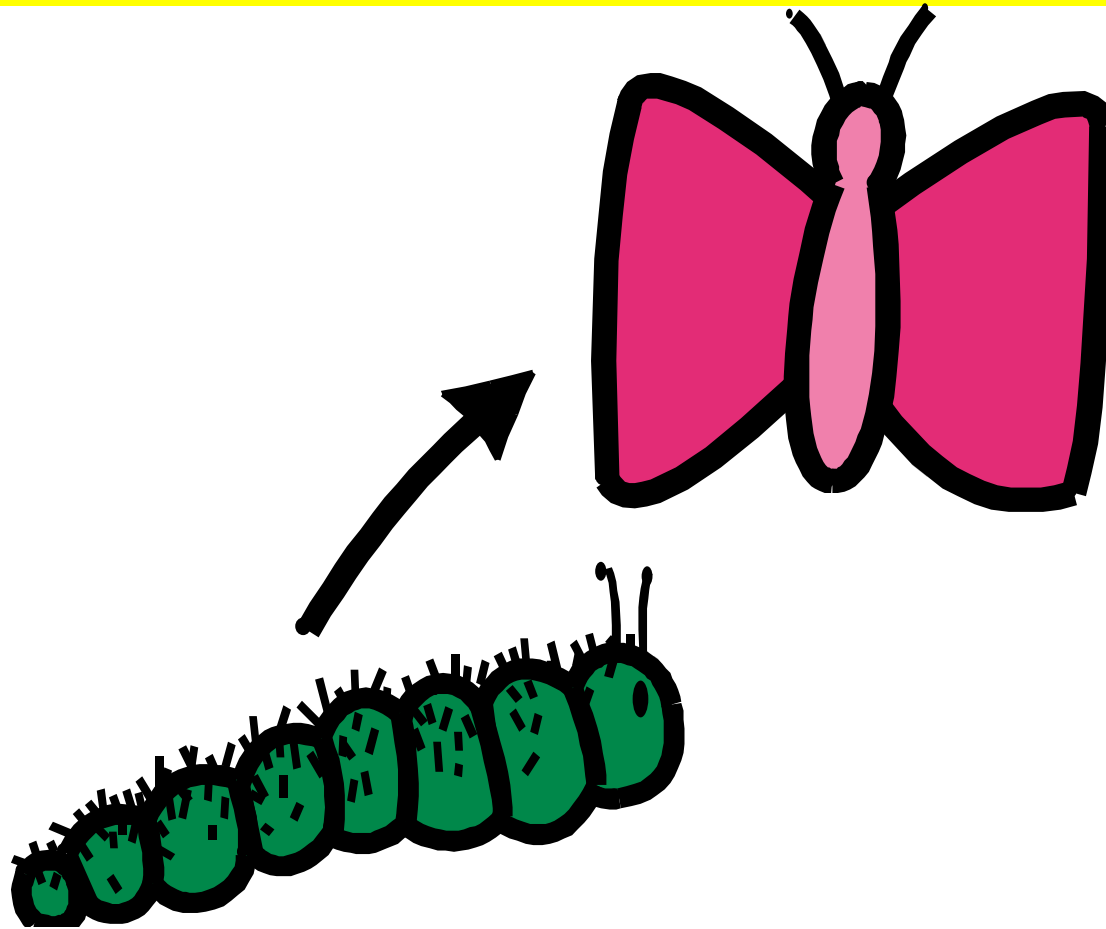


Normal puberty



Puberty is a time of great change and growth.



Puberty:

- *Puberty is the stage of growth leading to **sexual maturity** and **reproductive capacity**.*

Initial physical changes:

In girls:

Breast development

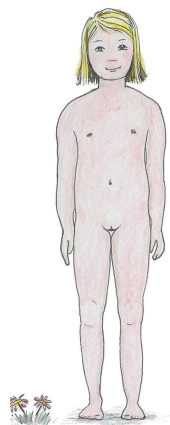
In boys:

Testicular growth

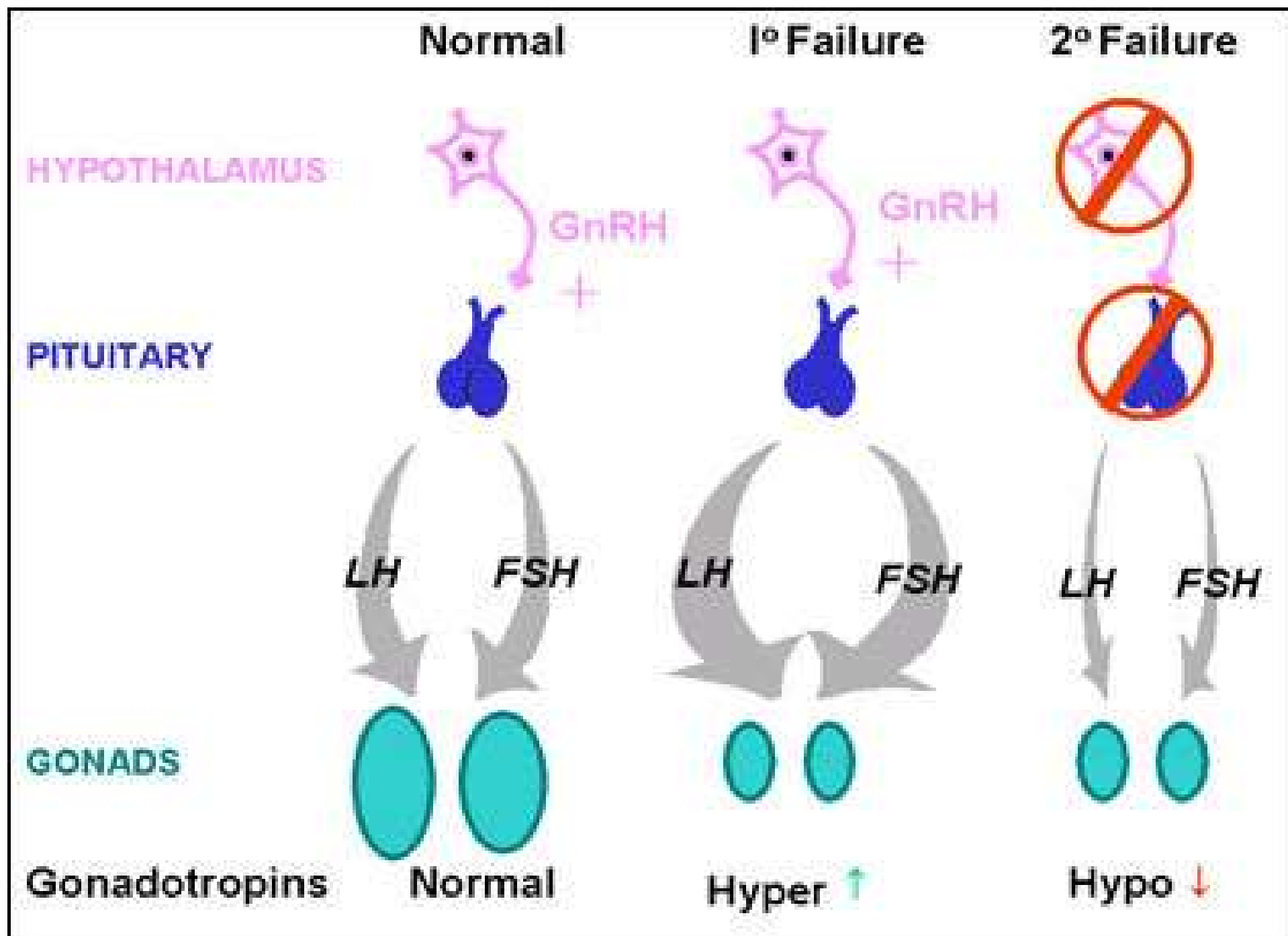
Physical change at puberty:

Puberty is associated with:

- *linear growth*
- *weight gain*
- *Increase of body fat*



Hormonal Changes During Puberty



Gonadotropin Releasing-Hormone:

GnRH:

- *secreted by 1000 neurons located in the **mediobasal hypothalamus.***
- *GnRH responsible for **gonadotropin secretion** by the *pituitary gland.**

Gonadotropin Releasing-Hormone:

- *GnRH is the **major** but **not only** hormone responsible for the **onset & progression of puberty.***

Gonadotropin Releasing-Hormone & puberty:

Pulsatile GnRH secretion occur :

- *2 years before the appearance of secondary sexual characteristics.*

Gonadotropin Releasing-Hormone:

- *Stimulates the **release of LH and FSH** from the pituitary which in turn stimulate the gonads.*
- *LH and FSH have **negative feedback** effects on the hypothalamus.*
- *Sex steroids **inhibit** both **hypothalamus** and **pituitary**.*

Gonadotropins & puberty :

- ***Pulsatile secretion of Gn** is responsible for enlargement and maturation of the gonads and the secretion of sex hormones.*

Gonadotropins & peripubertal period:

- ❖ *Sleep-entrained Gn secretion has **pulsatile fashion** and reflects endogenous episodic discharge of GnRH.*
- ❖ *There is **nocturnal pulses** of LH.*

Gonadotropins & pubertal period :

- ✓ *Gn pulses further increase becoming apparent during daytime.*
- ✓ *Mean LH and FSH levels increase.*
- ✓ *LH pulses become evident about 90-120 min.*

secondary sex characteristics:

Girls:

- *Gn stimulate synthesis of **estradiol** in ovary .*

Estrogen Actions:

- *Breast maturity.*
- *Genital growth .*
- *Maturation of the vaginal mucosa, uterine.*
- *Endometrial growth.*
- *Body composition changes.*
- *stimulating skeletal maturation.*

Secondary sex characteristics:

- ✓ ***LH*** stimulates ***testosterone*** synthesis by the testicular ***Leydig*** cells.
- ✓ ***FSH*** stimulates ***seminiferous tubule*** maturation (***spermatogenesis***).

Testosterone :

Androgen stimulates

- *Pubic and axillary hair.*
- *Apocrine gland maturation.*
- *Male secondary sexual characteristics.*

*Resulting in adult-type body odor
skin changes related to acne.*

Terminology

Gonadarche:

- ❖ *An increase in the activity of the hypothalamic-pituitary-gonad (HPG) axis during puberty.*

Thelarche:

- ❖ *Onset of **breast development** in females .*
- ❖ *May be **unilateral** for **several** months.*

Menarche:

- *Is the **first menstrual period.***
- *Menarche correlates directly with skeletal age.*

Pubarche:

Onset of sexual hair

Adrenarche:

- *Increased **adrenal androgen** secretion.*
- *Dehydroepiandrosterone sulfate(DHEAS) DHEA.*
- *Begin to increase in girls around **six years** of age.*
- *Begins **before gonadarche.***

Pubarche&Gonadarche:

- *It is now evident that the two events are independent processes.*

Age of Puberty

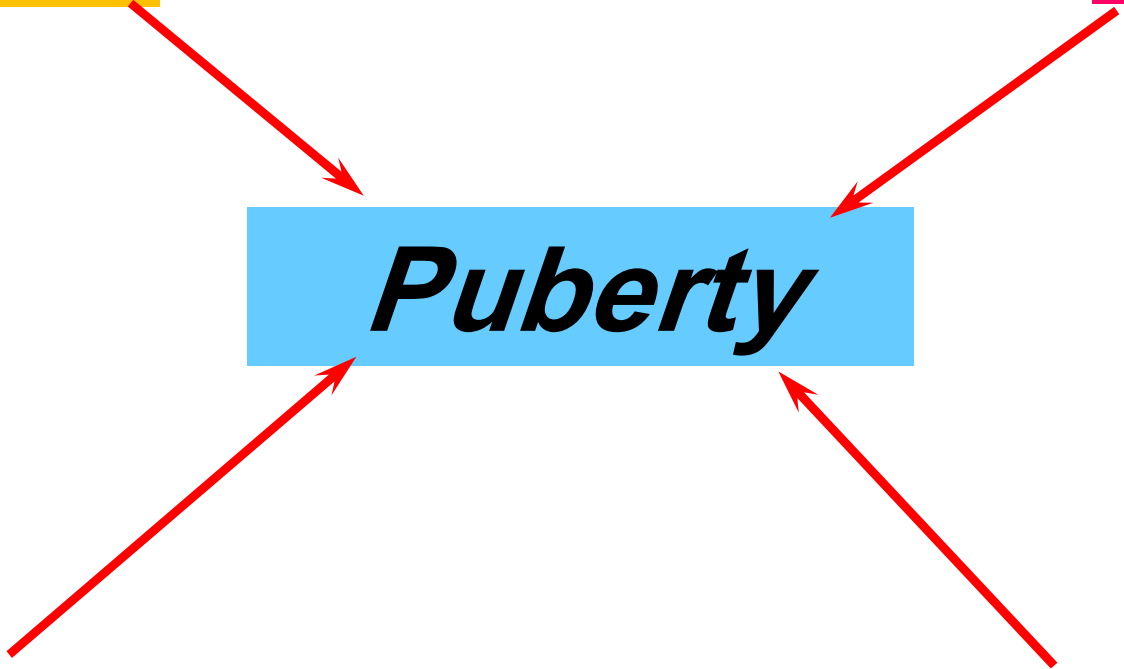
Hormonal

Genetic

Puberty

Environment

Nutritional



Age of puberty:

- *The age of onset of puberty correlated with osseous maturation than with chronological age.*

Tanner staging system:

- ✓ *Physical changes are described by using the **Tanner** staging system.*

Normal Female Development

Tanner stages of puberty in girls

Stage 1 <i>(Prepubertal)</i>	Elevation of papilla only.	No pubic hair.
Stage 2	Elevation of breast and papilla as small mound, areola diameter enlarged. Median age: 9/8	Sparse, long, pigmented hair, along labia majora. Median age: 10/5
Stage 3	Further enlargement without separation of breast and areola. Median age: 11/2	Dark, course, curled hair sparsely spread over mons. Median age: 11/4
Stage 4	Secondary mound of areola and papilla above the breast. Median age: 12/1	Adult type hair, abundant but limited to mons. Median age: 12
Stage 5	Recession of areola to contour of breast. Median age: 14/6	Adult type spread in quantity and distribution. Median age: 13/7

I



II



III



IV



V



Mean age of Tanner stage 2 breast:

- white girls is 8/0 → 10/4 years.
- black girls 9/6 → 9/5 years .

Events after Tanner stage 2 Breast:

Appearance of pubic hair:

6-12 mo later

Menarche is usually

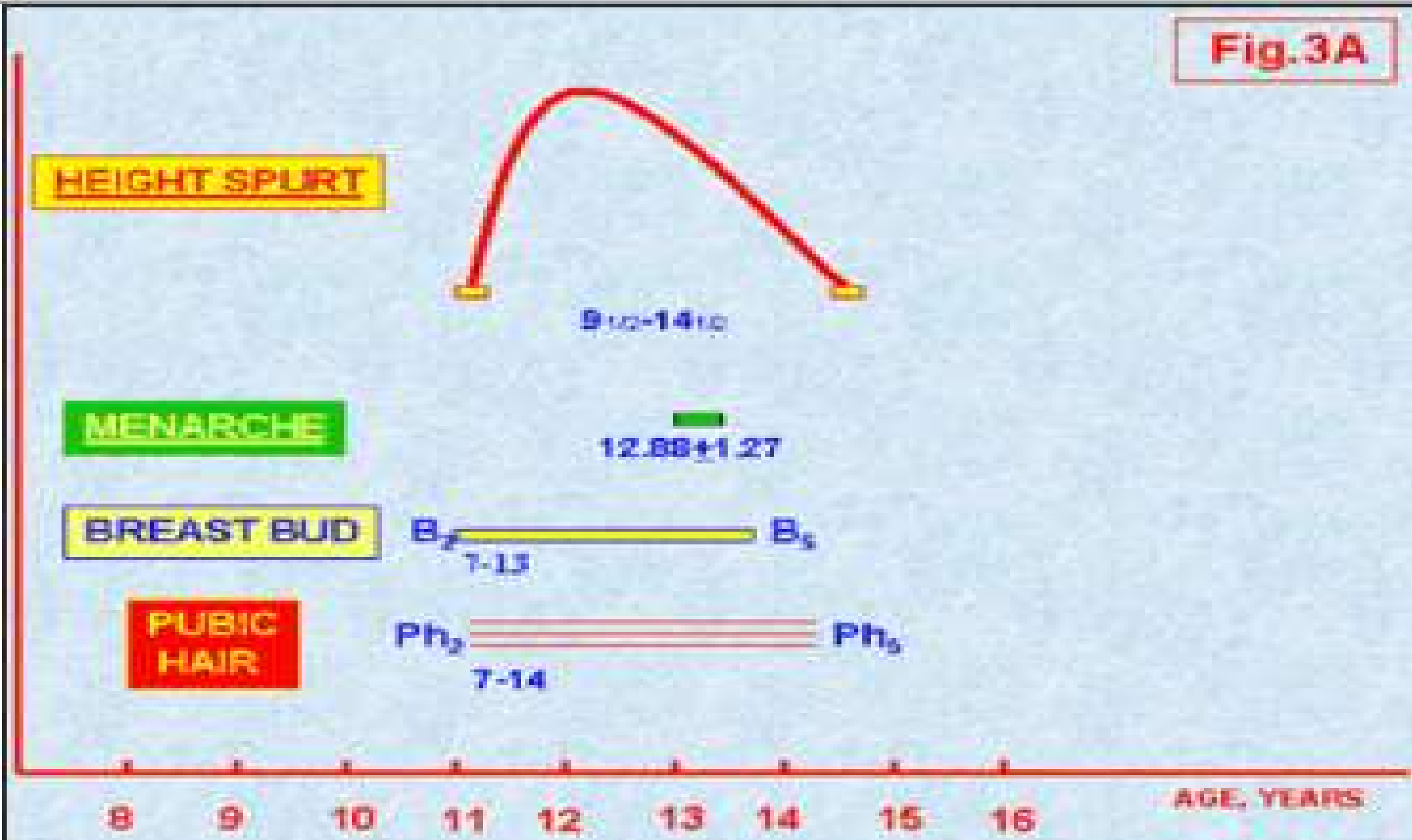
After 2-2.5 yr

May be 6 yr

Menstruation begin mid to late puberty

girls

Fig.3A



Normal Male development

physical change in boys:

The first signs of puberty

- *A testis with a volume of 3 cc.*
- *longest diameter of testis 2.5 cm.*
- *Thinning of the scrotum.*

physical change in boys:

- *These are followed by pigmentation of the scrotum and growth of the penis.*
- *Pubic hair then appears .*
- *Axillary hair begins at mid-puberty.*

Penile length

in stretched flaccid state

- pre-puberty \longrightarrow 6/2 cm
- Adult male \longrightarrow 12/4 \pm 2/7 cm

