CHAPTER 3

Growth and Development of Children

OUTLINE

LEARNING OBJECTIVES

After completion of the chapter the reader should be able to

1. Describe the major events that occur during prenatal growth and development.
2. Define the embryonic period.
3. Define the terms "low birth weight," "small for gestational age," and "large for gestational age."
4. Identify the reasons for abnormal intrauterine growth.
5. Describe the grasp and Babinski's reflexes.
6. List four methods of heat loss in the newborn.
7. Explain the major cardiovascular changes after birth.
8. Describe the immaturity of the urinary system after birth.

KEY TERMS

Achondroplasia: A type of dwarfism that is usually a sporadic mutation.
Amniotic fluid: A liquid produced by and contained within the fetal membranes during pregnancy.
Blastocyst: A thin-walled, hollow structure that contains the inner cell mass (embryoblast), from which the embryo arises.
Cleavage: The process of mitotic cell divisions that produces a blastula from a fertilized ovum.
Ductus arteriosus: The shunt that connects the pulmonary artery to the aortic arch in developing infants.
Embryo: The developing offspring, from the 2nd through the 8th week of pregnancy.
Embryoblast: The inner cell mass, from which the embryo arises.
Fertilization: The union of a male sperm and a female ovum; also called conception.
Fetus: The developing offspring, from the 8th week until birth.
Foramen ovale: The second shunt in a fetal heart; it allows blood to enter the left atrium from the right atrium.
Full term: A fetus that has reached 37 weeks of development and is essentially able to survive outside of the womb.
Grasp reflex: A pathologic reflex induced by stroking the palm, with the result that the fingers flex in a grasping motion. In newborns and young infants the tonic grasp reflex is normal.
Hyperplasia: An abnormal increase in cells that causes enlargement of a tissue or organ.
Hypokalemia: Lower than normal potassium in the blood.
Implantation: The process by which a fertilized egg implants in the uterine lining.

KEY TERMS CONTINUED

Morula: The round mass of blastomeres that results from cleavage of the fertilized ovum; it forms the blastula.
Polycythemia: Increased numbers of erythrocytes in the blood circulation.
Sepsis: A potentially serious systemic inflammatory response, affecting numerous parts of the body, commonly caused by septicemia (the presence of pathogenic microorganisms in the bloodstream).
Startle reflex: A reflex response to a sudden unexpected stimulus. The reaction may be accompanied by physiologic effects, including increased heartbeat and respiration, closing of the eyes, and flexion of the trunk muscles.
Sucking reflex: Involuntary sucking movements of the circumoral area in newborns in response to stimulation.
Trophoblast: Also called the "trophoderm"; it is the outermost layer of cells of the blastocyst that attaches the fertilized ovum to the uterine wall, providing nutrition to the embryo.
Zygote: The cell formed by fertilization, before the occurrence of cleavage.

Overview

Growth and development influence which illnesses may affect children and their response to these illnesses. Today, infant mortality rates are lower than ever before because of great advances in the development of medications and other treatments. Mortality rates for infants are higher today in Black, non-Hispanic people than for other groups of people. The incidence of premature births continues to cause higher numbers of infant deaths because the bodies of these infants may not be mature enough to survive. Infants with very low birth weight (less than 3.3 pounds) are increasing in number, partially because of an increase of twin, triplet, and higher-order multiple births.

Growth and Development

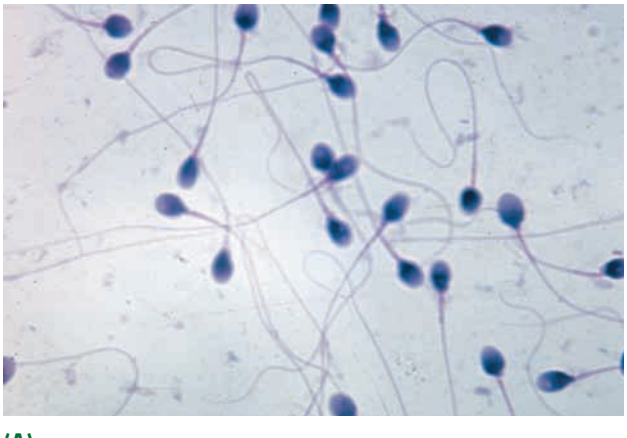
Growth and development include changing from a fertilized ovum (**zygote**) to an **embryo**, fetus, infant, child, and adult. *Physical growth* consists of changes in the body or its individual parts. Changes in body function or psychosocial behaviors are termed *development*. Rapid growth occurs during the first year of life, continuing throughout childhood.

Middle to late childhood is the period from beginning school (approximately age 6) through adolescence (beginning approximately at age 12), and is the period when children begin to develop strong peer relationships. Adolescence is a transitional period, between childhood and adulthood, considered to be from ages 13 to 19. It begins with the development of secondary sex characteristics and continues until the end of somatic growth. At puberty, growth spurts cause rapid development of specific areas of the body at certain times.

