

CUET · BIOLOGY · CLASS XII · CODE 304

# Human Reproduction

CUET unit: Reproduction → Human Reproduction

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## Snapshot

- Humans are sexually reproducing and viviparous; reproductive events include gametogenesis, insemination, fertilisation, implantation, gestation and parturition (NCERT §intro, p. 26).
- Covers male and female reproductive anatomy, spermatogenesis vs. oogenesis, the 28/29-day menstrual cycle with its four phases, fertilisation in the ampulla, implantation, placentation, parturition and lactation.
- CUET regularly tests cell-level detail (Sertoli/Leydig cells, granulosa/theca, acrosome), hormone-phase mapping (LH surge, hCG, hPL, relaxin, oxytocin) and process sequencing (cleavage → morula → blastocyst → implantation), so most questions are direct factual recall.

## Detailed Notes

### 2.1 Core concepts

- Reproductive events in humans: gametogenesis (sperms in males, ovum in females) → insemination → fertilisation → zygote → blastocyst formation → implantation → gestation → parturition; sperm formation continues into old age but ovum formation ceases around 50 years (NCERT §intro, p. 26).
- The male reproductive system, located in the pelvis, comprises a pair of testes plus accessory ducts, glands and the external genitalia (penis) (NCERT §2.1, p. 26).
- Testes lie outside the abdominal cavity within the scrotum, which keeps testicular temperature 2–2.5 °C below normal body temperature — necessary for spermatogenesis; each adult testis is 4–5 cm long, 2–3 cm wide, and contains about 250 testicular lobules (NCERT §2.1, p. 27).
- Each lobule has 1–3 highly coiled seminiferous tubules lined by male germ cells (spermatogonia) and Sertoli cells (which provide nutrition); interstitial spaces outside the tubules contain Leydig cells that synthesise and secrete androgens (NCERT §2.1, p. 27).
- Male accessory ducts in order: rete testis → vasa efferentia → epididymis → vas deferens → ejaculatory duct → urethra → urethral meatus; the vas deferens loops over the urinary bladder and is joined by the duct from the seminal vesicle to form the ejaculatory duct (NCERT §2.1, p. 27).

- Male accessory glands: paired seminal vesicles, a prostate, and paired bulbourethral glands; their secretions form the seminal plasma rich in fructose, calcium and certain enzymes; bulbourethral secretions also lubricate the penis (NCERT §2.1, p. 28).
- The female reproductive system has a pair of ovaries, a pair of oviducts, a uterus, a cervix, a vagina, external genitalia and a pair of mammary glands (NCERT §2.2, p. 28).
- Each ovary is 2–4 cm long, connected to the pelvic wall and uterus by ligaments, covered by a thin epithelium enclosing the ovarian stroma (peripheral cortex + inner medulla) (NCERT §2.2, p. 28).
- Each fallopian tube is 10–12 cm long; parts in order from the ovary are: infundibulum (with fimbriae that collect the ovum) → ampulla (wider) → isthmus (narrow lumen, joins uterus) (NCERT §2.2, pp. 28–30).
- The uterus (womb), shaped like an inverted pear, opens into the vagina through the cervix; the cervical canal plus vagina forms the birth canal; the uterine wall has three layers — perimetrium (outer thin), myometrium (middle thick smooth muscle, contracts at delivery) and endometrium (inner glandular, undergoes cyclical changes) (NCERT §2.2, p. 30).
- Female external genitalia: mons pubis, labia majora, labia minora, hymen and clitoris; presence/absence of hymen is not a reliable indicator of virginity (NCERT §2.2, p. 30).
- Each mammary gland has 15–20 mammary lobes containing alveoli that secrete milk; alveoli → mammary tubules → mammary duct → mammary ampulla → lactiferous duct → nipple (NCERT §2.2, p. 31).
- Spermatogenesis: diploid spermatogonia (46 chromosomes) on the inner wall of seminiferous tubules multiply mitotically; some become primary spermatocytes that undergo meiosis-I (reduction) → two haploid secondary spermatocytes (23 chromosomes each) → meiosis-II → four haploid spermatids; spermatids transform into spermatozoa via spermiogenesis, and are released by spermiation (NCERT §2.3, pp. 31–32).
- Hormonal regulation of spermatogenesis: GnRH (hypothalamus) at puberty → LH and FSH (anterior pituitary); LH acts on Leydig cells → androgens → spermatogenesis; FSH acts on Sertoli cells → factors supporting spermiogenesis (NCERT §2.3, pp. 31–32).
- Sperm structure: head (haploid nucleus capped by enzyme-filled acrosome), neck, middle piece (numerous mitochondria — energy for tail movement), and tail (motility); a human ejaculate contains 200–300 million sperms,  $\geq 60\%$  must be normal in shape/size and  $\geq 40\%$  vigorously motile for normal fertility (NCERT §2.3, p. 32).
- Oogenesis begins in embryonic life — a couple of million oogonia form in each foetal ovary, no new oogonia after birth; oogonia enter prophase-I and arrest as primary

