 46 chromosomes or 23 pair of chromosomes.   
Genes are specific units on the strands of DNA. There are about 25,000-30,000 different human genes.  
The Human Genome Project is an international research designed to explore and map the human genome. This mapping progressed rapidly and now there are questions and concerns about how to use the findings in an ethical, nondiscriminatory way. Questions about how to use this information in employment, insurance coverage, adoption, and other areas are still being considered.  
  
  
Conception is the process whereby genetic material from our biological mother and father are combined to make up our own unique genetic code. This diagram of the female reproductive system shows the location of the mother’s eggs or ova in the ovaries. Each month a ripened egg is released from one of the ovaries and is drawn into the fallopian tubes. The father’s genetic material is housed in sperm and released into the vagina during ejaculation. Millions of sperm are released but only one will reach the egg, usually in the fallopian tube as it travels toward the uterus. The fertilized egg or zygote then becomes imbedded in the lining of the uterus where growth continues.   
Watch the video assigned in this lesson, Life’s Greatest Miracle, for a more thorough and interesting presentation of this topic.  
  
Gametes are reproductive cells.  
The sperm is the male reproductive cell.  
The ova are female reproductive cells. The image on the right of the slide is of the sperm which is very small and the ovum which is one of the largest of cells.  
Gametes contain 23 chromosomes which is half the number of normal human cells.  
Sperm are produced beginning in puberty, at around age 12 in males, in a process known as spermatogenesis.  
Females are born with all of their eggs (about 300,000 to 400,000) but only about 400 of these eggs will ripen and mature, a process known as oogenesis, beginning at puberty. One of these ripened eggs is released each month during ovulation.   
  
  
The fertilized egg is called a zygote. Fertilization typically occurs in the fallopian tube. A tubal or ectopic pregnancy occurs if the zygote becomes imbedded in the fallopian tube rather than in the uterus. These pregnancies are usually nonviable and very painful.   
Meiosis is a process in which genetic material from sperm and egg combine.   
After the 5th doubling of cells containing this combined material, cells begin to migrate and differentiate into layers that serve as the rudiments of organ tissue.  
We’ll continue looking at prenatal development after the following discussion of genes.  
  
  
What determines the chromosomal sex of the child?   
Twenty-two chromosomes from each parent are similar in length. You see these matched in this image on the right known as a karyotype.  
The twenty-third pair of chromosomes contains either two x chromosomes or an x and a y.  
Half of sperm contain a y chromosome. All of the ova contain x chromosomes.   
If the 23rd position contains two x chromosomes, the child will be female. If it contains and x and a y, the child will be male.  
The video, Life’s Greatest Miracle, describes how the SRY gene sets up sexual differentiation.  
Can you select for either a male or female child? Microsort is a company that allows couples to select for the sex of their child to either balance their offspring by sex or if they are known carriers of a sex-linked disorder. Visit the website to learn more about this.  
  
  
Monozygotic (mono means one, zygote means fertilized egg) twins are genetically identical. They occur when a single fertilized egg splits apart after conception and each begin to develop. Identical twins are less common than non-identical twins and usually share the same phenotype (appearance).   
Dizygotic twins occur when two eggs are released and fertilized by two separate sperm. They do not share the same DNA. Rather, they are as genetically similar as would be any two siblings with the same biological parents. These are more common than identical twins and are becoming increasingly common with the use of fertility drugs that stimulate the release of eggs.  
Are there other possibilities? Yes.   
  
  
Here is an informative diagram showing varying degrees of placentation or sharing of the same placenta. This depends on when the split occurs.  
  
  
The word genotype refers to the actual genetic material contained in your cells. It is your genetic code.  
The word phenotype refers to the physical traits that are actually expressed in a person. It’s what you see when you look at the person next to you.   
Why is it that all of your genetic coding is not expressed?  
  
  
What determines the expression of genes?  
Some traits are expressed based on an additive pattern or the average of all of the genes you have inherited through the generations. Height and skin tone are traits that follow such a pattern. (Of course, your actual height can also be reduced without adequate nutrition.)  
Other traits follow a dominant/recessive pattern which means that if dominant gene is paired with a recessive gene on your chromosomes, the dominant gene will be expressed. Curly hair is dominant gene linked. Red hair is a recessive trait.  
Some genes are expressed even though a particular member of a pair (or allele) is not totally dominant. Some alleles share dominance. For example, having wavy rather than straight or curly hair may be a result of partial dominance.  
Environmental factors can also trigger our make-up. One example is the relationship between oxygen deprivation triggering pain for those with sickle cell anemia.   
  
  
Now let’s turn our attention to some abnormalities and disorders that are associated with chromosomes and genes.   
Chromosomal abnormalities occur when there is more than 23 pair of chromosomes in cells. The most common cause of these abnormalities is maternal age. There is some evidence that the age of the father can also be correlated with an increased risk of some kinds of diseases as well, but there is more to learn about this relationship.   
The most common chromosomal abnormality is Down syndrome usually caused by an additional copy of genetic material on the 21st chromosome. The likelihood of these increases with maternal age.  
It is estimated that half of all zygotes contain an abnormal number of chromosomes. Trisomy, for example, can occur on the 13th or 18th chromosome. Usually the organism is nonviable if this occurs on positions other than the 21st or 23rd.  
  