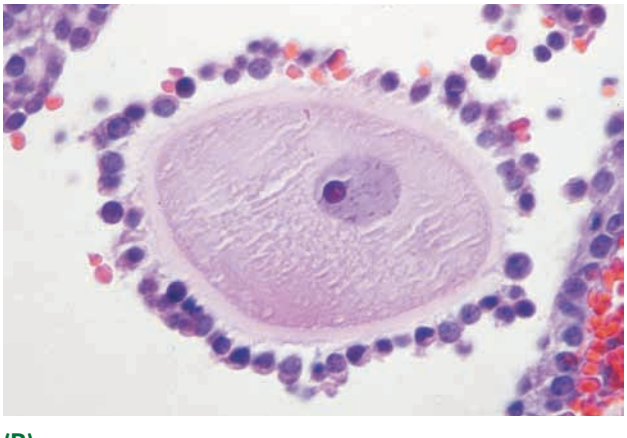
Linear growth results from skeletal growth, and it stops when the skeleton is fully mature. Beginning at age 3 years a normal child grows between 5 and 6 centimeters for the next 9 years. Growth then slows down, and most organ systems reach maturity. To reach adult height, growth spurts occur during adolescence. Boys gain about 20 centimeters and girls 16 centimeters during adolescence.

Prenatal Growth and Development

Human growth and development begin when an ovum is fertilized by a sperm cell (**Figure 3–1**). Fertilization is also known as *conception*. When a developing offspring is implanted into the wall of the uterus, *pregnancy* begins. A pregnancy consists of three periods, called trimesters. At least several hundred sperm cells must be present to produce enough enzymes to allow one sperm cell to penetrate the ovum.



(A)



(B)

Figure 3–1 (A) Normal sperm in vaginal secretions. The darkly staining head containing the genetic material is covered by a lightly staining head-cap that contains the enzymes needed to penetrate the ovum during fertilization. The long narrow tail provides propulsion (original magnification 1,000). (B) Mature ovum with adherent granulosa cells. The nucleus is seen near the center of the cell. The homogeneous band surrounding the ovum is the zona pellucida (original magnification X 400).

In just 24 hours the one-celled organism divides into two cells. Within 72 hours it further divides into 16 cells and is called a **morula**. These mitotic divisions are referred to as **cleavage**. Peristaltic movements propel the morula down the oviduct to the uterus. About 4 days after **fertilization** the morula is divided into two parts by uterine fluids. The placenta (**trophoblast**) forms from the outer layer, and the embryo (**embryoblast**) forms from the inner layer. The structure that is now developed is called the **blastocyst**, which attaches to the endometrium of the uterus by the 6th day (**Figures 3–2** and **3–3**). This **implantation** period continues during the 2nd week of development.

There are two main periods of prenatal development. The *embryonic period* takes place from the 2nd week to the 8th week after fertilization, with main organ systems developing and functioning at minimal levels. The *fetal period*, beginning during the 9th week, involves growth and differentiation of the organ systems of the body until birth.

RED FLAG

If a pregnant woman requires physical therapy, the physical therapist assistant (PTA) must follow the established plan of care in regards to educating her about prenatal exercise, proper nutrition and rest, and avoiding smoking and drinking alcohol.

Embryonic Development

When the blastocyst is implanted and days go by, a tiny space appears in the embryoblast. This becomes the primordium of the amniotic cavity. A flat, semiround *embryonic disk* forms, which becomes all three germ layers of the embryo (ectoderm, mesoderm, and endoderm). Development increases during the 3rd week as the embryonic disk matures (*gastrulation*) (**Figure 3–4**). The ectoderm differentiates to become the epidermis and nervous system. The endoderm develops into the epithelial linings of the respiratory and digestive tracts as well as glandular cells of the liver, pancreas, and other organs. The mesoderm forms many structures, including the connective and smooth muscle tissues, skeletal tissue, striated muscle tissue, blood cells and vessels, bone marrow, and the reproductive and excretory organs.

The axial skeleton and neurologic system also begin to form during the 3rd week. Many neural-related structures form during the 4th week, and during this period

RED FLAG

It is vital that the pregnant female consume the recommended dietary amounts of folic acid for normal neural tube development. The neural tube develops fully during week 4 of pregnancy. Incomplete neural tube development can result in a condition known as *spina bifida*.