- *lower age limit of pubertal onset, is 9/.*

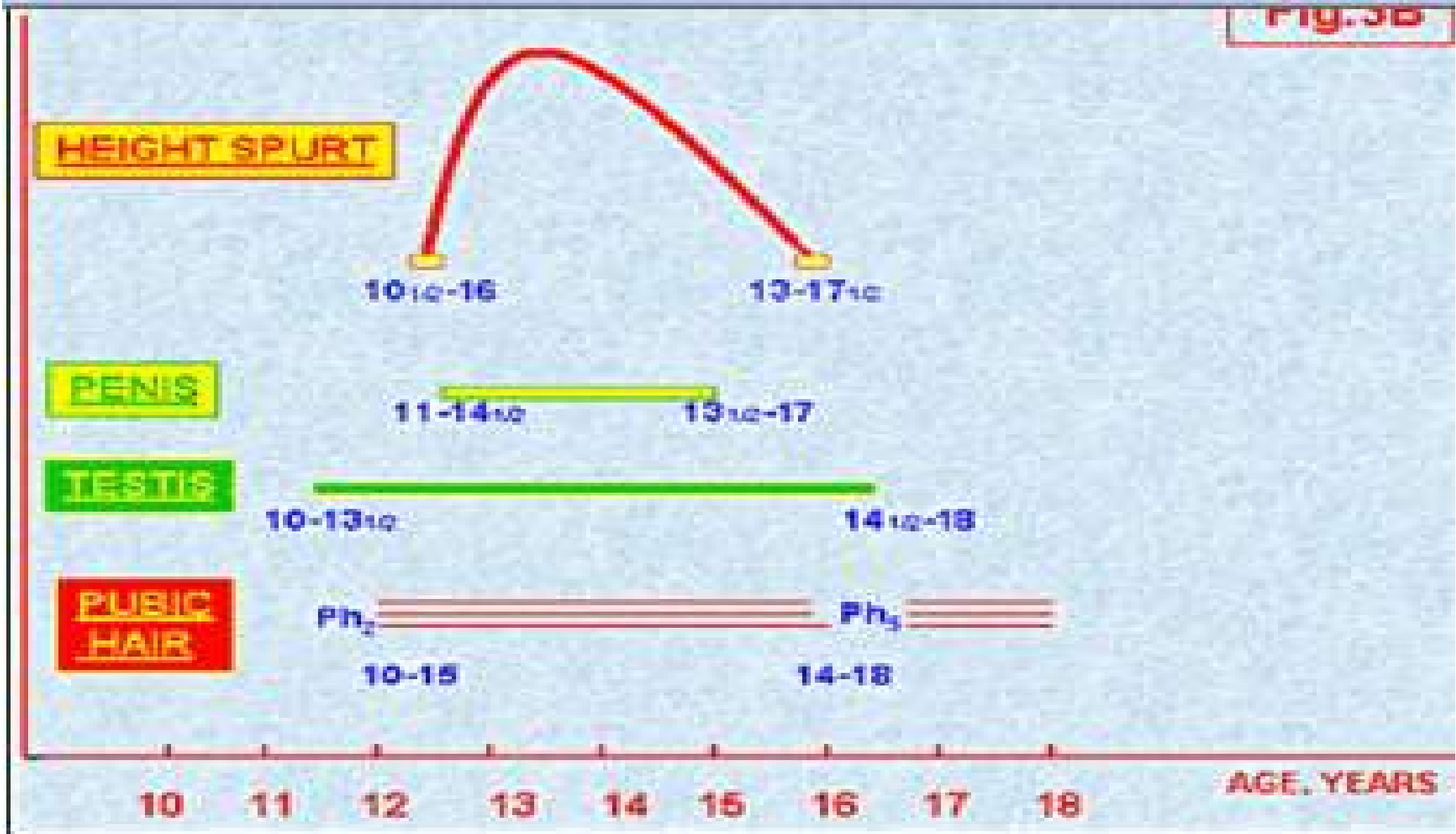
Spermatogenesis:

Begin mid to late puberty

boys



Fig. 3B



tanner stages of puberty in boys

stage	genitals	testicle length	pubic hair	other
I	infrequent erections	less than 1/6 cm	villus hair only	adrenarche
II	scrotum skin thins and reddens; frequent erections	2/5 to 3/2 cm	sparse, slightly pigmented at the base of the penis	leaner body
III	lengthening of penis	3/3 to 4/0 cm	coarser, darker, curled over the junction of the pubes	some temporary swelling of breasts, voice breaks
IV	thickening of penis, darkening of scrotum skin	4/1 to 4/5 cm	adult type, covering the pubes	acne, underarm hair, voice deepens
V	adult genitals	4/5 cm	adult type, spreading	beard, continuing muscle dev

I



3

<2,5

II



4

2,5-3,2

III



10

3,6

IV



16

4,1-4,5

V



25

>4,5

Growth Velocity & Height

Growth Velocity & Height:

Estradiol is the key hormone stimulating skeletal maturity in both sexes.

- *somatic growth directly.*
- *indirectly via increased growth hormone secretion.*

Accelerated Growth Begins


- *Onset of puberty in girls.*
- *Mid-puberty in boys.*

Boys & Growth velocity :

- *Before puberty* → *3/5 cm/year*
- *First year of puberty* → *7 cm/yr*
- *During second year* → *9 cm/year*
- *peak growth velocity* → *mid-puberty*

•

Boys & peak Growth velocity :

- Genital stage IV-V  and 14 yr.
- Growth spurt occurs 2 yr later than in girls.
- *Growth may continue* beyond 18 yr of age .

Girls & Growth velocity

- *First year of puberty* → 9 cm/yr
- *second year* → 11 cm/year

Girls & Peak height velocity

- *At breast stage* ——— *II-III*

**Between 11 and 12 yr
precedes menarche**

- *1 to 1.5 cm of height after menarche*

A bouquet of colorful roses in a glass vase filled with confetti. The roses are in shades of yellow, orange, pink, and purple. The vase is filled with multi-colored confetti. The background is a soft, out-of-focus indoor setting.

Thanks for your attention