  
Trisomy 21 is the cause of most Down syndrome. It is the most common chromosomal abnormality.  
Individuals with Down syndrome can experience varying degrees of intellectual developmental delay and have some distinctive physical features such as folds of skin that come lower over the eyes and short fingers and toes.   
However, it is important to note that there is more variation in individuals with Down syndrome than similarity.   
  
  
Sex linked chromosomal abnormalities occur on the 23rd chromosome.  
There are numerous sex-linked disorders.  
The most common are Turner’s syndrome in females and Klinefelter’s Syndrome in males.  
  
  
Turner’s syndrome occurs when there is only one X chromosome on the 23rd position.   
  
  
Some possible signs of Turner Syndrome include being short, having a low hairline, no menstruation, and sterility.  
  
  
Genetic disorders are associated with specific genes.   
Some are linked to dominant genes such as Huntington’s disease.  
Others, such as sickle-cell anemia and cystic fibrosis, are recessive disorders.  
  
  
Let’s explore prenatal development. Prenatal development is divided into three periods: the germinal period, the embryonic period, and the fetal period.  
  
  
The germinal period begins at conception and continues until the organism is attached to the lining of the uterus, about 14 days.  
During the germinal period, cells first make copies of them and then after reaching about 100 cells in number, begin to differentiate or specialize.   
The failure rate of organisms during this period is quite high at roughly 60 to 70 percent.  
  
  
Once the organism is embedded in the lining of the uterus, it is referred to as an embryo. This lasts from the 3rd through the 8th week of development.  
During this period, all of the major structures of the body begin to form.  
This development occurs in two directions, from the midlife outward (proximodistal development) and from head to tail, known as cephalocaudal development.   
The failure rate during this stage is about 20 percent.  
At the end of this stage, the embryo takes on a distinctly human appearance.  
  
  
The longest period of prenatal development is the fetal period which begins at the 9th week after conception and lasts until birth.   
By the 12th week, the genitals have formed. Development of all the structures of the body continues and by the end of the third month, all structures are present although immature.   
The 4th through the 6th month (also known as the second trimester of pregnancy) is a pivotal time. Reflexive action, sleep patterns, hearing, and dramatic spurts in the growth of the brain occur in this time frame.   
The fetus reaches the age of viability or the first chance of surviving outside the womb at about 24 weeks after gestation.  
During the last 3 months of development, the fetus gains weight and organ systems (particularly the digestive and respiratory systems) continue to mature.   
About 5 percent of fetuses fail during this period. Usually before 22 weeks.  
  
  
Teratology is the study of factors that can contribute to birth defects. These can include pollutants, exposure to harmful substances such as drugs and alcohol, and maternal diseases.  
  
  
The risks associated with teratogens depend on a number of variables.   
First is the timing of the exposure to a teratogenic substance. The structures that are forming are the most vulnerable to severe teratogenic effects or damage. You will see some of the critical periods for various structures in the following slide.   
The amount of exposure that can have a teratogenic effect depends on the size and metabolism of the mother.   
Genetics can also play a role in determining risk as is evidenced in the differences of defects found in dizygotic twin studies. Both have been exposed to the same prenatal environment, but the extent of damage can vary.  
  
  
This chart indicates the most severe risks to certain structures in blue. Note that the embryonic period is most vulnerable to teratogenic effects.   
  
  
The most commonly used teratogen is alcohol.   
The effects of alcohol use are most significant if the mother drinks early in pregnancy, especially in the 2nd month of development.  
Moderate to heavy drinking has been associated with fetal alcohol damage.  
  
  
This young boy was born with fetal alcohol spectrum disorder and has some of the facial characteristics associated with exposure to alcohol during the second month of development.   
  
  
Some problems associated with fetal alcohol spectrum disorders include learning difficulties, impaired motor skills (for example, a newborn may have trouble sucking), a flattened nose, widely spaced eyes, a small head, long term psychosocial problems such as social relationships or behavior in school, and neurological, kidney, bone and heart problems.  
Fetal alcohol spectrum disorders are the leading cause of intellectual developmental delay.  
  
  
The use of tobacco early in pregnancy is associated with stunted growth. A mother who smokes later in her pregnancy can have a low birth weight baby.   
Placenta previa, SIDS, and neurological problems have also been associated with tobacco use.  
  
  
Prescribed and over the counter medications can also be damaging. Good prenatal care and heading warning labels on those drugs is important for pregnant mothers.  
Illegal drugs such as heroin, cocaine, and marijuana are also damaging. Heroin addiction can be passed on to the baby and is associated with preterm birth. Cocaine use is associated with stillbirths and low birth weight. Marijuana use is linked to neurological damage and ADHD.   
Pollutants, HIV and maternal diseases such as rubella can lead to neurological damage, HIV, and deafness, respectively.  
  
  
We now turn our attention to pregnancy and childbirth.  
  