- oocytes inside primary follicles; many degenerate, leaving 60,000–80,000 primary follicles per ovary at puberty (NCERT §2.3, pp. 32–33).
- Follicle progression: primary follicle → secondary follicle (more granulosa layers + new theca) → tertiary follicle (fluid-filled antrum; theca splits into theca interna and theca externa); primary oocyte completes meiosis-I unequally → large haploid secondary oocyte + tiny first polar body; tertiary follicle matures into Graafian follicle, secondary oocyte gains a zona pellucida, then Graafian follicle ruptures to release ovum — ovulation (NCERT §2.3, p. 33).
  - Menstrual cycle is the reproductive cycle of female primates; the first menstruation is menarche; cycle averages 28/29 days; one ovum is released per cycle; menopause occurs around age 50 (NCERT §2.4, pp. 33, 35).
  - Four phases: menstrual phase (3–5 days, endometrium breaks down, occurs only if ovum is not fertilised) → follicular phase (follicles mature, endometrium regenerates, FSH/LH and estrogens rise) → ovulatory phase (LH surge at ~day 14 ruptures Graafian follicle → ovulation) → luteal phase (Graafian follicle remnants become corpus luteum, which secretes progesterone to maintain endometrium for implantation) (NCERT §2.4, pp. 33–35).
  - During pregnancy, menstrual cycles stop; without fertilisation, the corpus luteum degenerates, the endometrium disintegrates and menstruation begins a new cycle (NCERT §2.4, p. 35).
  - Fertilisation: motile sperms travel cervix → uterus → ampullary region of the fallopian tube; ovum and sperms must reach the ampulla simultaneously; on contact with the zona pellucida the sperm triggers a membrane block to additional sperms (only one sperm fertilises); acrosomal enzymes help the sperm penetrate the zona pellucida and plasma membrane; entry of the sperm induces the secondary oocyte to complete meiosis-II — producing the second polar body and a haploid ovum (ootid); haploid sperm and ovum nuclei fuse → diploid zygote (NCERT §2.5, pp. 35–36).
  - Sex determination: human female is XX, male is XY; 50% of sperms carry X and 50% Y; XX zygote → female, XY zygote → male — sex of the baby is determined by the father (NCERT §2.5, p. 36).
  - Cleavage: as the zygote moves through the isthmus toward the uterus, mitotic divisions produce 2, 4, 8, 16 blastomeres; the 8–16 blastomere embryo is the morula; morula transforms into a blastocyst as it enters the uterus (NCERT §2.5, pp. 36–37).
  - Blastocyst → trophoblast (outer layer) + inner cell mass (becomes embryo); the trophoblast attaches to the endometrium, uterine cells then divide and cover the blastocyst — implantation, leading to pregnancy (NCERT §2.5, p. 37).
  - After implantation, chorionic villi appear on the trophoblast and interdigitate with the uterine tissue to form the placenta — the structural and functional unit between foetus and mother; the placenta supplies O<sub>2</sub> and nutrients, removes CO<sub>2</sub> and wastes, and is connected to the foetus by the umbilical cord (NCERT §2.6, p. 37).

