

ESSENTIALS OF LIFE-SPAN DEVELOPMENT

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BIOLOGICAL BEGINNINGS

2

CHAPTER OUTLINE

- The evolutionary perspective
- Genetic foundations of development
- The interaction of heredity and environment: The nature-nurture debate
- Prenatal development
- Birth and the postpartum period

THE EVOLUTIONARY PERSPECTIVE

- *Natural selection* - Evolutionary process by which those individuals of a species that are best adapted are the ones that survive and reproduce
- *Adaptive behavior* - Promotes an organism's survival in its natural habitat

THE EVOLUTIONARY PERSPECTIVE

- **Evolutionary psychology**
 - Emphasizes the importance of adaptation, reproduction, and survival of the fittest in shaping behavior
 - Growing interest in using concepts of evolutionary psychology to understand human development
 - Extended childhood period evolved
 - Domain-specific psychological mechanisms
 - Evolved mechanisms are not always adaptive in contemporary society

THE EVOLUTIONARY PERSPECTIVE

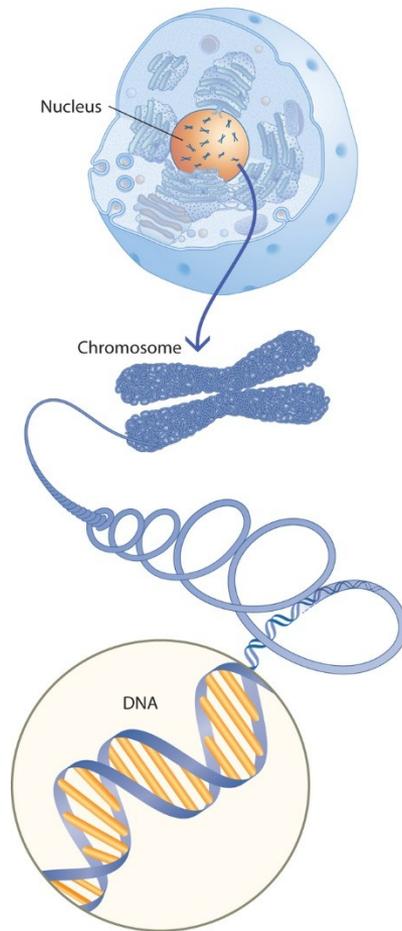
- Evaluating Evolutionary Psychology
 - Evolution gave us biological potentialities, but it does not dictate behavior
 - People have used their biological capacities to produce diverse cultures
 - Aggressive and peace-loving, egalitarian and autocratic
 - Studying specific genes in humans and other species and their links to traits and behaviors
 - Best approach for testing ideas coming out of evolutionary psychology

GENETIC FOUNDATIONS OF DEVELOPMENT

- Human life begins as a single cell
- Nucleus of each cell contains chromosomes
 - **Chromosomes:** Threadlike structures made up of deoxyribonucleic acid
 - **DNA:** A complex double-helix molecule that contains genetic information
- **Genes:** Units of hereditary information, are short segments of DNA