  
Not all mothers experience pregnancy in the same ways. Some have more discomfort than others. Some commonly experienced discomforts include nausea, heartburn, backache, constipation, shortness of breath, and varicose veins. Nausea is common early in pregnancy as estrogen levels rise. The other symptoms increase as the baby grows and puts pressure on the body.   
These symptoms are rarely treated, however. Exercise, keeping one’s feet elevated, and delivery will ultimately relieve these symptoms.  
  
  
Major complications of pregnancy include severe vomiting which can lead to dehydration.  
Threatened abortion occurs when the body begins to produce contractions early in the pregnancy. The mother may be advised to stay in bed, but sometimes a spontaneous miscarriage occurs.  
Preeclampsia is a condition that can occur after 20 weeks of pregnancy and involves headaches, increased blood pressure, swelling or edema, and a buildup of protein in the urine as the kidneys lose their ability to filter urine.   
An ectopic or tubal pregnancy in the fallopian tube and is typically surgically removed.  
Maternal mortality rates are very high in many parts of the world. A thousand women a day die in childbirth due to infection, excessive bleeding, and other complications of pregnancy.  
  
  
Low birth weight babies weigh less than 5.8 pounds or less than 2500 grams. About 8.2 percent of babies in the United States are of low birth weight.   
Low birth weight is associated with smoking, alcohol use, poor nutrition, drug use, disease and infection. Low birth weight can result in infant mortality, respiratory infection (particularly if the baby is also preterm), and longer term developmental delay. Very low-birth weight babies are more at risk of developing cerebral palsy.  
Preterm babies are born before completing 37 weeks of development. About 13 percent of babies in the United States are preterm. Preterm babies are more at risk for low birth weight.  
Fetal anoxia or oxygen deprivation during delivery can lead to brain damage.  
  
  
Now let’s explore a variety of approaches to childbirth. In the United States, there has been an emphasis on education or “prepared” childbirth to train couples about what to expect during labor and delivery.   
  
  
The Dick-Read method of childbirth comes from the British obstetrician Grantly Dick-Read.   
He wrote a book in the 1940s called “Childbirth without Fear” in which he promoted the idea that pain is increased by fear and that education reduces a woman’s fear about childbirth.  
The Dick-Read method still enjoys a wide audience.  
  
  
Fernand Lamaze, a French obstetrician, visited Russia and was impressed with their techniques of childbirth. He brought the principles of teaching a mother how to be in control during delivery, using a variety of breathing techniques to manage pain, and of having a coach to assist during delivery to his teaching about childbirth.  
His technique, known as the Lamaze Method, has been taught in the United States since the late 1950s.  
  
  
There are many other approaches to childbirth.  
The LeBoyer method emphasizes gentle birthing under soft lighting and a soothing environment.   
Home births represent about 1 percent of all births in the United States. The majority of these are assisted by midwives.   
About 1/3rd occur in free-standing birthing centers. Women who use birthing centers and midwives tend to be over 25, white, and have had previous children.   
  
  
These are the stages of a normal delivery.  
The first stage is the longest stage and can last on average about 12-16 hours for first babies and 6-9 hours for subsequent children.   
During this stage, the uterus begins to contract and as labor progresses; contractions last longer and come more frequently. Minute long contractions that come 5 minutes apart are often used as the point at which to start preparing for delivery and to call your physician or midwife if available.   
The cervix or opening to the uterus begins to dilate to about 10 centimeters or just less than 4 inches in diameter.  
This stage may also be signaled by a bloody discharge or release of amniotic fluid if the amniotic sack breaks. In this case, labor must be induced if contractions aren’t progressing to reduce the risk of infection.  
  
The second stage lasts about 10-40 minutes and involves the passage of the baby through the birth canal.   
In a normal delivery, the head is delivered first and the mother is encouraged to push and relax through contractions.  
A surgical incision known as an episiotomy may be made to extend the vaginal opening if needed.  
  
  
The third stage involves the delivery of the placenta or afterbirth.  
If an episiotomy has been performed, it is now sutured.  
This is typically a relatively painless stage.  
  
  
The condition of the newborn is often assessed at 1 minute and 5 minutes after delivery using the APGAR.  
The APGAR scale is a measure of heart rate, respiration, muscle tone, reflex response, and color.  
A skilled practitioner can conduct the APGAR easily and quickly.  
The newborn is given a score of 0 to 2 on each of the measures. A perfect APGAR would be a score of 10.   
But few babies receive a 10 on their first reading. Less than five is a cause for concern. The score should improve upon the second reading.  
  
  
Another assessment that is often used is the Brazelton Neonatal Behavioral Assessment Scale.  
This is designed to look at the newborn’s neurological condition by witnessing the sympathetic and parasympathetic nervous system as it responds to stress as well as determining whether the baby has normal motor control.  
The baby’s motor development is examined perhaps by moving the baby and seeing if its head and eyes move to follow an object.  
Is the baby cuddly when held or is it flaccid or stiff?   
When the bottom of the baby’s feet is slapped, the baby should begin to cry in response to stress.  
And the baby should be able to calm back down soon after as evidence of physiological control.