FREE NOTES · NCERT + NEET LEVEL

Human Reproduction

Male and female reproductive systems, gametogenesis (spermatogenesis, oogenesis), menstrual cycle, fertilisation and implantation, pregnancy and embryonic development, parturition and lactation.

01 Male reproductive system
02 Female reproductive system
03 Gametogenesis
04 Menstrual cycle
05 Fertilisation and implantation
06 Pregnancy, parturition, lactation
07 Extra + tricks
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11 Quick revision

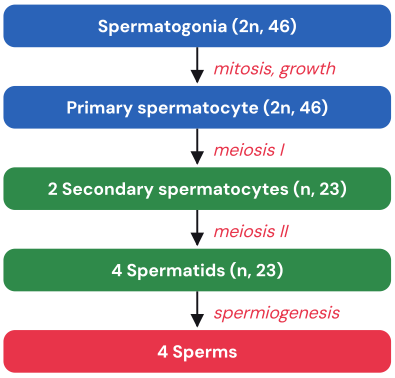
01 Male reproductive system

- **Testes** in scrotum (2–2.5 °C below body temperature, needed for spermatogenesis). Each testis ~4–5 cm long; ~250 compartments (**testicular lobules**), each with 1–3 **seminiferous tubules**.
- Tubules lined by spermatogonia (male germ cells) and **Sertoli cells** (nourish germ cells). Outside tubules: **Leydig/interstitial cells** secrete androgens; also immunocompetent cells.
- Ducts: rete testis → vasa efferentia → epididymis → vas deferens → ejaculatory duct → urethra (urinogenital duct) → urethral meatus.
- Accessory glands: paired seminal vesicles, bulbourethral glands, prostate: seminal plasma (fructose, Ca^{2+}, enzymes); bulbourethral secretion lubricates penis.

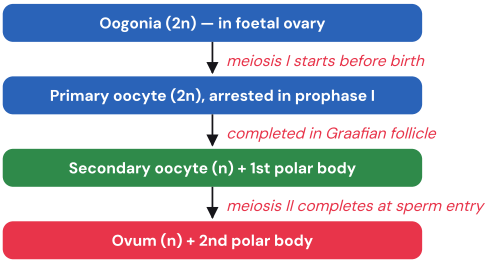
02 Female reproductive system

- **Ovaries** (2–4 cm), ovarian stroma with peripheral cortex and inner medulla; ovarian follicles.
- **Oviduct** (fallopian tube, 10–12 cm): infundibulum with **fimbriae** (collect ovum) → ampulla (wider; site of fertilisation) → isthmus → uterus.
- **Uterus** (womb, inverted pear): perimetrium, **myometrium** (thick smooth muscle; strong contractions in delivery), **endometrium** (glandular; cyclic changes). Cervix + vagina = birth canal.
- External genitalia: mons pubis, labia majora, labia minora, hymen, clitoris. Mammary glands: 15–20 lobes of alveoli (secrete milk) → mammary tubules → ducts → ampulla → lactiferous duct.

03 Gametogenesis



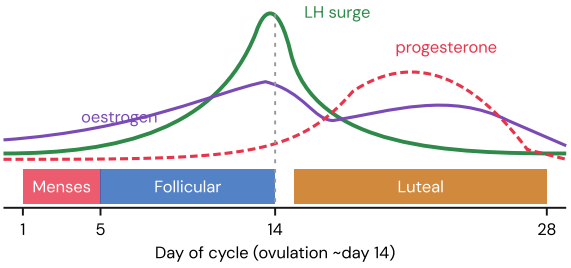
Spermatogenesis (starts at puberty)



Oogenesis

- Hormones: GnRH (hypothalamus) ⇒ LH (Leydig cells → androgens) and FSH (Sertoli cells → factors for spermiogenesis).
- Sperm: head (acrosome with enzymes for fertilisation + nucleus), neck, middle piece (mitochondria for energy), tail. 200–300 million sperms per ejaculate; ≥60% normal shape and ≥40% vigorous motility needed for fertility.
- Follicles: primordial → primary → secondary → tertiary (antrum) → **Graafian follicle**. ~60,000–80,000 primary follicles left at puberty.

04 Menstrual cycle



Phases and hormone levels in a 28-day cycle

- First menstruation at puberty = **menarche**; stops at ~50 years = **menopause**. Occurs only in primates.
- **Menstrual phase** (days 1–5): breakdown of endometrium when ovum not fertilised.
- **Follicular/proliferative phase**: follicles grow, endometrium regenerates; FSH and LH rise gradually; oestrogen secreted.
- **Ovulation** (~day 14): **LH surge** ruptures Graafian follicle, releases secondary oocyte.
- **Luteal/secretory phase**: corpus luteum secretes **progesterone** (maintains endometrium). No fertilisation ⇒ corpus luteum degenerates ⇒ menstruation.

