

# 19 DEVELOPMENT: BIRTH THROUGH DEATH

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## Overview

Our Birth to Death chapter is an all encompassing review of the physiological changes that occur throughout a normal life span. In determining what a normal life consists of we included functions that are likely to happen to a large percentage of the population. While any one person is not likely to experience all of the events listed in this chapter they will undoubtedly go through some of the processes.

## Apoptosis

Apoptosis is the process of regulated cell death and removal. In some cases cell damage can trigger apoptosis, but it is usually a normal function of the cell. Apoptosis results in controlled auto digestion of the cells content. The cell membrane stays in place and the cells contents are not dispersed. When this process is near completion "eat me" signals, like phosphatidylserine, appear on the surface of the cell membrane. This in turn attracts phagocytic scavengers that complete the process of removing the dead cell without eliciting an inflammatory response. Unlike necrosis, which is a form of cell death that results from acute cellular injury, apoptosis is carried out in an ordered process that generally confers advantages during an organism's life cycle.

### Apoptosis Rates

The rate at which cells die varies widely between different cell types of the body. Some cells, such as white blood cells, live for only a matter of hours where other cells can live an throughout the entire lifetime of the host.

### Homeostasis

Apoptosis is a regulated function that results in a relatively consistent number of cells in the body. This balancing act is part of the Homeostasis (see chapter 1) required by living organisms to maintain their internal states within certain limits. An example of this is that blood cells are constantly being replaced and apoptosis takes place to eliminate a similar number of older cells.

### Development

Apoptosis also plays a key role in growth and development. An example of how apoptosis enables development is the differentiation of human fingers in a developing embryo. Apoptosis is the function that enables the embryos fingers to separate.

### Disorders

Too much apoptosis causes cell-loss disorders such as osteoporosis, whereas too little apoptosis results in uncontrolled cell proliferation, namely cancer.

## Growth and development

Growth is physical change and can be weighed and measured. Development is psychological and social. It's behaviors and thinking patterns. Growth and development work hand in hand to affect the whole person. (We can not simply speak we must also have the physical structure to support that speech.

Growth and development is happening from the time of fertilization until the day we die. This process ranges from being fairly simple to very complex. It also happens in a certain order; for example, we first learn to hold our heads up, then move our arms, use our hands, then comes crawling, and finally walking. Growth and development occurs in stages and must complete stage one before going to the next stage. Each stage is important and needed to get our bodies ready for the next stage.

The rate at which we grow and develop is not a constant. The rates change. Growth is a lot more rapid in infants than in any other age. Children can have growth spurts, some developing quicker than others, and it varies from individual to individual.

## Hormonal causes of growth

The following chart summarizes hormones that regulate growth. [Chapter 14, The endocrine system](#) has more information on this topic.

HORMONE	PRODUCTION SITE	ACTION	REGULATION
GH Growth Hormone	Anterior pituitary	Promotes protein synthesis and growth; lipolysis and increased blood glucose	Stimulated by GH-RH Growth Hormones - Releasing Hormones  Inhibited by somatostatin
TSH Thyroid Stimulating Hormone	Anterior Pituitary	Stimulates secretion of thyroid hormones	Stimulated by TRH Thyrotropin-releasing hormone  Inhibited by thyroid hormones.
FSH Follicle Stimulating Hormone and LH Luteinizing Hormone	Anterior Pituitary	Promotes gamete production and sex steroid hormone secretion	Stimulated by GnRH Gonadotropin-releasing hormone  Inhibited by sex steroids

Reflex	Stimulation	Response	Age of disappearance	Function
Eye blink	Bright light shinning in eyes or clap hands by eyes	closes eyelids quickly	Permanent	This reflex protects the infant form a lot of stimulation

Withdrawal	Stick sole of foot with stimulus like a pin	This cause the foot to withdraw, this occurs with the use of flexing of the knee to hip	Decreases after the 10th day of birth	This is a protection for the infant in a instance of unpleasant tactile stimulation
Rooting	Touch cheek near the corner of the mouth	The infants head will turn towards the site of stimulation	3 weeks (due to the voluntary response that is now capable for infant to do at this time)	This reflex helps baby to find the mothers nipple
Sucking	Place fingers in infant's mouth	The infant will suck finger rhythmically	4 months (voluntary sucking will come about)	This helps with feeding
Swimming	Place the baby in pool of water face down	The baby paddles and kicks in swimming movements	4 to 6 month	This helps baby to survive if dropped into the water
Moro	Hold infant in a cradling horizontal position and slightly lower the baby in a fast motion toward the ground while making a loud sound supporting the baby	The baby will make a embracing motion and arch its back extending its legs throwing its arms outward, and finally it will bring arms in toward its body	6 months	In the evolutionary past this may have helped the baby cling to the mother
Palmar grasp	Place the finger in baby's palm and press against the palm	The baby will immediately grasp the finger	3 to 4 months	This prepares infant for when voluntary grasping comes about
Tonic neck	Turn the baby's head to one side while the baby is awake	This will cause the baby to extend one arm in front of its eye on one side on the side to which the head has been turned	4 months	This may prepare for voluntary reaching
Stepping/marching	When you hold the baby under the arm and permit the bare feet of the baby to touch a flat surface	The baby will lift one foot after the other in a stepping fashion	2 months (this applies to a baby who has gained weight a baby who is not as heavy this reflex may be submissive)	This prepares the baby for voluntary walking

Babinski	Touch the foot in a stroking manner from the toe toward the heel	The baby's toes will fan out and curl as the foot twists in	8 to 12 months	Unknown
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## Neonatal

The neonatal period extends from birth to somewhere between 2 weeks and 1 month.

Immediately after the baby is born uterine contractions force blood, fluid, and the placenta from the mother's body. The umbilical cord—the baby's lifeline to it's mother—is now severed. Without the placenta to remove waste, carbon dioxide builds up in the baby's blood. This, along with other factors including steps taken by medical personnel, stimulates the control centers in the brain which in turn responds by triggering inhalation. Thus the newborn takes it's first breath. As the newborns lungs begin to function, the bypass vessels of fetal circulation begin to close. The heart bypass, the foramen ovale, normally closes slowly during the first year.

During this period the body goes through drastic physiological changes. The most critical need is for the body to get enough oxygen as well as an adequate supply of blood. (The respiratory and heart rate of a newborn is much faster than that of an adult.)

### The newborn's appearance

A newborn's skin is oftentimes grayish to dusky blue in color. As soon as the newborn begins to breathe, usually within a minute or two, the skin's color returns to its normal tones. Newborns are wet, covered in streaks of blood, and coated with a white substance known as vernix caseosa, which is hypothesized to act as an antibacterial barrier. The newborn may also have Mongolian spots, various other birthmarks, or peeling skin, particularly at the wrists, hands, ankles, and feet.

A newborn's shoulders and hips are narrow, the abdomen protrudes slightly, and the arms and legs are relatively short. The average weight of a full-term newborn is approximately 7 ½ pounds (3.2kg), but can be anywhere from 5.5–10 pounds (2.7–4.6kg). The average total body length is 14–20 inches (35.6–50.8cm), although premature newborns may be much smaller. The Apgar score is a measure of a newborn's transition from the womb during the first ten minutes of life.