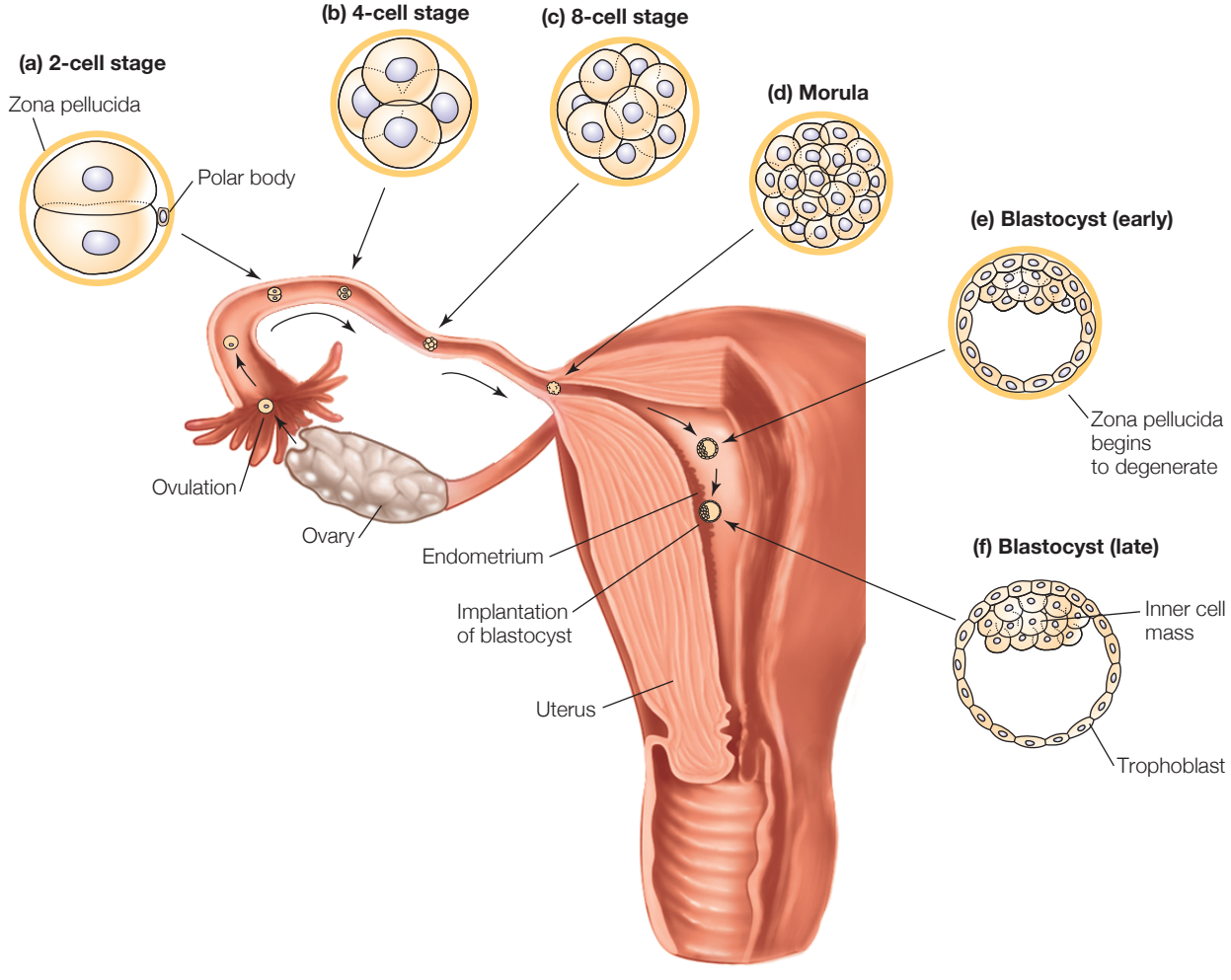


Figure 3–2 The blastocyst contacting the uterine wall.

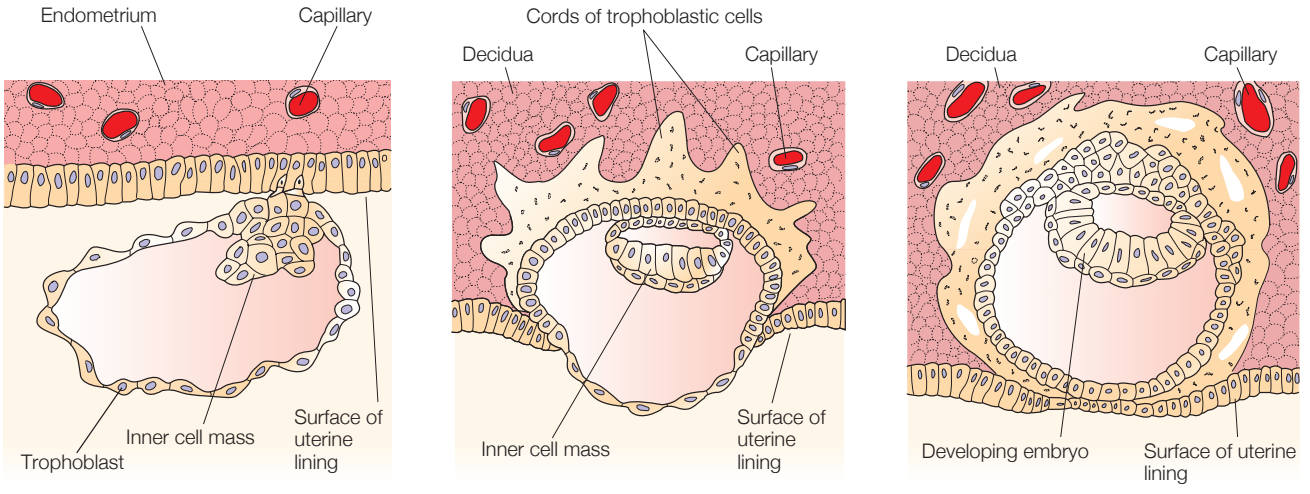


Figure 3–3 The blastocyst beginning to implant.