05 Fertilisation and implantation

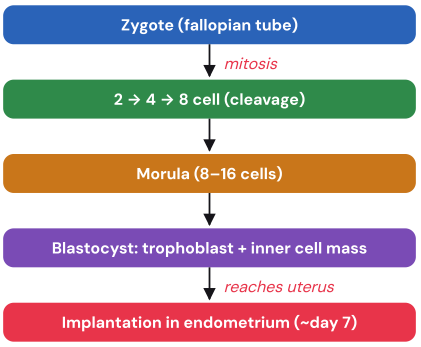
- Fertilisation in **ampullary** region of oviduct. Sperm contacts zona pellucida; changes block entry of more sperms (polyspermy prevented). Acrosome enzymes help entry; secondary oocyte completes meiosis II ⇒ ovum + second polar body ⇒ zygote.
- Sex decided by sperm: X sperm ⇒ XX (female); Y sperm ⇒ XY (male).
- Cleavage ⇒ blastomeres ⇒ **morula** (8–16 cells) ⇒ **blastocyst**: trophoblast (outer, attaches to endometrium) + inner cell mass (becomes embryo). Embedding in endometrium = **implantation** ⇒ pregnancy.
- Inner cell mass contains **stem cells** (can form all tissues and organs).

06 Pregnancy, parturition, lactation

- **Placenta**: chorionic villi + uterine tissue; supplies O_2, nutrients; removes CO_2, wastes; joined to embryo by umbilical cord. Endocrine: hCG, hPL, oestrogens, progestogens; relaxin (later). hCG, hPL, relaxin produced only during pregnancy.
- Germ layers: ectoderm, mesoderm, endoderm from inner cell mass.
- Development: heart by end of 1st month; limbs and digits by end of 2nd month; major organs, external genitalia by end of 12 weeks (1st trimester); first movements and hair on head in 5th month; by end of 24 weeks (2nd trimester) body hair, eyelids separate, eyelashes. Gestation ~9 months.
- **Parturition**: **foetal ejection reflex** (signals from foetus and placenta) ⇒ oxytocin from pituitary ⇒ uterine contractions (positive feedback). Relaxin softens pelvic ligaments.
- **Lactation**: **colostrum** (first milk, with IgA antibodies) gives newborn resistance.

07 Extra + tricks

- Sperm: head (acrosome = modified Golgi), middle piece (mitochondria, spiral), tail (axoneme). Ovum is surrounded by zona pellucida and corona radiata.
- Testis structure: tunica albuginea, ~250 lobules, Sertoli cells (also called nurse cells), Leydig cells between tubules.
- Trophoblast forms chorion (placenta); inner cell mass forms embryo. Stem cells of inner cell mass are pluripotent.
- Trick for 1st trimester milestones: **"1 heart, 2 limbs, 3 organs"** = heart by month 1, limbs by month 2, major organs by month 3.
- Hormones: GnRH → LH, FSH; menstrual cycle phases: menstrual → follicular → ovulatory → luteal.



Embryo development up to implantation

08 Important Q&A

Q1. Why are testes located in the scrotum?

Scrotum keeps testes 2–2.5 °C lower than body temperature, necessary for spermatogenesis.

Q2. How many sperms and ova are formed from 100 primary spermatocytes and 100 primary oocytes?

400 sperms and 100 ova.

Q3. Which hormone surge causes ovulation?

LH surge (mid-cycle, ~day 14).

09 Common mistakes

- Saying fertilisation occurs in uterus (it is ampulla of oviduct).
- Saying ovum is released at ovulation (it is secondary oocyte).
- Mixing Sertoli (nourish) and Leydig (androgens) cells.
- Thinking mother decides sex of child.

10 Practice (NEET style)

1. Site of fertilisation?
2. Hormone of corpus luteum?
3. First milk?
4. Hormones made only in pregnancy?
5. Stage that implants?

ANSWERS

1) Ampulla of oviduct · 2) Progesterone · 3) Colostrum · 4) hCG, hPL, relaxin · 5) Blastocyst

11 Quick revision: 5 minutes before the exam

MALE

- Seminiferous tubules
- Sertoli nourish, Leydig androgen
- 1 spermatocyte → 4 sperms

FEMALE

- Fimbriae, ampulla
- 1 oocyte → 1 ovum + polar bodies
- Graafian follicle

CYCLE

- Menses 1–5
- LH surge day 14
- Progesterone luteal

PREGNANCY

- Morula → blastocyst → implant
- Placenta hCG, hPL
- Oxytocin, colostrum

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.