A newborn's head is very large in proportion to the rest of the body, and the cranium is enormous relative to his or her face. While the adult human skull is about 1/8 of the total body length, the newborn's is twice that. At birth, many regions of the newborn's skull have not yet been converted to bone. These "soft spots" are known as fontanel; the two largest are the diamond-shaped anterior fontanel, located at the top front portion of the head, and the smaller triangular-shaped posterior fontanel, which lies at the back of the head.

During labor and birth, the infant's skull changes shape to fit through the birth canal, sometimes causing the child to be born with a misshapen or elongated head. This will usually return to normal on its own within a few days or weeks. Special exercises sometimes advised by physicians may assist the process.

Some newborns have a fine, downy body hair called lanugo. It may be particularly noticeable on the back, shoulders, forehead, ears and face of premature infants. Lanugo disappears within a few weeks. Likewise, not all infants are born with lush heads of hair. Some may be nearly bald while others may have very fine, almost invisible hair. Some babies are even born with a full head of hair. Amongst fair-skinned parents, this fine hair may be blond, even if the parents are not. The scalp may also be temporarily bruised or swollen, especially in hairless newborns, and the area around the eyes may be puffy.

A newborn's genitals are enlarged and reddened, with male infants having an unusually large scrotum. The breasts may also be enlarged, even in male infants. This is caused by naturally-occurring maternal hormones and is a temporary condition. Females (and even males) may actually discharge milk from their nipples, and/or a bloody or milky-like substance from the vagina. In either case, this is considered normal and will disappear in time.

The umbilical cord of a newborn is bluish-white in color. After birth, the umbilical cord is normally cut, leaving a 1–2 inch stub. The umbilical stub will dry out, shrivel, darken, and spontaneously fall off within about 3 weeks. Occasionally, hospitals may apply triple dye to the umbilical stub to prevent infection, which may temporarily color the stub and surrounding skin purple.

Newborns lose many of the above physical characteristics quickly. Thus prototypical older babies look very different. While older babies are considered "cute", newborns can be "unattractive" by the same criteria and first time parents may need to be educated in this regard.

#### Neonatal jaundice

Neonatal jaundice is usually harmless: this condition is often seen in infants around the second day after birth, lasting till day 8 in normal births, or to around day 14 in premature births. Serum Bilirubin normally drops to a low level without any intervention required: the jaundice is presumably a consequence of metabolic and physiological adjustments after birth. A common treatment is to use bilirubin lights on the newborn baby.

## Changes in body Size and Muscle fat makeup

By the end of the first year an infant's height is increased by 50% since its birth and by the age of 2 the baby will have grown 75% greater.

By 5 months a baby will have doubled its weight, and tripled its weight by the first year. By the age of 2, a baby's weight will have quadrupled.

Infants and toddlers grow in little spurts over the first 21 months of life. A baby can go through periods of 7 to 63 days with no growth but they can add as much as an inch in one 24 hour period. During the day before a growth spurt, parents described their babies as irritable and very hungry.

The best way to estimate a child's physical maturity is to use *skeletal age*, a measure of bone development. This is done by having a x-ray of the long bones of the body to see the extent to which soft, pliable cartilage has hardened into bone.

## Changes in body Proportions

**Cephalocaudal trend** means that growth occurs from head to tail. The head develops more rapidly than the lower part of the body. At birth the head takes up to one fourth of the total body length and legs only one third. The lower body catches up by age 2 and the head accounts for only one fifth and legs for nearly one half of the body length.

**Proximodistal trend** means that head growth proceeds literally from near to far or from center of the body outward.

At birth the brain is nearer its adult shape and size than any other physical structure. The brain continues to develop at an astounding pace throughout infancy and toddlerhood.

## The Brain Development

The neurons of infants and adults differ in 2 significant ways: Growth of neural fibers and synapses increases connective structures. When synapses are formed, many surrounding neurons die. This occurs in 20 to 80 percent of the brain region.

**Dendrites synapses:** Synapses are tiny gaps between neurons where fibers from different neurons come close together but do not touch. Neurons release chemicals that cross the synapses sending messages to one another. During the prenatal period the neural tube produces far more neurons than the brain will ever need. **Myelination:** The coating of neural fibers with a fatty sheath called myelin that improves the efficiency of message transfer. Multi-layered lipid cholesterol and protein covering produced by neuroglia cause a rapid gain in overall size of brain due to neural fibers and myelination.

**Synaptic pruning:** Neurons seldom stimulated soon lose their synapses. Neurons not needed at the moment return to an uncommitted state so they can support future development. However, if synaptic pruning occurs in old age neurons do lose their synapses. If neurons are stimulated at young age even though neurons were pruning they will be stimulated again.

**Cerebral Cortex:** Surrounding the brain, it is the largest most complex brain structure. The cortex is divided into four major lobes: occipital lobe, parietal lobe, temporal lobe, and frontal lobe which is the last to develop.

**Brain plasticity:** The brain is highly plastic. Many areas are not yet committed to specific functions. If a part of the brain is damaged, other parts can take over tasks that they would not normally have handled.

## Changing states of Arousal

How children develop more regular “sleep patterns” around 4 to 6 months of age: Sleep patterns are more developed as the brain develops. It is not until the first year of life that the secretion of *melatonin*, a hormone produced in the brain, affects more drowsiness in the night than in the day. In addition, REM is decreased.

## Infancy

Infancy is the period that follows the neonatal period and includes the first two years of life. During this time tremendous growth, coordination and mental development occur. Most infants learn to walk, manipulate objects and can form basic words by the end of infancy. Another characteristic of infancy is the development of deciduous teeth.

### Deciduous Teeth

*Deciduous teeth*, otherwise known as milk teeth, baby teeth, or primary teeth, are the first set of teeth in the growth development of humans and many other animals. They develop during the embryonic stage of development and erupt - become visible in the mouth - during infancy. They are usually lost and replaced by permanent teeth, but in the absence of permanent replacements, they can remain functional for many years. (Concise)

Deciduous teeth start to form during the embryo phase of pregnancy. The development of deciduous teeth starts at the sixth week of development as the dental lamina. This process starts at the midline and then spreads back into the posterior region. By the time the embryo is eight weeks old, there are ten areas on the upper and lower arches that will eventually become the deciduous dentition. These teeth will continue to form until they erupt in the mouth. In the deciduous dentition there are a total of twenty teeth: five per quadrant and ten per arch. The eruption of these teeth begins at the age of six months and continues until twenty-five to thirty-three months of age. The first teeth seen in the mouth are the mandibular centrals and the last are the maxillary second molars.

The deciduous dentition is made up of centrals, laterals, canines, first molars, and second molars; there is one in each quadrant, making a total of four of each tooth. All of these are replaced with a permanent counterpart except for the first and second molars; they are replaced by premolars. These teeth will remain until the age of six. At that time, the permanent teeth start to appear in the mouth resulting in mixed dentition. The erupting permanent teeth causes root resorption, where the permanent teeth push down on the roots of the deciduous teeth causing the roots to be dissolved and become absorbed by the forming permanent teeth. The process of shedding deciduous teeth and the replacement by permanent teeth is called exfoliation. This will last from age six to age twelve. By age twelve there are only permanent teeth remaining.