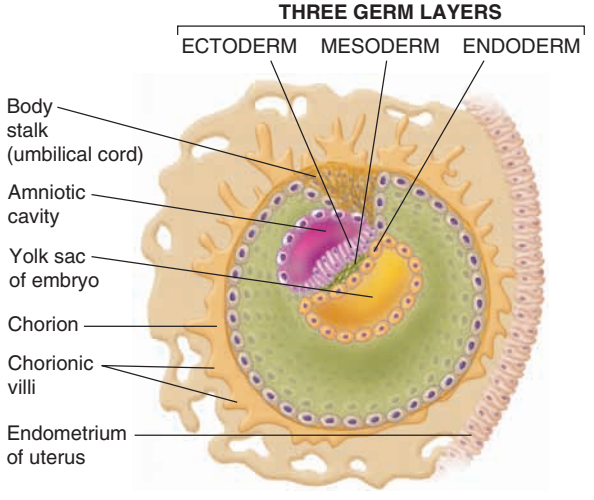


Figure 3–4 Formation of the three primary germ layers.

disturbances to embryonic development may result in brain and spinal defects. The first functional organ system to develop is the cardiovascular system, including a primitive version of the heart.

Also during the 4th week the embryo curves and folds into a "C"-shaped structure, with small visible buds that form the limbs. Also visible at this time are the basic structures of the eyes and ears. During the 5th week the head and brain develop and grow rapidly. During the 6th week the upper limbs are formed, with the fingers beginning to form during week 7 (**Figure 3–5**). The intestines enter the umbilical cord during this time. By only the 8th week of development the embryo appears human-like. Its eyes are open, and the eyelids and auricles of the ears can be identified.

Fetal Development

Between week 9 and birth the embryo is called a **fetus**. During the 9th to 12th weeks the growth of the fetal body increases while growth of the head slows. By week 11 the intestines have returned to the abdomen, and the skull and long bones begin ossification. The fetal external genitalia mature during the 12th week. Most red blood cells are formed in the liver before this point, and this process (erythropoiesis) now transfers into the spleen. Urine begins to form between weeks 9 and 12 and is excreted into the amniotic fluid.

Between weeks 13 and 16 the skeleton greatly ossifies, the scalp shows signs of hair patterns, and, in females, the ovaries differentiate. Growth slows between weeks 17 and 20, and the skin of the fetus is covered with fine hair (*lanugo*) and a cheese-like white *vernix caseosa*. The eyebrows and hair on the head are present. The uterus forms in females and the testes begin to descend in males. Brown protective

Figure 3–5 Relationship of the embryo to the amnionic sac, yolk sac, and chorionic cavity at about 7 weeks after conception. The chorionic sac has been bisected. At this stage, villi still arise from the entire periphery of the chorion, and the amnionic sac surrounding the embryo does not completely fill the chorionic cavity. The embryo is attached to the chorion by the umbilical cord (not shown in the photograph). The yolk sac is located to the right of the amnionic sac, between the amnionic sac and the chorion.

Figure 3–6 Progressive changes in size of the fetus at various stages of gestation. Left, Three and one-half months (32 grams). Center, Four and one-half months (230 grams). Right, Five and one-half months (420 grams).

fat forms near the heart and the blood vessels of the brain and kidneys.

The fetus gains significant amounts of weight during weeks 21 to 25. Rapid eye movements begin at week 21, and the fetus may become visibly startled beginning at weeks 22 to 23. **Figure 3–6** shows the development of a fetus between 3½ and 5½ months of gestation.

RED FLAG
The startle reflex includes an attempt to move away from the stimulus, contraction of the arms and legs, and blinking of the eyes. This protective reflex persists into adulthood but is usually not as pronounced as in childhood.

The alveolar lung cells begin to secrete surfactant, and the pulmonary system is able to support respiration starting at weeks 26 through 29. Breathing movements are present, and if the fetus is delivered prematurely at this stage it has a higher potential for survival.

During weeks 30 to 34 white body fat increases significantly. At week 35 the fetus can grasp and its pupils have a light reflex. If a normal-weight fetus is born at this time it is not premature in regards to weight but only to delivery date. Most infants are born at 266 days (38 weeks) after fertilization, or 40 weeks after the last menstrual period. All major systems are then developed well enough to ensure life outside of the womb.

Birth Weight and Gestational Age

Fetal weight gain is linear between 20 and 38 weeks of gestation. In the final half of the pregnancy the fetus gains 85 percent of its birth weight. Growth rates decline after 38 weeks of gestation because of reduced function of the placenta and the size of the uterus. Weight gain increases again after birth.