FIGURE 2.2 - CELLS, CHROMOSOMES, DNA, AND GENES

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Cell



GENETIC FOUNDATIONS OF DEVELOPMENT

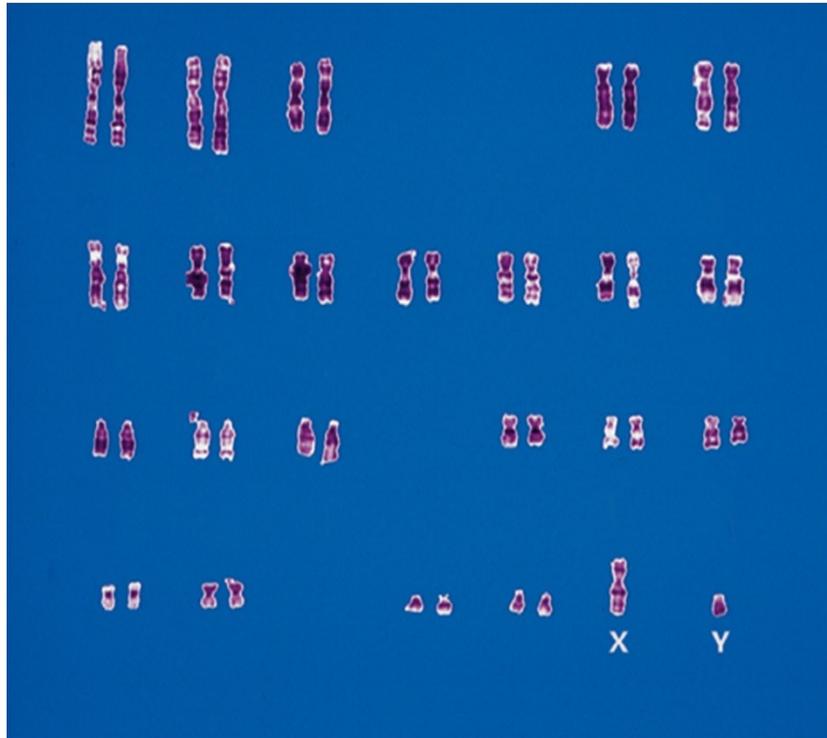
- *Human genome* – complete set of developmental instructions for creating proteins that initiate the making of a human organism
 - Genome consists of many genes that collaborate:
 - With each other
 - With nongenetic factors inside and outside the body
- Activity of genes is affected by their environment
 - Stress, radiation, and temperature can influence gene expression
 - Exposure to radiation changed the rate of DNA synthesis in cells

GENETIC FOUNDATIONS OF DEVELOPMENT

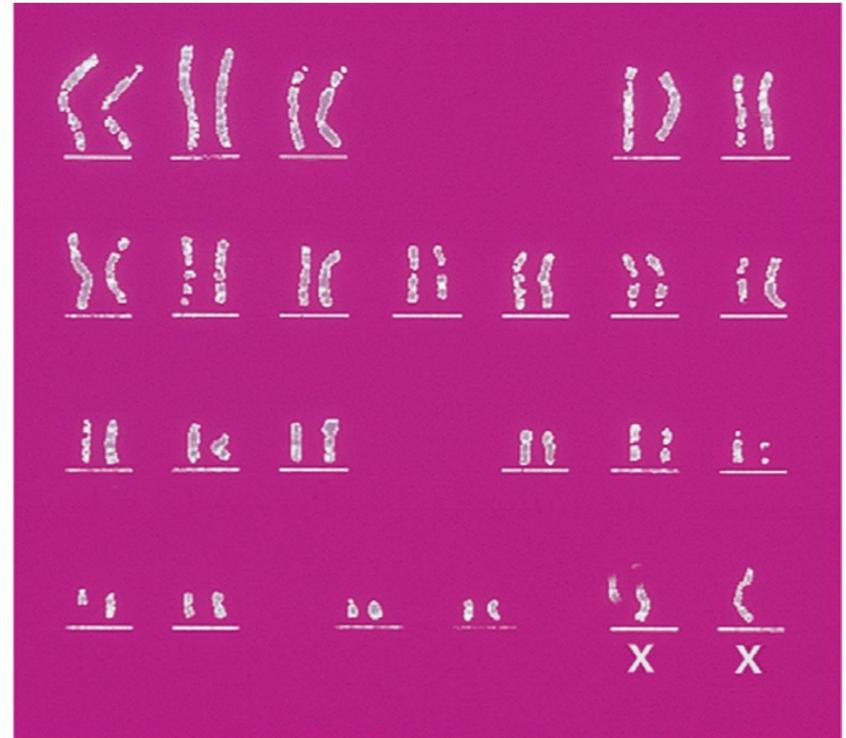
- Mitosis, meiosis, and fertilization
 - **Mitosis:** Reproduction of cells
 - **Meiosis:** Cell division that forms sperm and eggs (gametes)
 - **Fertilization:** A stage in reproduction when an egg and a sperm fuse to create a single cell, called a zygote
 - **Zygote:** A single cell formed through fertilization