Deciduous teeth are considered essential in the development of the oral cavity by dental researchers and dentists. The permanent teeth replacements develop from the same tooth bud as the deciduous teeth; this provides a guide for permanent teeth eruption. Also the muscles of the jaw and the formation of the jaw bones depend on the primary teeth in order to maintain the proper space for permanent teeth. The roots of deciduous teeth provide an opening for the permanent teeth to erupt through. These teeth are also needed in the development of a child's ability to speak and chew their food correctly.

## Female

For females puberty is caused by alterations in brain functions that result in an increase in the secretion of gonadotropin-releasing hormone (GnRH) from the hypothalamus. Increased levels of GnRH stimulates the secretion of pituitary gonadotrophins FSH and LH causing follicle development and estrogen secretion. Estrogen is responsible for accessory sex organs and secondary sex

characteristics. Menarche, the first menstrual cycle, occurs at about 12.5 years of age as a result of the release of FSH.

### **Breast development**

The first physical sign of puberty in girls is usually a firm, tender lump under the center of the areola(e) of one or both breasts, occurring on average at about 10.5 years. This is referred to as thelarche. By the widely used Tanner staging of puberty, this is stage 2 of breast development (stage 1 is a flat, prepubertal breast). Within 6-12 months, the swelling has clearly begun in both sides, softened, and can be felt and seen extending beyond the edges of the areolae. This is stage 3 of breast development. By another 12 months (stage 4), the breasts are approaching mature size and shape, with areolae and papillae forming a secondary mound. In most young women, this mound disappears into the contour of the mature breast (stage 5), although there is so much variation in sizes and shapes of adult breasts that distinguishing advanced stages is of little clinical value.

### **Pubic hair in girls**

Pubic hair is often the second unequivocal change of puberty. It is referred to as pubarche and the pubic hairs are usually visible first along the labia. The first few hairs are described as Tanner stage 2. Stage 3 is usually reached within another 6–12 months, when the hairs are too numerous to count and appear on the mons as well. By stage 4, the pubic hairs densely fill the "pubic triangle." Stage 5 refers to spread of pubic hair to the thighs and sometimes as abdominal hair upward towards the umbilicus. In about 15% of girls, the earliest pubic hair appears before breast development begins.

### **Vagina, uterus, ovaries**

The mucosal surface of the vagina also changes in response to increasing levels of estrogen, becoming thicker and a duller pink in color (in contrast to the brighter red of the prepubertal vaginal mucosa). Whitish secretions (physiologic leukorrhea) are a normal effect of estrogen as well. In the next 2 years following thelarche, the uterus and ovaries increase in size. The ovaries usually contain small cysts visible by ultrasound.

### **Menstruation and fertility**

The first menstrual bleeding is referred to as **menarche**. The average age of menarche in American girls is about 12.7 years, usually about 2 years after thelarche. Menses (menstrual periods) are not always regular and monthly in the first 2 years after menarche. Ovulation is necessary for fertility, and may or may not accompany the earliest menses. By 2 years after menarche, most girls are ovulating at least several times a year. Over 90% of girls who experience menarche before age 13 years are experiencing very regular, predictable menses accompanied by ovulation within 2 years, and a higher proportion of those with later menarche may not establish regular ovulation for 4 years or more. However, initiation of ovulation after menarche is not inevitable, and a high proportion of girls with continued irregularity several years from menarche will continue to have prolonged irregularity and anovulation, and are at higher risk for reduced fertility.

### **Pelvic shape, fat distribution, and body composition**

During this period, also in response to rising levels of estrogen, the lower half of the pelvis widens (providing a larger birth canal). Fat tissue increases to a greater percentage of the body composition

than in males, especially in the typical female distribution of breasts, hips, and thighs. This produces the typical female body shape. Also, the fat goes to the buttocks of a girl, giving their buttocks more shape and curve.

### **Body and facial hair in girls**

In the months and years following the appearance of pubic hair, other areas of skin which respond to androgens develop heavier hair (androgenic hair) in roughly the following sequence: underarm (axillary) hair, perianal hair, upper lip hair, sideburn (preauricular) hair, and periareolar hair. Arm and leg hair becomes heavier more gradually over 10 years or more. Although in Western culture, hair in some of these areas is unwanted, it rarely indicates a hormone imbalance unless it occurs elsewhere as well (such as under the chin and in the midline of the chest).

### **Height growth in girls**

The estrogen-induced pubertal growth spurt in girls begins at the same time the earliest breast changes begin, or even a few months before, making it one of the earliest manifestations of puberty in girls. Growth of the legs and feet accelerates first, so that many girls have longer legs in proportion to their torso in the first year of puberty. The rate of growth tends to reach a peak velocity (as much as 7.5-10 cm or 3-4 inches per year) midway between thelarche and menarche and is already declining by the time menarche occurs. In the 2 years following menarche most girls grow about 5 cm (2 inches) before growth ceases at maximal adult height. This last growth primarily involves the spine rather than the limbs.

### **Body odor, skin changes, and acne**

Rising levels of androgens can change the fatty acid composition of perspiration, resulting in a more "adult" body odor. This often precedes thelarche and pubarche by 1 or more years. Another androgen effect is increased secretion of oil (sebum) from the skin. This change increases the susceptibility to acne vulgaris, a characteristic affliction of puberty greatly variable in its severity.

## **Male**

The onset of puberty for males is similar to that of females. GnRH secretion from the hypothalamus results in an increase in pituitary gonadatropins secretion LH / ICSH and FSH. The pituitary gonadatropins stimulate the seminiferous tubules and testosterone secretion. Testosterone causes changes in the accessory reproductive organs, secondary sex characteristics and male sex drive.

### **Testicular size, function, and fertility**

In boys, testicular enlargement is the first physical manifestation of puberty (and is termed gonadarche). Testes in prepubertal boys change little in size from about 1 year of age to the onset of puberty, averaging about 2–3 cc in volume and about 1.5-2 cm in length. Testicular size continues to increase throughout puberty, reaching maximal adult size about 6 years later. While 18-20 cc is reportedly an average adult size, there is wide variation in the normal population.

The testes have two primary functions: to produce hormones and to produce sperm. The Leydig cells produce testosterone (as described below), which in turn produces most of the changes of male

puberty. However, most of the increasing bulk of testicular tissue is spermatogenic tissue (primarily Sertoli and interstitial cells). The development of sperm production and fertility in males is not as well documented. Sperm can be detected in the morning urine of most boys after the first year of pubertal changes (and occasionally earlier).

### **Genitalia**

A boy's penis grows little from the fourth year of life until puberty. Average prepubertal penile length is 4 cm. The prepubertal genitalia are described as stage 1. Within months after growth of the testes begins, rising levels of testosterone promote growth of the penis and scrotum. This earliest discernible beginning of pubertal growth of the genitalia is referred to as stage 2. The penis continues to grow until about 18 years of age, reaching an average adult size of about 7-14 cm.

Although erections and orgasm occur in prepubertal boys, they become much more common during puberty, accompanied by a markedly increased libido. Ejaculation becomes possible early in puberty; prior to this boys may experience dry orgasms. Emission of seminal fluid may occur due to masturbation or spontaneously during sleep (commonly termed a wet dream, and more clinically called a nocturnal emission). The ability to ejaculate is a fairly early event in puberty compared to the other characteristics. However, in parallel to the irregularity of the first few periods of a girl, for the first one or two years after a boy's first ejaculation, his seminal fluid may contain few active sperm.