Most newborns average in weight between 6.6 and 8.8 pounds. Those weighing less than 5.5 pounds are classified as low-birth-weight infants; other subclassifications are very low birth weight, which is less than 3.3 pounds, and extremely low birth weight, which is less than 2.2 pounds. **Full-term** infants are born between weeks 38 and 41. Newborns with the highest survival rate weigh between 6.6 and 8.8 pounds at birth, which normally occurs between weeks 38 and 42.

Abnormal Intrauterine Growth

Normal intrauterine growth requires many different factors. When something goes wrong, abnormal growth can occur at any time, with immediate and long-term consequences. Classifications of newborns by birth weight and gestational age are shown in **Figure 3–7**. These classifications illustrate the standards with which gestational age can be assessed and normal or abnormal growth rates can be identified.

Small for Gestational Age

Smaller than normal fetal growth is described as *small for gestational age* (SGA). It is defined as being less than two standard deviations below the average for gestational age (which means below the 10th percentile). SGA is also described as *intrauterine growth retardation* (IUGR). Growth retardation can be symmetric, asymmetric, proportional, or disproportional. Symmetric growth retardation can be reversed after birth. Proportional growth retardation may be caused by chromosomal abnormalities, congenital infections, and environmental toxins. Asymmetric growth retardation may be corrected after birth with good nutrition. The most common form of disproportional growth retardation is **achondroplasia**, which is recognizable after the 24th week of gestation. It is signified by a slightly enlarged head, short limbs, underdevelopment of the middle of the face, and shortened fingers.

RED FLAG
Among the common problems of the premature infant are variations in thermoregulation, chilling, apnea, respiratory distress, **sepsis**, and poor sucking or swallowing reflexes.

The maternal environment can drastically affect birth weight and size. Poor maternal nutrition, adolescent pregnancy, short intervals between pregnancies, heavy physical

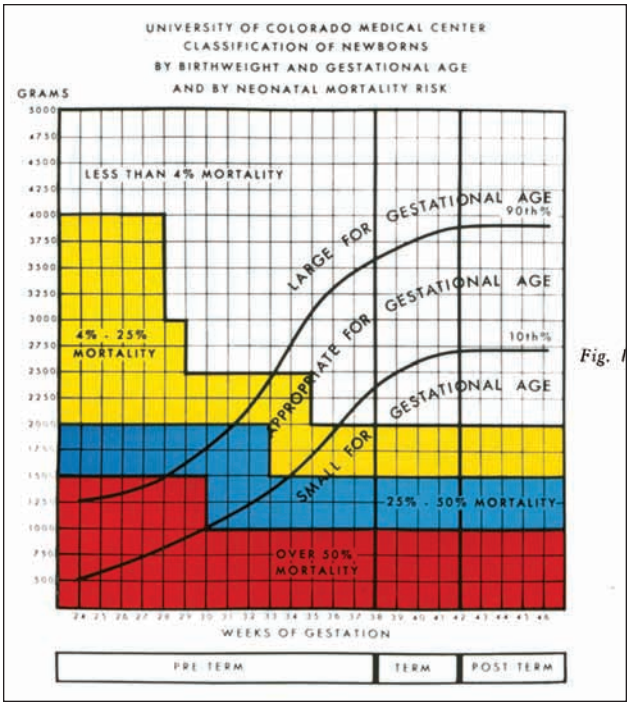


Figure 3–7 Classification of newborns by birth weight, gestational age, and neonatal mortality risk.

Source: Reprinted from Battaglia, C., Lubchenco, L. A Practical classification of newborn infants by weight and gestational age. *J Pediatr.* 1967 Aug;71(2):159–63.

labor while pregnant, and unusual dietary habits may all cause poor fetal growth. Diseases that may also contribute to SGA or IUGR include hypertension, diabetes mellitus, and chronic illnesses and infections. Drugs, including alcohol and tobacco, have numerous potential risks to the fetus. Mortality rates among infants with IUGR are 10 to 20 times higher than for normal infants and may be related to congenital anomalies, hypoxia, hyperbilirubinemia, hypoglycemia, and **polycythemia**.

Long-term effects of growth retardation may cause the individual to remain small throughout life, especially if the problem began earlier in development.

RED FLAG
Low birth weight is a significant criterion for identifying the high-risk infant with incomplete organ system development. It may result in significant long-term problems.

Promoting closeness between the parent and the physiologically stable preterm infant (by preparing the parent and providing the environment for skin-to-skin contact) is called *kangaroo care*.

Large for Gestational Age

Fetal overgrowth and a birth weight above the 90th percentile are described as *large for gestational age* (LGA). Maternal causes include diabetes (if poorly controlled during pregnancy) and maternal body size, with heavy women tending to have LGA infants. Fetal causes include mostly chromosome and gene disorders.

RED FLAG
Important functions of the PTA are to involve the parents in the care of the infant (teaching handling techniques that enhance motor development), to explain therapeutic procedures, and to facilitate attachment between the infant and the family.

