PIPADOR REVISION

MRCOG Part 1 Revision Notes

Oogenesis and Folliculogenesis

PHYSIOLOGY • LECTURE 143

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG PART 1 REVISION NOTES | PHYSIOLOGY

143 Oogenesis and Folliculogenesis

Germ cells, meiotic arrest, follicle development, steroidogenesis, ovulation and ovarian reserve

6–7 million	1–2 million	≈ 400–500	≈ 85 days
Oocytes at 20 weeks' gestation	At birth	Ovulated in a lifetime	Preantral follicle → ovulation

■ KEY FACTS: Learning objectives

- Describe the origin of germ cells and the stages and arrests of oogenesis.
- Describe the stages of folliculogenesis, recruitment, selection and atresia.
- Explain the two-cell, two-gonadotrophin theory and the roles of AMH and inhibin.
- Describe ovulation and the corpus luteum; relate to ovarian reserve, PCOS, POI and IVF.

143.1 Primordial germ cells and the oocyte pool

Primordial germ cells in yolk-sac wall (≈ wk 3–4) ▶ Migrate via hindgut dorsal mesentery to **genital ridge** (wk 5–6; KIT/KIT-ligand) ▶ **Oogonia** proliferate by mitosis → peak ≈ 6–7 million at 20 wk ▶ Enter **meiosis I** and arrest → **primary oocytes** in primordial follicles ▶ Massive **atresia** throughout life

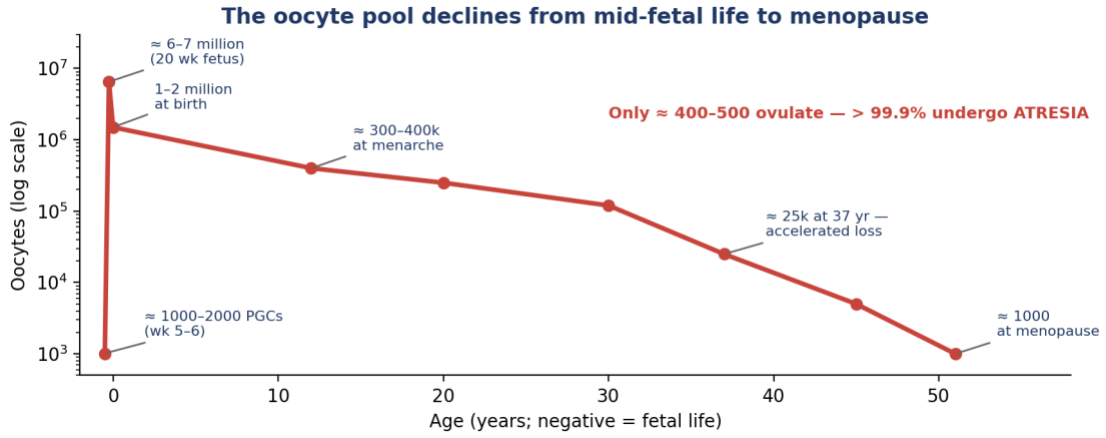


Figure 143.1 — Oocyte numbers from fetal life to menopause

■ CLINICAL CORRELATION

- Failure of migration → gonadal agenesis; **extragonadal germ cell tumours** (midline: sacrococcygeal, mediastinal).
- **Turner syndrome (45,X)**: germ cells are present in fetal ovaries but undergo **accelerated atresia** → streak gonads, primary amenorrhoea or premature ovarian insufficiency.