### **Pubic hair in boys**

Pubic hair often appears on a boy shortly after the genitalia begin to grow. As in girls, the first appearance of pubic hair is termed pubarche and the pubic hairs are usually first visible at the dorsal (abdominal) base of the penis. The first few hairs are described as stage 2. Stage 3 is usually reached within another 6–12 months, when the hairs are too numerous to count. By stage 4, the pubic hairs densely fill the "pubic triangle." Stage 5 refers to spread of pubic hair to the thighs and upward towards the umbilicus as part of the developing abdominal hair.

### **Body and facial hair in boys**

In the months and years following the appearance of pubic hair, other areas of skin which respond to androgens develop heavier hair (androgenic hair) in roughly the following sequence: underarm (axillary) hair, perianal hair, upper lip hair, sideburn (preauricular) hair, periareolar hair, and the rest of the beard area. Arm, leg, chest, abdominal, and back hair become heavier more gradually. There is a large range in amount of body hair among adult men, and significant differences in timing and quantity of hair growth among different ethnic groups.

### **Voice change**

Under the influence of androgens, the voice box, or larynx, grows in both genders. This growth is far more prominent in boys, causing the male voice to drop, rather abruptly, about one octave, because the larger vocal folds have a lower fundamental frequency. Occasionally, this is accompanied by cracking and breaking sounds in the early stages. Most of the voice change happens during stage 4 of male puberty around the time of peak growth. However, it usually precedes the development of significant facial hair by several months to years.

### **Height growth in boys**

Compared to girls' early growth spurt, growth accelerates more slowly in boys and lasts longer, resulting in a taller adult stature among males than females (on average about 10 cm or 4 inches). The difference is attributed to the much greater potency of estradiol compared to testosterone in promoting bone growth, maturation, and epiphyseal closure. In boys, growth begins to accelerate about 9 months after the first signs of testicular enlargement and the peak year of the growth spurt occurs about 2 years after the onset of puberty, reaching a peak velocity of about 8.5–12 cm or 3.5–5 inches per year. The feet and hands experience their growth spurt first, followed by the limbs, and finally ending in the trunk. Epiphyseal closure and adult height are reached more slowly, at an average age of about 17.5 years. As in girls, this last growth primarily involves the spine rather than the limbs.

### **Male musculature and body shape**

By the end of puberty, adult men have heavier bones and nearly twice as much skeletal muscle. Some of the bone growth (e.g., shoulder width and jaw) is disproportionately greater, resulting in noticeably different male and female skeletal shapes. The average adult male has about 150% of the lean body mass of an average female, and about 50% of the body fat.

This muscle develops mainly during the later stages of puberty, and muscle growth can continue even after a male is biologically adult. The peak of the so-called "strength spurt," the rate of muscle growth, is attained about one year after a male experiences his peak growth rate.

### **Breast development in boys: pubertal gynecomastia**

Estradiol is produced from testosterone in male puberty as well as female, and male breasts often respond to the rising estradiol levels. This is termed gynecomastia. In most boys, the breast development is minimal, similar to what would be termed a "breast bud" in a girl, but in many boys, breast growth is substantial. It usually occurs after puberty is underway, may increase for a year or two, and usually diminishes by the end of puberty. It is increased by extra adipose tissue if the boy is overweight.

Although this is a normal part of male puberty, breast development for some boys is as unwelcome as upper lip hair in girls. If the boy's distress becomes too substantial during development, the problem can be removed or corrected surgically.

## **Adolescence**

Adolescence is the period of psychological and social transition between childhood and adulthood. Adolescence is the transitional stage of human development in which a juvenile matures into an adult. This transition involves biological, social, and psychological changes, though the biological ones are the easiest to measure objectively. The time is identified with dramatic changes in the body, along with developments in a person's psychology and academic career. In the onset of adolescence, children usually complete elementary school and enter secondary education, such as middle school or high school. A person between early childhood and the teenage years is sometimes referred to as a pre-teen or 'tween.

Physical maturation resulting from puberty leads to an interest in sexual activities, sometimes leading to teenage pregnancy. Since teens may not be emotionally or mentally mature enough or financially able to support children, sexual activity among adolescents is sometimes considered

problematic.

At this age there is also a greater probability of drug and alcohol use, or mental health disorders such as schizophrenia, eating disorders such as anorexia, and clinical depression. The unstable emotions or lack of emotional intelligence among some adolescents may also lead to youth crime.

Searching for a unique identity is one of the problems that adolescents often face. Some, but not all, teenagers often challenge the authority or the rules as a way to establish their individuality. They may crave adulthood and to find their place in the society.

Among many people of this age, role models such as sports players, rock stars and film|movie and television performers are very popular, and adolescents often express a desire to be like their chosen role model. For this reason, people who are considered role models are often heavily criticized for their behavior, because in our time they are, we might say almost without exception, not socially conscious enough for the standard to which most children are held by most parents today. Of course, this doesn't mean that proper upbringing and an inspired life are contradictions; but there rages an argument about how soon one must make room for the other.

## Adulthood

The term adult generally refers to a fully developed person from maturity (the end of puberty) onward. For females, age 17, and for males, age 18 is considered to be physiologically adult. Adulthood can refer to a person's ability to care for them self independently, and raise a family of their own; or it can simply mean reaching a specified age. Graduating high school, residing in one's own residence and attaining financial independence are all synonymous with adulthood in the United States.

### Adult characteristics

There are some qualities that symbolize adulthood in most cultures. Not always is there a concordance between the qualities and the physical age of the person.

The adult character is comprised of:

- **Self-control** - restraint, emotional control.
- **Stability** - stable personality, strength.
- **Independence** - ability to self-regulate.
- **Seriousness** - ability to deal with life in a serious manner.
- **Responsibility** - accountability, commitment and reliability.
- **Method/Tact** - ability to think ahead and plan for the future, patience.
- **Endurance** - ability and willingness to cope with difficulties that present themselves.
- **Experience** - breadth of mind, understanding.
- **Objectivity** - perspective and realism.

Abraham Maslow, a psychologist, developed Maslow's Hierarchy of Needs. It is a chart outlining basic needs that a person must meet to function and survive in life, and attempts to explain what motivates people in life. The needs on the lower level must be met before moving up the ladder, as the higher needs only come into focus once all the needs that are lower down in the pyramid are satisfied.

People can get stuck on levels and some people may never reach certain levels because of circumstances in their life. When one stage is fulfilled you naturally move to the next.

**Physical or Physiological:** These include shelter, oxygen, food, water, rest and elimination, all of which are vital to a person's life and essential to survival.

**Security or Safety:** This involves not only actually being secure and safe, but also the feeling of safety and security. This is something that people typically learn from their childhood and something that helps lay the groundwork for developing other skills and moving up to the next step in the ladder.

**Social (Love/Belonging):** This involves developing friendships and eventually relationships. This involves emotionally-based relationships in general, such as friendship, sexual intimacy, and having a supportive and communicative family.

**Esteem:** This is where people learn to develop self-esteem and confidence. According to Maslow, all humans have a need to be respected, to have self-respect, and to respect others. People need to engage themselves in order to gain recognition and have an activity or activities that give the person a sense of contribution, be it in a profession or hobby,

**Self-Actualization:** The highest level you can reach according to Maslow. Maslow writes the following of self-actualizing people:

- They embrace the facts and realities of the world (including themselves) rather than denying or avoiding them.
- They are spontaneous in their ideas and actions.
- They are creative.
- They are interested in solving problems; this often includes the problems of others. Solving these problems is often a key focus in their lives.
- They feel a closeness to other people, and generally appreciate life.
- They have a system of morality that is fully internalized and independent of external authority.
- They have discernment and are able to view all things in an objective manner. Prejudices are absent.