FIGURE 2.3 - THE GENETIC DIFFERENCE BETWEEN MALES AND FEMALES

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(a)



(b)

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GENETIC FOUNDATIONS OF DEVELOPMENT

- Sources of variability
 - Combining the genes of two parents in off spring increases genetic variability
 - Important sources of variability:
 - Chromosomes in the zygote are not exact copies of those in the mother's ovaries and the father's testes
 - *Mutated genes* – permanently altered segment of DNA

GENETIC FOUNDATIONS OF DEVELOPMENT

- **Genotype:** A person's genetic material
- **Phenotype:** Observable characteristics
 - For each genotype, a range of phenotypes may be expressed
- *Susceptibility genes* – those that make an individual more vulnerable to specific diseases or acceleration of aging
- *Longevity genes* - those that make an individual less vulnerable to certain diseases and more likely to live to older ages

GENETIC FOUNDATIONS OF DEVELOPMENT

- Dominant and recessive genes principle
 - One gene of a pair always exerts its effects (dominant), overriding the potential influence of the other gene (recessive)
- Sex-linked genes
 - When a mutated gene is carried on the X chromosome, the result is called X-linked inheritance
 - Implications for males that differ greatly from females

GENETIC FOUNDATIONS OF DEVELOPMENT

- Polygenic inheritance
 - Polygenically determined by the interaction of many different genes
 - Gene-gene interaction - Studies that focus on the interdependence of two or more genes in:
 - Influencing characteristics, behavior, diseases, and development

GENETIC FOUNDATIONS OF DEVELOPMENT

- Chromosome abnormalities
 - Sometimes a gamete formed in which sperm and ovum do not have their normal set of 23 chromosomes
- **Down syndrome** – Chromosomally transmitted form of intellectual disability, caused by presence of an extra copy of chromosome 21
- Sex-linked chromosome abnormalities
 - Presence of an extra chromosome (either X or Y) or the absence of one X chromosome in females

GENETIC FOUNDATIONS OF DEVELOPMENT

- *Klinefelter syndrome (XXY)*
 - Males have an extra X chromosome
- *Fragile X syndrome*
 - Abnormality in the X chromosome, which becomes constricted and often breaks
- *Turner syndrome (XO)*
 - Females in which an X chromosome is missing
- *XYY syndrome*
 - Male has an extra Y chromosome

FIGURE 2.4 - SOME CHROMOSOME ABNORMALITIES

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Name	Description	Treatment	Incidence
Down syndrome	An extra chromosome causes mild to severe intellectual disabilities and physical abnormalities.	Surgery, early intervention, infant stimulation, and special learning programs	1 in 1,900 births at age 20 1 in 300 births at age 35 1 in 30 births at age 45
Klinefelter syndrome (XXY)	An extra X chromosome causes physical abnormalities.	Hormone therapy can be effective	1 in 600 male births
Fragile X syndrome	An abnormality in the X chromosome can cause intellectual disabilities, learning disabilities, or short attention span.	Special education, speech and language therapy	More common in males than in females
Turner syndrome (XO)	A missing X chromosome in females can cause intellectual disabilities and sexual underdevelopment.	Hormone therapy in childhood and puberty	1 in 2,500 female births
XYY syndrome	An extra Y chromosome can cause above-average height.	No special treatment required	1 in 1,000 male births

GENETIC FOUNDATIONS OF DEVELOPMENT

- Gene-linked abnormalities
 - Produced by defective genes
- *Phenylketonuria (PKU)*
 - Metabolic disorder that, left untreated, causes mental retardation
- *Sickle-cell anemia*
 - Blood disorder that limits the body's oxygen supply
 - Can cause joint swelling, as well as heart and kidney failure