Complications of LGA include trauma and asphyxia during birth. This is often due to difficulties during labor, hypoglycemia, and polycythemia. Increased levels of glucose stimulate the pancreas of the fetus to increase secretion of insulin and undergo **hyperplasia**. Insulin increases fat deposits in the infant, and those with macrosomia have enlarged viscera and appear large and plump. Hyperinsulinemia in the fetus is related to fetal hypoxia and polycythemia (which puts them at direct risk for hyperbilirubinemia). They are also at risk for hypoglycemia.

Prenatal assessment of gestational age includes careful menstrual history, uterine size, detection of fetal heart rate and movements, ultrasonography, and **amniotic fluid** studies. *Postnatal assessment* of gestational age requires examination of external physical and neuromuscular characteristics and should be a part of every initial examination of newborns.

RED FLAG
LGA infants born of mothers with gestational diabetes are generally obese and plethoric, with very pink skin and red, shiny cheeks.

Growth of Organ Systems

Most full-term infants range in length between 18.9 and 20.9 inches, with height increasing by 1 inch per month over the first 6 months. The trunk of the infant's body grows more than other body areas, and at 1 year of age length is about 50 percent longer than at birth. Many organ systems are at minimal functioning levels at birth, potentially leading to a variety of infant health problems. A summary of the various periods of development from birth to adolescence is listed in **Table 3–1**.

TABLE 3–1 Periods of Childhood Development

Period	Ages	Comments
Newborn (neonatal period)	Birth to 4 weeks	Greatest risk of death at any time in life up to 65 years. Skeleton is not fully developed, and many bones are soft and pliable. Body systems are very immature.
Infancy	5 weeks to 12 months	Organ systems mature rapidly so that the infant develops immunity. The infant normally will begin rolling over, sitting up, standing, and eventually walking.
Early childhood	13 months to 5 years	Includes the toddler and preschool years. Growth slows, most organ systems have matured, and the child becomes independent and mobile.
Middle to late childhood	6 years to 12 years, ending in adolescence	Schooling begins, and the child begins to develop strong peer relationships. Growth is still slower than it will become during adolescence. Muscle mass increases while baby fat decreases. Motor skills are greatly increased.

Nervous System

During infancy the nervous system matures and grows rapidly. In fact, this system grows more rapidly (proportionally) before birth than after. The most rapid periods of nervous system growth are between weeks 15 and 20 of gestation and then again between 30 weeks, gestation up to 1 year of age. The nervous system is incompletely integrated at birth yet still able to sustain life outside of the uterus. Normal reflexes can be used to evaluate the level of the developing infant's central nervous system. These include the **startle reflex**, the **sucking reflex**, and the **grasp reflex** (**Figure 3–8**). Other reflexes, with their normal and abnormal states, are listed in **Table 3–2**.

RED FLAG
The grasp reflex involves the stimulation of the infant's palm or fingers, resulting in the infant grasping onto the stimulating object.

Figure 3–8 Newborn baby grasping a finger.

TABLE 3–2 Infant Reflexes

Reflex	Description	Comments
Asymmetric tonic neck reflex (ATNR)	When the infant's face is turned to one side, the arm and leg on that side of the body extend, and the arm and leg on the opposite side bend, resembling the position of a classically trained fencer. It is important in helping the infant to coordinate body movements on both sides of the body.	Normally lasts from birth until 6 months of age. Also known as the "fencing reflex." Beyond 6 months of age, this reflex may signify developmental delays. This reflex develops muscle tone and vestibular stimulation in utero. It also develops kicking movements and provides continuous motion, which stimulates the balance mechanism and increases neural connections.
Babinski's reflex	When the sole of the foot is firmly stroked, the big toe bends back and the other toes fan out.	This reflex disappears after the age of two years. After age two, this reflex signifies damage to the nerve paths connecting spinal cord and brain.
Rooting reflex	When the side of the infant's cheek is stroked with a finger, the baby will turn the head and open the mouth to follow the direction of the stroking. This is how the baby hunts for the mother's breast.	This reflex disappears after three to four months. If retained, there may be hypersensitivity around the lips or mouth. Speech or articulation problems may result, as well as difficulty chewing or swallowing, and there may be drooling or dribbling from the mouth.
Stepping reflex	If the baby is held upright with the feet on a hard surface, the feet will make a stepping action, even though actual walking may be many months away.	This reflex usually disappears after a few months, with no commonly associated abnormalities.
Symmetric tonic neck reflex (STNR)	When the infant's head and neck are extended, a "crawl" position is achieved by extending the arms and bending the knees.	Also called the "crawling reflex" it disappears when neurologic and muscular development allows independent limb movement for actual crawling. If it remains present in older children, it may result in poor posture, poorly developed muscle tone, poor hand-eye coordination, and inability to sit still and concentrate.
Tonic labyrinthine reflex (TLR)	Tilting the infant's head back while lying on the back causes the back to stiffen and/or arch backwards, the legs to straighten and push together, the toes to point, the arms to bend at the elbows and wrists, and the hands to become fisted or the fingers to curl.	After the newborn stage, the presence of this reflex is referred to as "abnormal extensor" tone or pattern. This may result in poor posture, tendency to walk on the toes, poor balance, motion sickness, spacial orientation difficulties, oculo-motor problems, visual-perceptual problems, and a dislike of physical activities such as sports.