In short, self-actualization is reaching one's fullest potential.

Most people accomplish the two lower levels in their lifetime, but may get stuck on upper levels. While self-actualization is a useful concept to many, others insist there is no proof that every individual has this capacity or even the goal to achieve it.

## Menopause

Menopause occurs as the ovaries stop producing estrogen, causing the reproductive system to gradually shut down. As the body adapts to the changing levels of natural hormones, vasomotor symptoms such as hot flashes and palpitations, psychological symptoms such as increased depression, anxiety, irritability, mood swings and lack of concentration, and atrophic symptoms such as vaginal dryness and urgency of urination appear. Together with these symptoms, the woman may also have increasingly scanty and erratic menstrual periods.

Technically, menopause refers to the cessation of menses; whereas the gradual process through which this occurs, which typically takes a year but may last as little as six months or more than five years, is known as climacteric. Popular use, however, replaces climacteric with menopause. A natural or physiological menopause is that which occurs as a part of a woman's normal aging process. However, menopause can be surgically induced by such procedures as hysterectomy (when this procedure includes oophorectomy, removal of the ovaries).

The average onset of menopause is 50.5 years, but some women enter menopause at a younger age, especially if they have suffered from cancer or another serious illness and undergone chemotherapy. Premature menopause (or premature ovarian failure) is defined as menopause occurring before the age of 40, and occurs in one percent of women. Other causes of premature menopause include autoimmune disorders, thyroid disease, and diabetes mellitus. Premature menopause is diagnosed by measuring the levels of follicle stimulating hormone (FSH) and luteinizing hormone (LH); the levels of these hormones will be higher if menopause has occurred. Rates of premature menopause have been found to be significantly higher in both fraternal and identical twins; approximately five percent of twins reach menopause before the age of 40. The reasons for this are not completely understood. Transplants of ovarian tissue between identical twins have been successful in restoring fertility.

Post-menopausal women, especially Caucasian women of European descent, are at increased risk of osteoporosis.

Animals other than human beings rarely experience menopause, possibly because they simply do not live long enough to reach it. However, recent studies have shown menopause in gorillas, with an average age of 44 at onset.

Perimenopause refers to the time preceding menopause, during which the production of hormones such as estrogen and progesterone diminishes and becomes more irregular. During this period fertility diminishes. Menopause is arbitrarily defined as a minimum of twelve months without menstruation. Perimenopause can begin as early as age 35, although it usually begins much later. It can last for a few months or for several years. The duration of perimenopause cannot be predicted in advance.

## Grandmother Hypothesis

Human females have the unique distinction of being one of the only species to stop reproduction well before the end of their life span. This evolutionary distinction is odd because most other species continue to reproduce until death, thus maximizing the number of offspring they produce. The grandmother hypothesis essentially states that the presence of a grandmother has beneficial effect on the survival of an infant. Humans are one of the slowest developing species in the animal kingdom, and unlike many species infants, toddlers and children must be continuously cared for to ensure their survival. (Compare that to the salmon that swims up stream, spawns and dies)

## Etiology

The cessation of menses is the result of the eventual atresia of almost all oocytes in the ovaries. This causes an increase in circulating FSH and LH levels as there are a decreased number of oocytes responding to these hormones and producing estrogen. This decrease in the production of estrogen

leads to the post-menopausal symptoms of hot flashes, insomnia, osteoporosis, atherosclerosis, vaginal atrophy and depression.

Cigarette smoking has been found to decrease the age at menopause by as much as one year however, premature menopause (before the age of 40) is generally idiopathic.

## Symptoms

The clinical features of menopause are caused by the estrogen deficiency.

- vasomotor instability
- hot flashes, hot flushes
- sleep disturbances
- Urogenital atrophy
- dyspareunia
- itching
- dryness
- bleeding
- urinary frequency
- urinary urgency
- urinary incontinence
- skeletal

### Breast Atrophy

- skin thinning
- decreased elasticity
- Psychological

### Mood Disturbance

- irritability
- fatigue
- decreased libido
- memory loss
- depression

**Treatments:** Medical treatments for menopausal symptoms have been developed. Most notably, Hormone Replacement Therapy (HRT), has been used to reduce the weakening of bones (known as osteoporosis). However, some women have resisted the implication that menopause is a disorder, seeing it as a natural stage of life. There has also been scientific controversy over whether the benefits of HRT outweigh the risks. For many years, women were advised to take hormone therapy after menopause to reduce their risk of heart disease and various aspects of aging. However, a large, randomized, controlled trial (the Women's Health Initiative) found that women undergoing HRT had an increased risk of Alzheimer's disease, breast cancer, heart disease and stroke.

## Osteoporosis

Osteoporosis is a skeletal disease resulting in bone loss and changes in the bone quality that leads to diminished bone strength and an increased risk to sustain fractures. The main cause of osteoporosis is a loss estrogen following menopause. Osteoporosis can be prevented and treated using a number of different drugs and lifestyle modifications including proper diet, exercise and hormone replacement therapy. The link to Wikipedia Osteoporosis is a great source of additional information.

**Preventing Osteoporosis** The old saying that an ounce of prevention is worth a pound of cure holds true for osteoporosis. In researching osteoporosis I found that while there are some treatments for osteoporosis, a healthy lifestyle throughout your life is a much more effective way of combating the effects of this disease. It is generally acknowledged that a regular weight bearing exercise plan is helpful in maintaining bone mass. Additionally, adequate dietary calcium and vitamin D intake throughout ones life are important factors in building up and maintaining bone mass.

Estrogen and progesterone treatments in postmenopausal women have proven to be effective in treating bone loss. There are also two groups of drugs that interfere with the re-absorption of bone by osteoclasts called bisphosphonates and lective estrogen receptor modulators (SERMS).

An estimated 52 million men and woman will be afflicted with crumbling, weakend bone's by the year 2010. Osteoporosis is three to four time's more common in woman than men. While some men do get osteoporosis, they are less likley because men have frames that are 25 percent larger than a womans. Women are also more susceptible because they are more likely than a man to go on a crash diet. This kind of diet may interfere with the three main factors associated with osteoporosis and having healthy bones: having enough vitamin D, having enough calcium, and having enough estrogen. There are approximately 1 million to 1.3 millon hip fractures every year that are related to osteoporosis. Men on steroids, people with arthritis, people undergoing chemotherapy, along with those suffering from anorexia all have an increased chance of having bone loss.

### Osteoporosis related links

[Wikipedia Osteoporosis Page](#) This is a wikipedia link with a complete discussion of osteoporosis.

[National Osteoporosis Foundation](#) This page links to the National Osteoporosis Foundation

## Old Age

### Why do people age?

Some researchers believe we are programmed by an internal biological clock to age. The idea is that each type of cell, tissue and organ is like a clock that ticks at its own pace. In the body our cells divide 80 to 90 times at the most. At the end of each chromosome there are repeated stretches of DNA called telomeres. A bit of each telomere is lost during every cell division. When only a nub remains the cells stop dividing and die.