FIGURE 2.5 - SOME GENE-LINKED ABNORMALITIES

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Name	Description	Treatment	Incidence
Cystic fibrosis	Glandular dysfunction that interferes with mucus production; breathing and digestion are hampered, resulting in a shortened life span.	Physical and oxygen therapy, synthetic enzymes, and antibiotics; most individuals live to middle age.	1 in 2,000 births
Diabetes	Body does not produce enough insulin, which causes abnormal metabolism of sugar.	Early onset can be fatal unless treated with insulin.	1 in 2,500 births
Hemophilia	Delayed blood clotting causes internal and external bleeding.	Blood transfusions/injections can reduce or prevent damage due to internal bleeding.	1 in 10,000 males
Huntington disease	Central nervous system deteriorates, producing problems in muscle coordination and mental deterioration.	Does not usually appear until age 35 or older; death likely 10 to 20 years after symptoms appear.	1 in 20,000 births
Phenylketonuria (PKU)	Metabolic disorder that, left untreated, causes intellectual disability.	Special diet can result in average intelligence and normal life span.	1 in 10,000 to 1 in 20,000 births
Sickle-cell anemia	Blood disorder that limits the body's oxygen supply; it can cause joint swelling, as well as heart and kidney failure.	Penicillin, medication for pain, antibiotics, and blood transfusions.	1 in 400 African American children (lower among other groups)
Spina bifida	Neural tube disorder that causes brain and spine abnormalities.	Corrective surgery at birth, orthopedic devices, and physical/medical therapy.	2 in 1,000 births
Tay-Sachs disease	Deceleration of mental and physical development caused by an accumulation of lipids in the nervous system.	Medication and special diet are used, but death is likely by 5 years of age.	1 in 30 American Jews is a carrier.

THE INTERACTION OF HEREDITY AND ENVIRONMENT: THE NATURE-NURTURE DEBATE

- **Behavior genetics**
 - Field that seeks to discover the influence of heredity and environment on individual differences in human traits and development
- **Twin study:** Behavioral similarity of identical and fraternal twins is compared
- **Adoption study:** Seek to discover whether, in behavior and psychological characteristics, adopted children are:
 - More like their adoptive parents, who provided a home environment
 - More like their biological parents, who contributed their heredity

THE INTERACTION OF HEREDITY AND ENVIRONMENT: THE NATURE-NURTURE DEBATE

- Heredity-environment correlations
 - *Passive genotype-environment correlations* - Occur because biological parents, who are genetically related to the child, provide a rearing environment for the child
 - *Evocative genotype-environment correlations* - Occur because a child's characteristics elicit certain types of environments
 - *Active (niche-picking) genotype-environment correlations* - Occur when children seek out environments that they find compatible and stimulating

THE INTERACTION OF HEREDITY AND ENVIRONMENT: THE NATURE-NURTURE DEBATE

- **Epigenetic view**
 - Development is the result of an ongoing, bidirectional interchange between heredity and environment
- **Gene X environment (G X E) interaction:** Interaction of:
 - Specific measured variation in the DNA
 - Specific measured aspect of the environment

FIGURE 2.6 - COMPARISON OF THE HEREDITY - ENVIRONMENT CORRELATION AND EPIGENETIC VIEWS

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Heredity-Environment Correlation View