- Placenta as endocrine tissue produces hCG, hPL, estrogens and progesterones; relaxin is secreted later in pregnancy by the ovary; hCG, hPL and relaxin are produced only during pregnancy; estrogens, progesterones, cortisol, prolactin, thyroxine all rise in maternal blood (NCERT §2.6, p. 37).
- Embryonic development milestones: inner cell mass → ectoderm + endoderm + mesoderm (the three germ layers containing stem cells); month 1 — heart formed (audible by stethoscope); end of month 2 — limbs and digits; end of 12 weeks (first trimester) — major organ systems formed, external genitals well-developed; month 5 — first foetal movements and head hair; end of 24 weeks (second trimester) — body covered with fine hair, eyelids separate, eyelashes form; 9 months — fully developed foetus ready for delivery (NCERT §2.6, pp. 37–38).
- Parturition: gestation period ~9 months; vigorous uterine contractions expel the foetus; signals from the fully developed foetus and placenta trigger mild contractions (foetal ejection reflex) → release of oxytocin from the maternal pituitary → stronger uterine contractions → more oxytocin (positive feedback); placenta is expelled soon after the infant (NCERT §2.7, p. 38).
- Lactation: mammary glands differentiate during pregnancy and start producing milk towards the end of pregnancy; colostrum, the milk of the first few days, contains antibodies essential for the newborn's resistance; breast-feeding in early infancy is recommended (NCERT §2.7, p. 38).

## 2.2 Definitions to memorise

Term	Definition	Page
Scrotum	Pouch outside the abdominal cavity that holds the testes at 2–2.5 °C below body temperature, essential for spermatogenesis.	27
Seminiferous tubule	Highly coiled tubule inside a testicular lobule (1–3 per lobule), lined by spermatogonia and Sertoli cells, where sperms are produced.	27
Leydig cells	Interstitial cells outside seminiferous tubules that synthesise and secrete androgens.	27
Sertoli cells	Cells inside the seminiferous tubule that provide nutrition to the developing male germ cells.	27
Seminal plasma	Combined secretions of seminal vesicles, prostate and bulbourethral glands; rich in fructose, calcium and enzymes.	28
Semen	Seminal plasma together with sperms.	32
Fimbriae	Finger-like projections at the edges of the infundibulum that help collect the ovum after ovulation.	29
Endometrium	Inner glandular layer of the uterus that undergoes cyclical changes during the menstrual cycle.	30
Myometrium	Middle thick smooth-muscle layer of the uterus; contracts strongly during delivery.	30

Term	Definition	Page
Spermiogenesis	Transformation of spermatids into spermatozoa.	31
Spermiation	Release of sperms from the seminiferous tubules after their heads are embedded in Sertoli cells.	31
Acrosome	Cap-like structure on the anterior sperm head filled with enzymes that help fertilisation.	32
Primary oocyte	Diploid cell arrested in prophase-I of meiosis; surrounded by granulosa cells in the primary follicle.	32
Graafian follicle	Mature ovarian follicle (formerly tertiary) that ruptures at ovulation to release the secondary oocyte.	33
Zona pellucida	Membrane that forms around the secondary oocyte; sperm contact with it triggers a block to polyspermy.	33, 35
Menarche	First menstruation, occurring at puberty.	33
Menopause	Cessation of menstrual cycles around 50 years of age.	35
LH surge	Rapid rise of LH at mid-cycle (~day 14) that induces rupture of the Graafian follicle (ovulation).	35
Corpus luteum	Structure formed from remnants of the Graafian follicle after ovulation; secretes large amounts of progesterone.	35
Cleavage	Mitotic divisions of the zygote in the isthmus as it travels to the uterus, producing blastomeres.	36
Morula	Embryo with 8–16 blastomeres.	36–37
Blastocyst	Stage with outer trophoblast and inner cell mass; the form in which the embryo implants.	37
Implantation	Embedding of the blastocyst in the endometrium; marks the beginning of pregnancy.	37
Placenta	Structural and functional unit between developing foetus and maternal body, formed by chorionic villi + uterine tissue.	37
Parturition	Process of childbirth — delivery of the foetus by vigorous uterine contractions.	38
Colostrum	Milk produced in the first few days of lactation; rich in antibodies for the newborn.	38

### 2.3 Diagrams / processes to remember

- **Figure 2.1 (a) & (b)** Male pelvis and male reproductive system showing testes, ducts, glands and external genitalia (pp. 26–27).
- **Figure 2.2** Sectional view of a seminiferous tubule showing spermatogonia, Sertoli cells and Leydig cells in the interstitium (p. 28).