A different hypothesis is that aging is a result of accumulated damage to DNA from environmental

attacks and a decline in DNA's mechanism of self repair. Things such as free radicals attack DNA and other molecules causing structural changes. These changes in DNA endanger the synthesis of enzymes and other proteins that are required for life. This damage interferes with cell division.

Most researchers believe that aging is a combination of an internal clock that ticks out the life span of cells and the accumulation damage to DNA.

## Old Age Diseases

### Diabetes

Diabetes mellitus is a disease characterized by persistent hyperglycemia (high blood sugar levels), resulting either from inadequate secretion of the hormone insulin, an inadequate response of target cells to insulin, or a combination of these factors. Diabetes is a metabolic disease requiring medical diagnosis, treatment and lifestyle changes

Type 1 diabetes mellitus is characterized by loss of the insulin-producing beta cells of the islets of Langerhans of the pancreas. Sensitivity and responsiveness to insulin are usually normal, especially in the early stages. This type comprises up to 10% of total cases in North America and Europe, though this varies by geographical location. This type of diabetes can affect children or adults, but has traditionally been termed "juvenile diabetes" because it represents a majority of cases of diabetes affecting children. The most common cause of beta cell loss leading to type 1 diabetes is autoimmune destruction, accompanied by antibodies directed against insulin and islet cell proteins. The principal treatment of type 1 diabetes, even from the earliest stages, is replacement of insulin. Without insulin, ketosis and diabetic ketoacidosis can develop.

Type 2 diabetes mellitus is due to a combination of defective insulin secretion and defective responsiveness to insulin (often termed reduced insulin sensitivity). In early stages the predominant abnormality is reduced insulin sensitivity, characterized by elevated levels of insulin in the blood. The initial defect of insulin secretion is subtle and initially involves only the earliest phase of insulin secretion. In the early stages, hyperglycemia can be reversed by a variety of measures and medications that improve insulin sensitivity or reduce glucose production by the liver, but as the disease progresses the impairment of insulin secretion worsens, and therapeutic replacement of insulin often becomes necessary. Type 2 diabetes is quite common, comprising 90% or more of cases of diabetes in many populations. There is a strong association with obesity and with aging, although in the last decade it has increasingly begun to affect older children and adolescents. In the past, this type of diabetes was often termed adult-onset diabetes or maturity-onset diabetes.

Gestational diabetes, Type III, also involve a combination of inadequate insulin secretion and responsiveness, resembling type 2 diabetes in several respects. It develops during pregnancy and may improve or disappear after delivery. Even though it may be transient, gestational diabetes may damage the health of the fetus or mother, and about 40% of women with gestational diabetes develop type 2 diabetes later in life.

## Congestive Heart Failure

Congestive heart failure (CHF), also called congestive cardiac failure (CCF) or just heart failure, is a condition that can result from any structural or functional cardiac disorder that impairs the ability of the heart to fill with or pump a sufficient amount of blood throughout the body. It is not to be confused with "cessation of heartbeat", which is known as asystole, or with cardiac arrest, which is the cessation of normal cardiac function in the face of heart disease. Because not all patients have volume overload at the time of initial or subsequent evaluation, the term "heart failure" is preferred over the older term "congestive heart failure". Congestive heart failure is often undiagnosed due to a lack of a universally agreed definition and difficulties in diagnosis, particularly when the condition is considered "mild".

## Stroke

A stroke, also known as cerebrovascular accident (CVA), is an acute neurologic injury whereby the blood supply to a part of the brain is interrupted. Stroke can also be said to be a syndrome of sudden loss of neuronal function due to disturbance in cerebral perfusion. This disturbance in perfusion is commonly on the arterial side of the circulation, but can be on the venous side.

The part of the brain with disturbed perfusion can no longer receive adequate oxygen carried by the blood; brain cells are therefore damaged or die, impairing function from that part of the brain. Stroke is a medical emergency and can cause permanent neurologic damage or even death if not promptly diagnosed and treated. It is the third leading cause of death and adult disability in the US and industrialized European nations. On average, a stroke occurs every 45 seconds and someone dies every 3 minutes. Of every 5 deaths from stroke, 2 occur in men and 3 in women.

## Progeria

The term Progeria narrowly refers to Hutchinson-Gilford Progeria syndrome, but the term is also used more generally to describe any of the so-called "accelerated aging diseases". The word progeria is derived from the Greek for "prematurely old". Because the "accelerated aging" diseases display different aspects of aging, but never every aspect, they are often called "segmental progerias" by biogerontologists. Hutchinson-Gilford Progeria syndrome is an extremely rare genetic condition which causes physical changes that resemble greatly accelerated aging in sufferers. The disease affects between 1 in 4 million (estimated actual) and 1 in 8 million (reported) newborns. Currently, there are approximately 40-45 known cases in the world. There is no known cure. Most people with progeria die around 13 years of age. Progeria is of interest to scientists because the disease may reveal clues about the process of aging. Unlike most other "accelerated aging diseases" (such as Werner's syndrome, Cockayne's syndrome or xeroderma pigmentosum), progeria is not caused by defective DNA repair. It is caused by mutations in a LMNA (Lamin A protein) gene on chromosome 1. Nuclear lamina is a protein scaffold around the edge of the nucleus that helps organize nuclear processes such as RNA and DNA synthesis.

# The effects of Aging on the Bodys System

## Cardiovascular System

The heart loses about 1% of its reserve plumbing capacity every year after we turn 30. Change in blood vessels that serve brain tissue reduce nourishment to the brain, resulting in the malfunction and death of brain cells. By the time we turn 80, cerebral blood flow is 20% less, and renal blood flow is 50% less than when we were 30. Decreased blood supply may be a factor in age-related changes through out the body.

### Heart Attack / Myocardial infarction

Acute myocardial infarction (AMI or MI), commonly known as a heart attack, is a disease that occurs when the blood supply to a part of the heart is interrupted, causing death of heart tissue. It is the leading cause of death for both men and women all over the world. The term myocardial infarction is derived from myocardium (the heart muscle) and infarction (tissue death). The phrase "heart attack" sometimes refers to heart problems other than MI, such as unstable angina pectoris and sudden cardiac death.

### Congestive Heart Failure

In the elderly, ventricular diastolic stiffness can lead to pulmonary circulatory congestion. Aortic stenosis and aortic insufficiency, elevate left ventricular preload to the point where the left ventricle becomes stiff and noncompliant, and is common in people 75 years of age or older. Elevated pressures are transmitted to the pulmonary vasculature and lead to pulmonary edema.

## Musculoskeletal System

### Bones

Aging is accompanied by the loss of bone tissue. The haversian systems in compact bone undergo slow erosion, lacunae are enlarged, canals become widened, and the endosteal cortex converts to spongy bone. The endosteal surface gradually erodes until the rate of loss exceeds the rate of deposition. Bone remodeling cycle takes longer to complete because bone cells slow in the rate of resorption and deposition of bone tissue. The rate of mineralization also slows down. The number of bone cells also decreases because the bone marrow becomes fatty and unable to provide an adequate supply of precursor cells. Because bones become less dense, they become more prone to fractures.