Heredity  Environment

Epigenetic View

Heredity  Environment

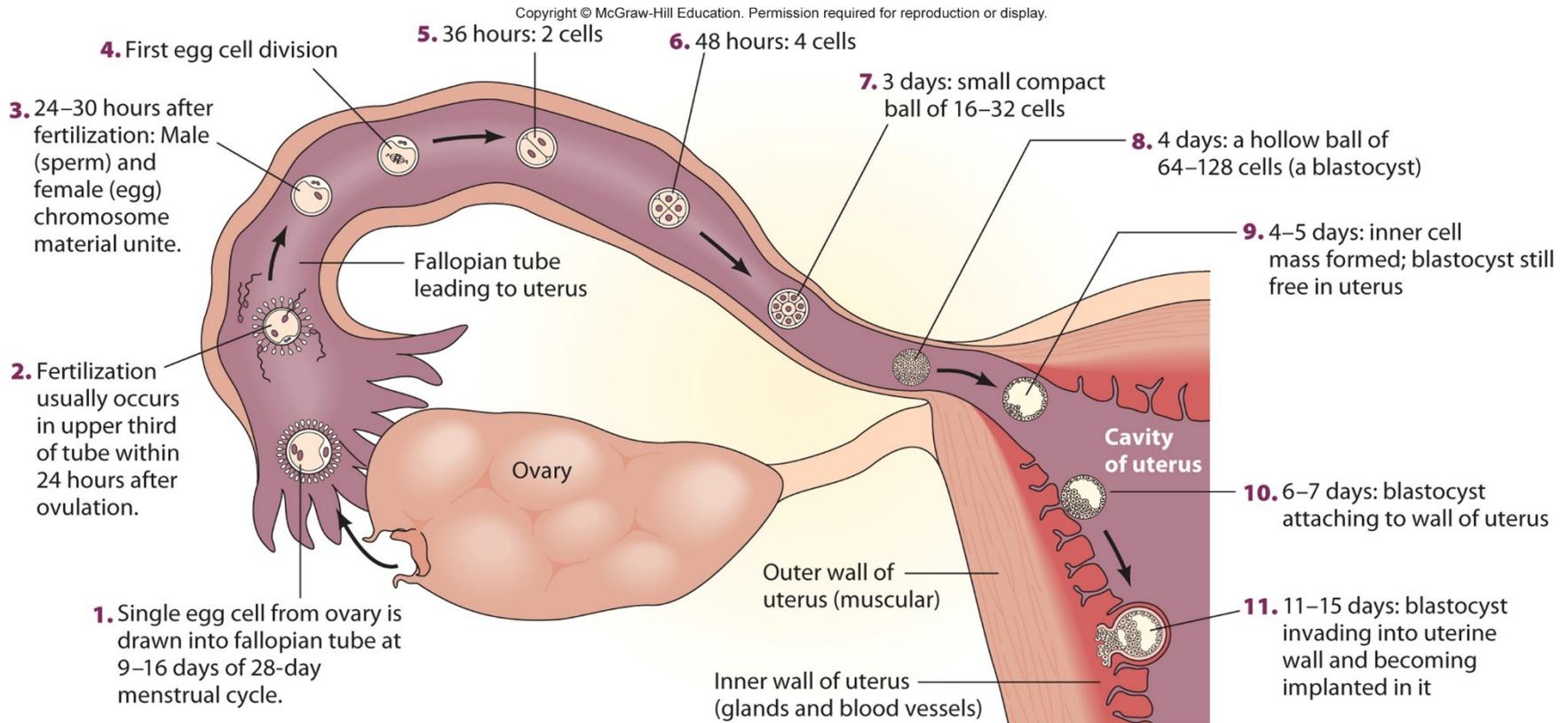
THE INTERACTION OF HEREDITY AND ENVIRONMENT: THE NATURE-NURTURE DEBATE

- Conclusions about heredity-environment interaction
 - Relative contributions of heredity and environment are not additive
 - Complex behaviors are influenced by genes in ways that gives people a propensity for a particular developmental trajectory

PRENATAL DEVELOPMENT

- **Germinal period**
 - Takes place in the first two weeks after conception
 - Includes:
 - Creation of fertilized egg (the zygote)
 - Cell division
 - Attachment of the multicellular organism to the uterine wall

FIGURE 2.7 - MAJOR DEVELOPMENTS IN THE GERMINAL PERIOD



THE COURSE OF PRENATAL DEVELOPMENT

- **Embryonic period**
 - Occurs from two to eight weeks after conception
 - Rate of cell differentiation intensifies
 - Support systems for cells form
 - Organs appear
 - **Organogenesis:** Process of organ formation during the first two months of prenatal development

THE COURSE OF PRENATAL DEVELOPMENT

- **Fetal period**
 - Extends from two months after conception until birth
 - Lasts about seven months
 - Growth and development continue their dramatic course during this time

FIGURE 2.8 - GROWTH AND DEVELOPMENT IN THE THREE TRIMESTERS OF PRENATAL DEVELOPMENT

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First trimester (first 3 months)



Conception to 4 weeks

- Is less than $\frac{1}{10}$ inch long
- Beginning development of spinal cord, nervous system, gastrointestinal system, heart, and lungs
- Amniotic sac envelops the preliminary tissues of entire body
- Is called a "zygote," then a "blastocyst"