Thermoregulation

Stable body temperature combines heat production, heat conservation, and heat loss. Heat may be produced in response to cold stress via voluntary and involuntary muscle activity (such as shivering) and non-shivering thermogenesis. This requires heat that is liberated from burning stores of brown fat. Heat is lost to the environment through the following four methods:

1. Radiation: transfer of heat from a warmer to cooler area that is not contacting the body
2. Convection: transfer of heat to surrounding environment via air currents
3. Conduction: transfer of heat to cooler surfaces in direct contact with the body
4. Evaporation: cooling that occurs secondary to water loss from the skin

Because preterm infants have a higher ratio of surface area to body mass, reduced subcutaneous tissue insulation, and immature skin with heightened water loss, their heat loss is accelerated.

Cardiovascular System

Major cardiovascular changes occur after birth. The circulation of blood changes as fetal shunts (the **foramen ovale** and **ductus arteriosus**) begin to close. The heart is large in relation to the chest cavity during birth, and it doubles in size and weight during the first year of life. At birth the right ventricle is stronger than the left ventricle, but this reverses during infancy. Systolic blood pressure rises as the heart rate gradually slows. Congenital disorders of the cardiovascular system are discussed in Chapter 6.

Respiratory System

RED FLAG

For preterm infants the thermal environment must be carefully regulated. They should be kept in neutral environments to maintain stable core temperatures. These infants must be kept in incubators to maintain a controlled, regulated temperature. In general, neutral temperatures inside incubators for preterm infants (based on the weight of the newborn) should range between 32.6 and 35.5°C.

The respiratory system makes major changes to allow the infant to breathe outside of the uterus. Respiration must begin at birth for the infant to survive, with the first breaths expanding the alveoli and initiating gas exchange. Infants breathe rapidly at first, usually from the abdomen, but this slows gradually. The respiratory system matures, increasing the amount of alveoli while the airways grow. Infants breathe through their noses until between 3 and 4 months of age. Therefore, upper airway obstructions can cause airway distress. Infectious agents can be easily transmitted through the lungs because the trachea is small and near to the branching structures of the bronchi. Normal infant respiration rates, as well as blood pressure and heart rates, with changes during development, are shown in **Table 3–3**. Middle ear infections are common in infants because their eustachian (auditory)

RED FLAG

Infants may be at risk for airway obstruction due to the small diameter and softness of the supporting trachea cartilage.

TABLE 3–3 Various Normal Rates from Infancy through Childhood

Age	Respiration Rate (Breaths per Minute)	Systolic Blood Pressure (mm Hg)	Heart Rate (Beats per Minute)
From birth to 1 year	30 to 40	70 to 90	110 to 160
From 1 to 2 years	25 to 35	80 to 95	100 to 150
From 2 to 5 years	25 to 30	80 to 100	95 to 140
From 5 to 12 years	20 to 25	90 to 110	80 to 120

tubes are short, straight, and in close communication with the ears.

Gastrointestinal System

Because of immaturity, most infants have poor digestive processes until about 3 months of age. Solid food may be incompletely digested and be actually visible in the stool. The first stool passed by an infant is called the *meconium*. It may contain amniotic fluid, intestinal secretions, shed mucosal cells, and blood. The meconium should occur within 24 to 48 hours after birth. However, because of lack of enteral nutrition due to illness or because of prematurity, the meconium may not occur for up to 7 days. The sucking reflex may be poor at birth, requiring days to be effective.

RED FLAG
Touching the roof of the infant's mouth with a finger, pacifier, or nipple stimulates the sucking reflex in newborns. It later becomes a conscious effort on behalf of the newborn.

The tongue thrust reflex is present, which helps in sucking, but it disappears at around 6 months of age. Infants require frequent feeding because of limited stomach capacity and rapid emptying. Stomach capacity increases quickly in the first months after birth.

Urinary System

The urinary system of infants is immature at birth. It is difficult for urine to be concentrated. The kidneys of infants are immature until 6 months of age. They may have limited ability to adjust to a restricted fluid intake. Infants should not be given water or very diluted formula, which can result in the retention of sodium ions and loss of potassium ions. This causes **hypokalemia** and arrhythmias, which are life threatening. Because their bladders are small, infants usually urinate frequently. When urinary tract system development is affected, this can be especially significant for girls, predisposing them to urinary tract infections as infants. Because the urethra in females is shorter than in males, they are more susceptible to urinary tract infections as newborns and infants.

PRECAUTION
Infant girls are more susceptible to urinary infections because bacteria such as *E. coli* from the feces may contaminate the urethra when the baby is cleaned.