- **Figure 2.3(a) & (b)** Female pelvis and female reproductive system showing ovary, oviduct parts (infundibulum, ampulla, isthmus), uterus, cervix, vagina (pp. 29).
- **Figure 2.4** Sectional view of a mammary gland — alveoli → mammary tubules → mammary duct → mammary ampulla → lactiferous duct → nipple (p. 30).
- **Figure 2.5** Enlarged seminiferous tubule showing the spermatogenic series (p. 31).
- **Figure 2.6** Structure of a sperm — head (with acrosome and haploid nucleus), neck, middle piece (mitochondria), tail (p. 32).
- **Figure 2.7** Sectional view of the ovary showing primary, secondary, tertiary and Graafian follicles, corpus luteum (p. 33).
- **Figure 2.8(a) & (b)** Schematic of spermatogenesis (four spermatids per primary spermatocyte) and oogenesis (one ovum + polar bodies) (p. 33).
- **Figure 2.9** Events of the menstrual cycle correlated with ovarian and pituitary hormone levels and endometrial changes (p. 34).
- **Figure 2.10** Ovum surrounded by several sperms at the zona pellucida (p. 35).
- **Figure 2.11** Transport of ovum, fertilisation in the ampulla, cleavage and passage of the growing embryo (zygote → 2/4/8/16 blastomeres → morula → blastocyst → implantation) (p. 36).
- **Figure 2.12** Human foetus within the uterus showing placenta and umbilical cord (p. 37).

## 2.4 Common confusions / NTA trap points

- **Sertoli vs Leydig cells.** Sertoli cells are inside the seminiferous tubule and nourish germ cells (FSH target); Leydig cells are in the interstitium and secrete androgens (LH target). NTA loves to swap these.
- **Follicle terminology vs oocyte stage.** The Graafian follicle releases a **secondary** oocyte, not an ovum in the strict sense — meiosis-II completes only on sperm entry, producing the ootid + second polar body.
- **Site of fertilisation.** Fertilisation occurs in the **ampullary region** of the fallopian tube, not in the uterus, ovary, or isthmus.
- **Hormone-phase mapping.** Progesterone dominates the luteal phase (corpus luteum); estrogens rise in the follicular phase; the LH surge defines the ovulatory phase. hCG/hPL/relaxin are pregnancy-only hormones.
- **Cleavage vs ordinary mitosis.** Cleavage divisions in the isthmus produce 2, 4, 8, 16 blastomeres without an increase in overall embryo size — the morula has 8–16 cells, the blastocyst has trophoblast + inner cell mass.
- **Number of sperms.** A normal ejaculate is 200–300 million sperms; at least 60% with normal shape/size and 40% vigorously motile for normal fertility — common distractors flip these percentages.

## Practice MCQs

**Q1.** The temperature of the testes is maintained about 2–2.5 °C lower than normal internal body temperature by which structure, and this is necessary for which process?

- A. Epididymis; sperm storage
- B. Scrotum; spermatogenesis
- C. Vas deferens; sperm transport
- D. Prostate gland; semen formation

**Q2.** Which cells in the testis synthesise and secrete androgens?

- A. Sertoli cells
- B. Spermatogonia
- C. Leydig (interstitial) cells
- D. Primary spermatocytes

**Q3.** Arrange the following parts of the male accessory duct system in the correct sequence through which sperms pass from the testis to outside the body. I. Rete testis II. Vas deferens III. Vasa efferentia IV. Epididymis V. Urethra (via ejaculatory duct)

- A. I → III → IV → II → V
- B. III → I → II → IV → V
- C. I → IV → III → II → V
- D. IV → I → III → II → V

 **12 more MCQs + answer key**

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## PYQ Alignment

Human Reproduction is one of the highest-yielding chapters in CUET Biology: each paper from 2023–25 has carried multiple direct-recall items, especially on Sertoli/Leydig cells, the order of male accessory ducts, the menstrual-cycle phase–hormone mapping (LH surge, progesterone, FSH), the site of fertilisation (ampulla), stages from zygote to blastocyst, and pregnancy-only hormones (hCG, hPL, relaxin); assertion–reason and match-the-following on oogenesis vs spermatogenesis are also routine.