### Joints

Cartilage becomes more rigid, fragile, and susceptible to fibrillation. Loss of elasticity and resiliency is attributed to more cross-linking of collagen to elastin, decrease in water content, and decreasing concentrations of glycosaminoglycans. Joints are also more prone to fracture due to the loss of bone mass.

### Muscles

Decrease in the range of motion of the joint is related to the change of ligaments and muscles. As the body ages, muscle bulk and strength declines especially after the age of 70. As much as 30% of skeletal muscle are lost by age 80. Muscle fibers, RNA synthesis and mitochondrial volume loss may all be contributors to muscle decline. Other factors that could contribute to muscle loss

of the aged are: change in activity level, reduced nerve supply to muscle, cardiovascular disease, and nutritional deficiencies.

## Nervous System

One of the effects of aging on the nervous system is the loss of neurons. By the age of 30, the brain begins to lose thousands of neurons each day. The cerebral cortex can lose as much as 45% of its cells and the brain can weigh 7% less than in the prime of our lives. Associated with the loss of neurons comes a decreased capacity to send nerve impulses to and from the brain. Because of this the processing of information slows down. In addition the voluntary motor movement's slow down, reflex time increases, and conduction velocity decreases. Parkinson's disease is the most common movement disorder of the nervous system. As we age there are some degenerative changes along with some disease's involving the sense organ's that can alter vision, touch, smell, and taste. Loss of hearing is also associated with aging. It is usually the result of change's in important structures of the inner ear.

## Alzheimer's disease

Alzheimer's disease (AD) is a neurodegenerative disease characterized by progressive cognitive deterioration together with declining activities of daily living and neuropsychiatric symptoms or behavioral changes. It is the most common cause of dementia. The most striking early symptom is short term memory loss (amnesia), which usually manifests as minor forgetfulness that becomes steadily more pronounced with illness progression, with relative preservation of older memories. As the disorder progresses, cognitive (intellectual) impairment extends to the domains of language (aphasia), skilled movements (apraxia), recognition (agnosia), and those functions (such as decision-making and planning) closely related to the frontal and temporal lobes of the brain as they become disconnected from the limbic system, reflecting extension of the underlying pathological process. This consists principally of neuronal loss or atrophy, together with an inflammatory response to the deposition of amyloid plaques and neurofibrillary tangles. Genetic factors are known to be important, and autosomal dominant mutations in three different genes (presenilin 1, presenilin 2, and amyloid precursor protein) have been identified that account for a small number of cases of familial, early-onset AD. For late onset AD (LOAD), only one susceptibility gene has so far been identified: the epsilon 4 allele of the apolipoprotein E gene. Age of onset itself has a heritability of around 50%.

## Dementia

Dementia (from Latin de- "apart, away" + mens (genitive mentis) "mind") is the progressive decline in cognitive function due to damage or disease in the brain beyond what might be expected from normal aging. Particularly affected areas may be memory, attention, language and problem solving, although particularly in the later stages of the condition, affected persons may be disoriented in time (not knowing what day, week, month or year it is), place (not knowing where they are) and person (not knowing who they are). Symptoms of dementia can be classified as either reversible or irreversible depending upon the etiology of the disease. Less than 10% of all dementias are reversible. Dementia is a non-specific term that encompasses many disease processes, just as fever is attributable to many etiologies.

## Digestive System

The changes associated with aging of the digestive system include loss of strength and tone of the muscular tissue and its supporting muscular tissue, decreased secretory mechanisms, decreased motility of the digestive organ's, along with changes in neurosensory feedback regarding enzyme and hormone release, and diminished response to internal sensations and pain. In the upper GI tract common changes include periodontal disease, difficulty in swallowing, reduced sensitivity to mouth irritations and sores, loss of taste, gastritis, and peptic ulcer disease. Changes that may appear in the small intestine include, appendicitis, duodenal ulcers, malabsorption, and maldigestion. Other pathologies that increase in occurrence with age are, acute pancreatitis, jaundice, and gallbladder problems. Large intestinal changes such as hemorrhoids, and constipation may also occur. Cancer of the rectum are quite common.

## Urinary System

As we get older kidney function diminishes, by age 70 the filtering mechanism is only about half as effective as it was at age 40. Because water balance is altered and the sensation of thirst diminishes with age, older people are more susceptible to dehydration. This causes more urinary tract infections in the elderly. Other problems may include nocturia (excessive urination at night), increased frequency of urination, polyuria (excessive urine production), dysuria (painful urination), incontinence, and hematuria (blood in the urine). Some kidney diseases that are common as we age include, acute and chronic kidney inflammation's, and renal calculi (kidney stone's). The prostate gland is often implicated in various disorders of the urinary tract. Prostate cancer is the most common cancer in elderly males. Because the prostate gland encircles part of the urethra, an enlarged prostate gland may cause difficulty in urination

## Respiratory Systems

With the advancing of age, the airways and tissue of the respiratory tract become less elastic and more rigid. The walls of the alveoli break down, so there is less total respiratory surface available for gas exchange. This decreases the lung capacity by as much as 30% by the age of 70. Therefore, elderly people are more susceptible to pneumonia, bronchitis, emphysema, and other pulmonary disorders. For a more complete discussion of the respiratory system please visit [the Respiratory System chapter](#)

### Lung cancer

Lung cancer is a cancer of the lungs characterized by the presence of malignant tumours. Most commonly it is bronchogenic carcinoma (about 90%). Lung cancer is one of the most lethal forms of cancer worldwide, causing up to 3 million deaths annually. Only one in ten patients diagnosed with this disease will survive the next five years. Although lung cancer was previously an illness that affected predominately men, the lung cancer rate for women has been increasing in the last few decades, which has been attributed to the rising ratio of female to male smokers. More women die of lung cancer than any other cancer, including breast cancer, ovarian cancer and uterine cancers combined. Current research indicates that the factor with the greatest impact on risk of lung cancer is long-term exposure to inhaled carcinogens. The most common means of such exposure is tobacco smoke.

## Senses

### Vision

Changes in vision begin at an early age. The cornea becomes thicker and less curved. The anterior chamber decreases in size and volume. The lens becomes thicker and more opaque, and also increases rigidity and loses elasticity. The ciliary muscles atrophy and the pupil constricts. There is also a reduction of rods and nerve cells of the retina.

### Hearing

Approximately one third of people over the age of 65 have hearing loss. The ability to distinguish between high and low frequency diminishes with age. Loss of hearing for sounds of high-frequency (presbycusis) is the most common, although the ability to distinguish sound localization also decreases.

### Taste and Smell

Sensitivity to odors and taste decline with age. The sense of smell begins to degenerate with the loss of olfactory sensory neurons and loss of cells from the olfactory bulb. The decline in taste sensation is more gradual than that of smell. The elderly have trouble differentiating between flavors. The number of fungiform papillae of the tongue decline by 50% by the age of 50. Taste could also be affected by the loss of salivary gland secretions, notably amylase.

## Cellular Aging

As people age, oxygen intake decreases as well as the basal metabolic rate. The decrease in the metabolic rate, delayed shivering response, sedentary lifestyle, decreased vasoconstrictor response, diminished sweating, and undernutrition are reasons why the elderly cannot maintain body temperature. There is also a decrease in total body water (TBW). In newborns, TBW is 75% to 80%. TBW continues to decline in childhood to 60% to 65%, to less than 60% in adults.