8 weeks

- Is just over 1 inch long
- Face is forming with rudimentary eyes, ears, mouth, and tooth buds
- Arms and legs are moving
- Brain is forming
- Fetal heartbeat is detectable with ultrasound
- Is called an "embryo"

12 weeks

- Is about 3 inches long and weighs about 1 ounce
- Can move arms, legs, fingers, and toes
- Fingerprints are present
- Can smile, frown, suck, and swallow
- Sex is distinguishable
- Can urinate
- Is called a "fetus"

Second trimester (middle 3 months)



16 weeks

- Is about 6 inches long and weighs about 4 to 7 ounces
- Heartbeat is strong
- Skin is thin, transparent
- Downy hair (lanugo) covers body
- Fingernails and toenails are forming
- Has coordinated movements; is able to roll over in amniotic fluid

20 weeks

- Is about 12 inches long and weighs close to 1 pound
- Heartbeat is audible with ordinary stethoscope
- Sucks thumb
- Hiccups
- Hair, eyelashes, eyebrows are present

24 weeks

- Is about 14 inches long and weighs about 1 to $1\frac{1}{2}$ pounds
- Skin is wrinkled and covered with protective coating (vernix caseosa)
- Eyes are open
- Waste matter is collected in bowel
- Has strong grip

Third trimester (last 3 months)



28 weeks

- Is about 16 inches long and weighs about 3 pounds
- Is adding body fat
- Is very active
- Rudimentary breathing movements are present

32 weeks

- Is $16\frac{1}{2}$ to 18 inches long and weighs 4 to 5 pounds
- Has periods of sleep and wakefulness
- Responds to sounds
- May assume the birth position
- Bones of head are soft and flexible
- Iron is being stored in liver

36 to 38 weeks

- Is 19 to 20 inches long and weighs 6 to $7\frac{1}{2}$ pounds
- Skin is less wrinkled
- Vernix caseosa is thick
- Lanugo is mostly gone
- Is less active
- Is gaining immunities from mother

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FIGURE 2.9 - EARLY FORMATION OF THE NERVOUS SYSTEM

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PRENATAL DEVELOPMENT

- Prenatal diagnostic testing
 - Used to determine if fetus is developing normally
 - Decision on a given test depends on mother's age, medical history, and genetic risks factors:
 - *Ultrasound sonography*
 - *Chorionic villus sampling*
 - *Amniocentesis*
 - *Maternal blood screening*
 - *Fetal MRI*
 - *Noninvasive prenatal diagnosis (NIPD)*

PRENATAL DEVELOPMENT

- **Teratogen**
 - Any agent that can potentially cause a birth defect or negatively alter cognitive and behavioral outcomes
 - Dose, genetic susceptibility, time of exposure influences severity of damage
- **Psychoactive drugs**
 - Caffeine
 - Alcohol
 - Nicotine
 - Cocaine
 - Marijuana
 - Heroin

PRENATAL DEVELOPMENT

- **Fetal alcohol spectrum disorders (FASD)**
 - A cluster of abnormalities and problems that appear in the offspring of mothers who drink alcohol heavily during pregnancy
 - Include facial deformities, defective limbs, face, and heart, learning problems, intellectual disability
- **Environmental Hazards**
 - Radiation, toxic waste, environmental pollutants
 - Maternal diseases

PRENATAL DEVELOPMENT

- Other Parental Factors
 - Maternal diet and nutrition
 - Maternal age
 - Emotional states and stress
 - Paternal factors

PRENATAL DEVELOPMENT

- Prenatal care
 - Varies enormously from one woman to another
 - Usually involves defined schedule of visits for medical care which includes screening for:
 - Manageable conditions
 - Treatable diseases that can affect the baby or the mother
 - Comprehensive educational, social, and nutritional services

BIRTH AND THE POSTPARTUM PERIOD

- The birth process
 - First stage
 - Longest stage
 - Uterine contractions begin at 15 to 20 minutes apart and last up to a minute each
 - Second birth
 - Baby's head starts to move through the cervix and the birth canal
 - Terminates when the baby completely emerges from the mother's body
 - Third stage (afterbirth)
 - Placenta, umbilical cord, and other membranes are detached and expelled

