➢ PUBERTY

- From the latin for ***pubes*** = hair
- **Pubescence** = period of time during which puberty takes place
- **menarche** = first menstruation
- Begins earlier and ends earlier in females as compared to males

- **FEMALE CHANGES**

1. 95% of females reach menarche between 11 and 15, average age =13
2. First ovulation can be up to two years later
3. Initial menstrual periods are irregular and heavy
4. Growth and widening of the pelvis
5. Increased gonadotropin (LH & FSH) levels lead to increased estradiol and estrone production by the ovaries = development of secondary sexual characteristics
6. Ovaries increase in size
7. Appearance of pubic and axillary (armpit) hair
8. Breasts grow and enlarge
9. Sweat and sebaceous (lubricating oil) glands become more active = acne may develop
10. Slight lowering of the voice
11. Metabolic rate, heart rate and blood pressure increase
12. Fat becomes deposited beneath the skin (subcutaneous fat) in the regions of the hips and breasts
13. Skeletal growth spurt occurs and usually ends by age 16.
14. Bone growth finally halted by large estrogen secretion from ovaries near end of puberty.

- **MALE CHANGES**

1. Testes, prostate and seminal vesicles increase in size
15. Increased gonadotropin (LH & FSH) levels lead to increased testosterone production by the testes = development of secondary sexual characteristics
2. Pubic, axillary, face, chest and extremity hair develops
3. Sweat glands develop in axillae and produce an oily secretion that is acted on by bacteria to cause a characteristic body odor
4. Sebaceous (lubricating oil) glands become active on the scrotum, face, back and chest = acne may develop
5. Nipple becomes darker and areola widens
6. Vocal cords in larynx double in length = much lower voice; on average adult male voice is a full octave below the average female voice
7. Scrotum and penis enlarge
8. Spontaenous erections increase in frequency; may occur in response to non-sexual stressful or emotional stimuli; spontaneous erection decrease in frequency after puberty
9. Nocturnal emissions ("wet dreams") begin; may or may not contain sperm; decrease in frequency after puberty
10. Growth spurt occurs
11. Fat is deposited early in the sequence without much skeletal or muscle growth; at age 10 to 13 females are typically taller than males of similar age
12. As testosterone levels increase, dramatic inceases in skeletal and muscle growth occur so that on average adult males are taller (average = 177.6 cm) than adult females (average = 169.2 cm).
13. Some estrogen is produced by Sertoli cells during puberty causing a slight lump of fat to form beneath the nipple (usually goes away in less than 2 years).

In both sexes there is an increase in gonadotropin secretion (LH & FSH). This increase in the pulsatile release of gonadotropins occurs in females earlier than males. The fluctuations in LH & FSH during puberty first occur during the sleeping hours with dramatic changes in

amplitude. In adults, gonadotropin levels fluctuate less markedly. In order for puberty to occur, these pulses must occur about once every 1 to 3 hours. Previous to puberty this pattern of pulsatile or episodic release of LH and FSH is not seen.

The level of growth hormone and TSH (thyroid stimulating hormone) released from the anterior pituitary increases causing increased protein synthesis in many cells, an elevation in blood sugar and increased thyroid hormones raise metabolic rate.

There are two basic theories as to what causes the increase in GnRH release (and subsequent increase in LH and FSH) during puberty. These two theories are not mutually exclusive and both probably occur to some extent in a variety of species including humans.

1. Gonadostat Hypothesis
This theory states that there is a decrease in the sensitivity of the brain (hypothalamus and pituitary) to negative feedback.

2. GnRH Pulse Theory