## Organism Aging

Aging is generally characterized by the declining ability to respond to stress, increasing homeostatic imbalance and increased risk of disease. Because of this, death is the ultimate consequence of aging. Differences in maximum life span between species correspond to different "rates of aging". For example, inherited differences in the rate of aging make a mouse elderly at 3 years and a human elderly at 90 years. These genetic differences affect a variety of physiological processes, probably including the efficiency of DNA repair, antioxidant enzymes, and rates of free radical production.

## Aubrey de Grey

Aubrey David Nicholas Jasper de Grey, Ph.D., (born 20 April 1963 in London, England) is a

controversial biomedical gerontologist who lives in the city of Cambridge, UK. He is working to expedite the development of a cure for human aging, a medical goal he refers to as engineered negligible senescence. To this end, he has identified what he concludes are the seven areas of the aging process that need to be addressed medically before this can be done. He has been interviewed in recent years in many news sources, including CBS 60 Minutes, BBC, the New York Times, Fortune Magazine, and Popular Science. His main activities at present are as chairman and chief science officer of the Methuselah Foundation and editor-in-chief of the academic journal Rejuvenation Research.

## Scientific Beginnings

- **Medieval times** In this time the thought was once children emerged from infancy, they were regarded as miniature already formed adults.
- **Religious influence of parenting 16th Century** Puritan belief harsh restrictive parenting practices were recommended as the most efficient means of taming the depraved child.
- **John Locke's 17th Century** Tabula Rosa = Blank slate in this the thought was that children are to begin with nothing at all and all kinds of experiences can shape their characters. This is seen as a negative vision of the development of children because children do contribute to his or her own development.
- **Jean Jacques Rousseau 18th Century** Noble savages = endowed with a sense of right or wrong. Children have built in moral sense 1st concept of stage, 2nd maturation of growth refers to genetically determined naturally unfolding course. He saw development as a discontinuous stagewise process mapped out by nature.
- **Charles Darwin the forefather of Scientific Child Study 1859-1936, 19th century** The famous theory of evolution, *the survival of the fittest*, and *natural selection*.
- **G. Stanley Hall regarded as the founder of the child study movement 1846-1924** One of the most influential American psychologists of the early twentieth century. The Normative Approach = normative period measures of large numbers of individuals and age related averages are computed to represent typical development.
- **The mental testing movement early 20th Century** French psychologist Alfred Binet and Colleague Theodore Simon were the first to come up with a successful intelligence test IQ at Stanford University.
- **Sigmund Freud 1856-1939** Theory *'psychosexual theory*, ID, Ego, and Superego.
- **Erik Erikson 1902-1994** Theory *psychosocial theory*
- **John Watson 1878-1958** Behaviorism and Social Learning Theory
- **Ivan Pavlov** Classical conditioning
- **B.F. Skinner** Operant Conditioning

- **Albert Bandura** Social learning theory
- **Jean Piaget's** Cognitive-developmental theory

## Review Questions

1. Which of the following is a characteristic of Deciduous teeth.
  - A) The 32 teeth that erupt after in the place of primary teeth.
  - B) Is the common name for teeth belonging to humans.
  - C) The first set of 20 teeth in the growth development.
  - D) Are teeth that have decayed to the pulp.
  - E) Consist of the first and second premolars and the third molar.
2. It is widely believed that which of the following causes puberty?
  - A) Alterations in brain functions that result in an increase in the secretion of Gonadotropin-releasing hormone (GnRH) from the hypothalamus
  - B) The release of testosterone and estrogen from the gonads.
  - C) Endochondral ossification and an increase in bone mass.
  - D) Environmental exposure to UVA and UVB radiation from the sun.
3. Which of the following factors does not contribute to osteoporosis?
  - A) A history of fracture as an adult, and family history of fractures.
  - B) The age of menarche (first menstrual bleeding)
  - C) Lack of a regular weight bearing exercise plan.
  - D) Inadequate dietary calcium and vitamin D intake throughout ones life
  - E) Tobacco smoking intake of soft drinks containing phosphoric acid.
4. What is Apoptosis and what cells does it affect?
  - A) Apoptosis is the death of skin cell due to UVA exposure.
  - B) Apoptosis is the death of skin cell due to UVB exposure.
  - C) Apoptosis is the death of skin cell due to UVA and UVB exposure.
  - D) Apoptosis is regulated cell death that affects most cells in the body.
  - E) Apoptosis is the unregulated death of cells due to acute cellular injury.
5. Which of the following statements is true about the Epiphyseal plate / line?
  - A) The epiphyseal line allows lengthwise growth of a bone.
  - B) The ossification of epiphyseal plate controls the stoppage of growth after puberty.
  - C) A fracture at the epiphyseal line during puberty can result in stunted bone growth.
  - D) The epiphyseal line is composed of cartilage.
  - E) All of the above are true.
6. Why are women more prone to osteoporosis than men?

Differences in average adult bone mass between men and women, menopause (decline in estrogen)

7. Why is an injury to the epiphyseal plate of a long bone during puberty more significant than a regular fracture?

A fracture to the epiphyseal plate during puberty can cause the plate to seal resulting in a stoppage of bone growth.

8. What is the average age of menarche (the first menstrual bleeding) in American girls? What factors contribute to onset of menarche?

About 12.7 years

## Glossary

Alzheimer's disease

The most common form of dementia. It is a progressive condition that destroys brain cells, resulting in the loss of intellectual abilities

Apoptosis

The process of regulated cell death

Appositional bone growth

The growth in diameter of bones around the diaphysis occurs by deposition of bone beneath the periosteum.

Bilirubin

A chemical breakdown product of hemoglobin.

canaliculi

small channels or canals in bone.

Deciduous teeth

The first set of teeth in the growth development of humans and many other animals. (milk teeth, baby teeth, or primary teeth)

Dementia

The progressive decline in cognitive function due to damage or disease in the brain beyond what might be expected from normal aging.

Epiphyseal Plate

The cartilage in growing long bones that allows lengthwise growth. The plate ossifies at the end of puberty.

Haversian system

The basic structural unit of compact bone which includes a central canal, lamellae, lacunae, osteocytes, and canaliculi.

### Intramembranous ossification

The type of bone formation responsible for the development of flat bones, especially those found in the skull. In intramembranous ossification mesenchymal cells develop into bone without first going through a cartilage stage.

### lacunae

spaces between bone lamellae.

### lamellae

concentric layers of bone matrix.

### Menopause

The permanent cessation of menstrual cycles.

### Menarche

The first menstrual bleeding, usually occurs at about 12.7 years of age.

### Mongolian spots

are common among darker-skinned races, such as Asian, East Indian, and African. They are flat, pigmented lesions with unclear borders and irregular shape. They appear commonly at the base of the spine, on the buttocks and back. They may also can appear as high as the shoulders and elsewhere. Mongolian spots are benign skin markings and are not associated with any conditions or illnesses.

### Necrosis

A form of cell death that results from acute cellular injury.

### Osteoporosis

A condition that is characterized by a decrease in bone mass and density, causing bones to become fragile.

### Puberty

The process of physical changes by which a child's body becomes an adult body capable of reproduction

### Pyloric Stenosis

Narrowing of the pyloric sphincter that reduces or eliminates the passage of food from the stomach to the small intestine, often causing projectile vomiting in infants.

### Trabeculae

spongy bones that make plates or bars instead of concentric layers.

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