### CUET 2025 — Actual PYQs from this chapter

**Q.7 (CUET 2025)** Match List-I (Technique / term) with List-II (Features).  
Technique (A) Amniocentesis (i) Ligation of fallopian tube (B) Maternal mortality rate (ii) Ligation of vas deferens (C) Vasectomy (iii) Death rate (D) Tubectomy (iv) Testing of sex

- A) [option not extracted — see source]
- B) [option not extracted — see source]
- C) [option not extracted — see source]
- D) [option not extracted — see source]

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.10 (CUET 2025)** Arrange the following events in the correct order pertaining to fertilization in human reproductive system: (A) Blastocyst becomes embedded in endometrium (B) Finger-like projections appear on trophoblast (C) Blastomeres arranged into trophoblast and inner cell mass (D) Zygote divides to form morula

- A) [option not extracted — see source]
- B) [option not extracted — see source]
- C) [option not extracted — see source]
- D) [option not extracted — see source]

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.37 (CUET 2025)** Which of the following is the primary female sex organ?

- A) Mammary glands
- B) Uterus
- C) Ovaries
- D) Cervix

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.38 (CUET 2025)** Which structure is haploid (n) in male reproductive system?

- A) Secondary spermatocytes

- B) Primary spermatocytes
- C) Leydig cells
- D) Sertoli cells

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.49 (CUET 2025)** Formation of diploid zygote is a result of:

- A) Emasculation
- B) Triple fusion
- C) Syngamy
- D) Bagging

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.50 (CUET 2025)** If there are 38 chromosomes in the zygote, how many chromosomes will be present in the haploid egg cell?

- A) 38
- B) 19
- C) 57
- D) 76

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

### CUET 2024 — Actual PYQs from this chapter

**Q.4 (CUET 2024)** In humans, mammary gland is divided into \_\_\_\_\_ lobes.

- A) 10–12
- B) 25–30
- C) 30–35
- D) 15–20

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.5 (CUET 2024)** Sex in human embryo is determined by:

- A) 'X' chromosome of egg
- B) 'X' or 'Y' chromosome of sperm
- C) Only 'Y' chromosome of sperm
- D) Health of mother

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.6 (CUET 2024)** Arrange stages of oogenesis in correct order. (A) Ovum (B) Oogonia (C) Primary oocyte (D) Secondary oocyte Options given.

- A) [option not extracted — see source]
- B) [option not extracted — see source]
- C) [option not extracted — see source]
- D) [option not extracted — see source]

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.18 (CUET 2024)** Match placental mammals with marsupial counterparts. Examples: Anteater, Bobcat, Lemur, Flying squirrel.

- A) [option not extracted — see source]
- B) [option not extracted — see source]
- C) [option not extracted — see source]
- D) [option not extracted — see source]

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

### CUET 2023 — Actual PYQs from this chapter

**Q.5 (CUET 2023)** Select the hormone which is not secreted by human placenta:

- A) Estrogen
- B) Progesterone
- C) Human chorionic gonadotropin
- D) Luteinising hormone

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key

**Q.6 (CUET 2023)** Select the correct statements regarding menstrual cycle in human female: (A) The first menstruation begins at puberty and is called menarche. (B) Ovulation takes place in the middle of the cycle (about 14th day). (C) In absence of fertilisation, corpus luteum degenerates leading to menstruation. (D) Menstrual cycle ceases around 50 years of age.

- A) A and B only
- B) B and D only
- C) A and C only
- D) C and D only

**Tests:** aligns with §2 (human reproduction) **Answer:** Not in extracted key — verify against official NTA key