SUMMARY

The growth and development of a child begin with the uniting of the ovum and sperm. Prenatal development consists of the periods of embryonic and fetal development. A zygote becomes an embryo, then a fetus, and, once born, must adjust to living outside of the womb. An infant is considered full term when born between the 38th and 41st weeks. Normal full-term birth weights are between 6.6 to 8.8 pounds.

The term *newborn* is defined as the period from birth to 4 weeks of age. Infancy is defined as the period from 5 weeks to 12 months of age. During this time the relative immaturity of many organ systems changes rapidly so they can become mature enough to protect against diseases and other conditions. Early childhood is the period from 13 months to 5 years of age and includes the toddler and preschool years. Growth slows down during this period, and most organ systems reach maturity.

Middle to late childhood is the period from beginning school through adolescence and is considered to be from age 6 to age 12. Children in this period begin to develop strong peer relationships. Adolescence is a transitional period, between childhood and adulthood. It generally is considered to cover from ages 13 to 19, beginning with the development of secondary sex characteristics and continuing until the end of somatic growth. Major growth spurts occur during this period, and major body changes are seen.

REVIEW QUESTIONS

Select the best response to each question.

1. During which period in a child's life is weight gain fastest in proportion to the child's total weight?
   a. the first 6 months
   b. from 6 months to 1 year of age
   c. preschool period
   d. adolescent period
2. The embryonic period takes place from the
   a. time of fertilization to the second week
   b. 1st week to 4th week after fertilization
   c. 2nd week to 8th week after fertilization
   d. 9 weeks to birth
3. The ectoderm differentiates to become
   a. smooth muscle tissues
   b. the nervous system
   c. the reproductive organs
   d. bone marrow
4. Proportional growth retardation may be caused by
   a. environmental toxins
   b. congenital infections
   c. chromosomal abnormalities
   d. all of the above
5. Most full-term infants increase in height how much per month, over the first 6 months?
   a. 1/8 inch
   b. 1/4 inch
   c. 1/2 inch
   d. 1 inch

6. What is the percentage of increase in length of an infant at 1 year of age, compared with his or her length at birth?
   a. 15
   b. 25
   c. 50
   d. 65
7. Which of the following fetal shunts begins to close after birth?
   a. foramen ovale
   b. foramen magnum
   c. ductus deferens
   d. foramen spinosum
8. Which of the following describes a newborn's action of flexing the fingers around an adult's finger?
   a. startle reflex
   b. sucking reflex
   c. grasping reflex
   d. none of the above
9. The round mass of blastomeres that results from cleavage of the fertilized ovum is called the
   a. zygote
   b. trophoblast
   c. blastula
   d. morula
10. The developing offspring from the 2nd through 8th week of pregnancy is called the
    a. embryoblast
    b. embryo
    c. fetus
    d. morula

CASE STUDIES

Karen Coupe, PT, DPT, MSEd

Case 1

A PTA is employed in a pediatric setting that treats a large population of infants who were born prematurely. Ninety percent of the preterm infants were born to parents with a variety of unhealthy behaviors. As part of a community service, the PTA is working in collaboration with the PT and a local physician to develop an educational workshop for parents-to-be. The focus of the workshop is to provide information on timelines, system development, and the promotion of healthy behaviors.

1. What are some important health behaviors the parent can do and/or avoid to help promote a healthy environment for the developing baby?
2. What are some of the potential negative effects of unhealthy health behaviors on the development of the baby?
3. Explain the prenatal timeline difference between the embryonic period and the fetal period of development.
4. During the embryonic period of development, explain in medical and then layman's terms which systems are developing.
5. During the fetal period of development, explain in medical and then layman's terms how the systems of the fetus are further developing. What is the critical timeline for survival if a fetus is born prematurely during this stage?

Case 2

A 6-month-old girl is referred to an early intervention program secondary to low muscle tone, difficulty feeding, and developmental delays. The PTA is reviewing the history and finds the following: premature birth at 28 weeks, birth weight 3 lb 2 oz.

1. The patient was born at 28 weeks. What is the normal gestation period?
2. Based on the time of birth, what systems were not yet fully developed?
3. Convert the birth weight into grams. What category of birth weight does this fall within?
4. Would you expect this infant to meet the same timeline for developmental milestones as a 6-month-old infant who went full term? Why or why not? How is the gestational age different from the chronological age?
5. Research the early intervention program in your city. What services are available?

WEBSITES

http://web.jjay.cuny.edu/~acarpi/NSC/14-anatomy.htm
http://www.aafp.org/afp/980800ap/peleg.html
http://www.benbest.com/science/anatmind/anatmd4.html
http://www.epigee.org/fetal.html
http://www.kidsgrowth.com/stages/guide/index.cfm
http://www.lpch.org/DiseaseHealthInfo/HealthLibrary/hrnewborn/sga.html
http://www.merck.com/mmhe/sec23/ch264/ch264f.html
http://www.unm.edu/~lkravitz/Article%20folder/thermoregulation.html
http://www.whattoexpect.com/pregnancy/your-baby/week-12/organ.aspx
http://www.visembryo.com/baby/