

Physical Changes in Adolescence

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(Typically ages 10-19; onset and timing vary by individual, sex, genetics, nutrition, and environment)

1. Overview

- **Adolescence** marks the transition from childhood to adulthood.
 - The primary driver is the **pubertal hormonal cascade** that initiates rapid growth and sexual maturation.
 - Changes can be grouped into **somatic (body) changes**, **reproductive system development**, and **secondary sexual characteristics**.
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2. Hormonal Regulation

Hormone	Source	Primary Action in Adolescence
Gonadotropin-releasing hormone (GnRH)	Hypothalamus	Pulsatile release triggers pituitary secretion of LH & FSH.
Luteinizing hormone (LH) & Follicle-stimulating hormone (FSH)	Anterior pituitary	Stimulate gonadal growth and sex-steroid production.
Estrogen	Ovaries (girls)	Drives breast development, uterine growth, fat distribution, epiphyseal plate closure.
Testosterone	Testes (boys)	Promotes muscle mass, deepening voice, facial & body hair, spermatogenesis.
Growth hormone (GH) & IGF-1	Pituitary & liver	Accelerate linear growth (growth spurt).
Adrenal androgens (DHEA, DHEAS)	Adrenal cortex	Contribute to pubic/axillary hair and skin oiliness.

The “pubertal clock” begins when GnRH pulses increase, typically around age 8-9 in girls and 9-10 in boys, but can vary by $\pm 2-3$ years.

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3. Growth Patterns

Feature	Girls	Boys
Onset of growth spurt	10?12?yr (?2?yr before menarche)	12?14?yr (?2?yr after testicular enlargement)
Peak height velocity (PHV)	8?10?cm/yr (?age 12)	9?11?cm/yr (?age 14)
Final adult height	Usually reached 1?2?yr after menarche	Reached 2?3?yr after PHV; epiphyses close ~2?yr later
Body composition	? body fat (especially hips & thighs)	? lean muscle mass, ? body fat proportion

- **Growth plates (epiphyses)** close under the influence of estrogen (both sexes). Early estrogen exposure ? earlier cessation of growth.

4. Development of Primary Sexual Organs

Sex	Change	Clinical Milestones
Female	Ovarian enlargement; onset of follicular activity; menarche (first menstrual bleed)	Menarche occurs ~2?2.5?yr after thelarche (breast budding).
Male	Testicular enlargement (?2.5?cm ? puberty), epididymal growth, onset of spermatogenesis	First sperm in ejaculate appears ~6?12?mo after testicular enlargement.

5. Secondary Sexual Characteristics

5.1. Girls

- **Thelarche** – breast bud development (Tanner stage?II).
- **Pubarche** – appearance of pubic hair (adrenarche).
- **Menarche** – first menstrual cycle (average