BIRTH AND THE POSTPARTUM PERIOD

- Childbirth setting and attendants
 - *Midwives* – Provides health care to women during pregnancy, birth, and postpartum period
 - *Doulas* – A caregiver who provides continuous physical, emotional, and educational support for the mother before, during, and after childbirth

BIRTH AND THE POSTPARTUM PERIOD

- Medication
 - Analgesia - Used to relieve pain
 - Include tranquilizers, barbiturates, and narcotics
 - Anesthesia - Used in late first-stage labor and during delivery to block sensation in an area of the body or to block consciousness
 - Epidural block
 - Oxytocin/pitocin - Synthetic hormone used to stimulate contractions

BIRTH AND THE POSTPARTUM PERIOD

- **Natural childbirth:** Method in which no drugs are given to relieve pain or assist in the birth process
- **Prepared childbirth:** Includes a special breathing technique to control pushing in the final stages of labor
 - More detailed education about anatomy and physiology
 - Also known as Lamaze method

BIRTH AND POSTPARTUM PERIOD

- Other nonmedicated techniques to reduce pain
 - Waterbirth
 - Massage
 - Acupuncture
- Cesarean delivery – Baby is removed from the uterus through an incision made in the mother’s abdomen
 - Benefits and risks of this procedure continue to be debated

BIRTH AND POSTPARTUM PERIOD

- Anoxia – Condition in which fetus/newborn has insufficient supply of oxygen
 - Can cause brain damage
- Baby has considerable capacity to withstand stress of birth
 - Hormones protect fetus in the event of oxygen deficiency
 - Immediately after birth, newborn is taken to be tested for signs of developmental problems that require urgent attention

BIRTH AND POSTPARTUM PERIOD

- **Apgar Scale**

- Widely used to assess the health of newborns at 1 and 5 minutes after birth
- Evaluates infants' heart rate, respiratory effort, muscle tone, body color, and reflex irritability
- Especially good at assessing newborn's ability to respond to stress of delivery and its new environment

BIRTH AND POSTPARTUM PERIOD

- *Low birth weight* - Weigh less than 5 pounds at birth
- *Very low birth weight* - Weigh under 3 pounds
- *Extremely low birth weight* - Weigh under 2 pounds
- *Preterm* - Born three weeks or more before the pregnancy has reached its full term
- *Small for date* – Below normal birth weight when length of pregnancy is considered
 - May be preterm or full term

BIRTH AND POSTPARTUM PERIOD

- Consequences of low birth weight
 - More health and developmental problems than normal birth weight infants, including:
 - Learning disability
 - Attention deficit hyperactivity disorder
 - Autism spectrum disorders
 - Breathing problems such as asthma
- Interventions in neonatal intensive care unit (NICU):
 - *Kangaroo care* – skin-to-skin contact with baby held against parent's bare chest
 - Massage therapy

BIRTH AND POSTPARTUM PERIOD

- *Bonding*
 - Formation of a connection, especially a physical bond between parents and the newborn in the period shortly after birth
 - *Bonding hypothesis* proposes “critical period” shortly after birth to form an emotional attachment and foundation for optimal development

BIRTH AND POSTPARTUM PERIOD

- Postpartum Period
 - Period after childbirth or delivery that lasts for about six weeks
 - Until the mother's body has completed its adjustment and has returned to a nearly pre-pregnant state
- Physical adjustments
 - Fatigue
 - Loss of sleep
 - Sudden and dramatic change in hormone production
 - *Involution* – uterus returns to pre-pregnant size

BIRTH AND POSTPARTUM PERIOD

- Emotional adjustments
 - Postpartum blues
 - Feeling anxious, depressed, or upset
 - May come and go for several months after birth, but usually go away after 1-2 weeks
 - Postpartum depression
 - Strong feelings of sadness, anxiety, despair, trouble coping with daily tasks
 - Symptoms linger for weeks or months and interfere with daily functioning