143.2 Oogenesis and meiotic arrest

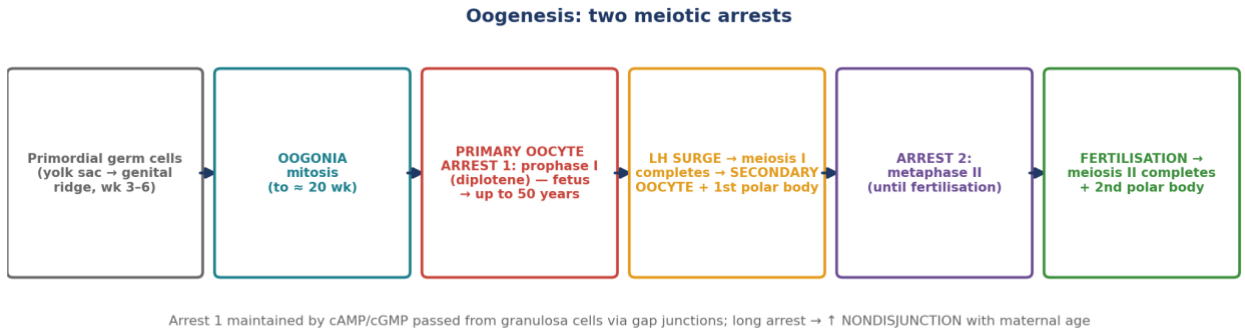


Figure 143.2 — Oogenesis: two meiotic arrests

Feature	Detail
Arrest 1	Prophase I (diplotene/dictyate) from fetal life until the pre-ovulatory LH surge — up to ≈ 50 years. Maintained by high oocyte cAMP (cGMP from granulosa via gap junctions inhibits PDE3A)
Resumption	LH surge closes gap junctions → ↓ cGMP → ↓ cAMP → MPF activation → germinal vesicle breakdown → meiosis I completes → secondary oocyte + 1st polar body
Arrest 2	Metaphase II (cytostatic factor) — completes only at fertilisation → ootid + 2nd polar body
Product	Each primary oocyte → one ovum (+ 2–3 polar bodies) — unequal cytoplasmic division conserves cytoplasm
Clinical	Prolonged arrest + cohesin loss → nondisjunction ↑ with maternal age (trisomy 21 ≈ 90% maternal meiosis I errors)

143.3 Folliculogenesis

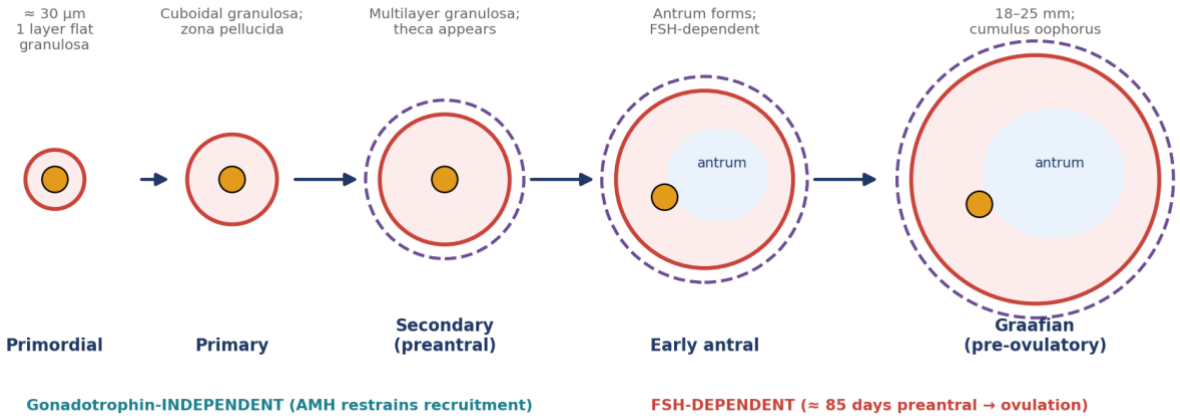


Figure 143.3 — Stages of follicle development

Stage	Size	Features	Control
Primordial	≈ 30 µm	Oocyte + single layer of flattened pre-granulosa cells	Dormant pool; activation (PI3K/AKT, FOXO3) restrained by AMH
Primary	≈ 60 µm	Cuboidal granulosa; zona pellucida (ZP1–4) forms	Gonadotrophin-independent (GDF-9, BMP-15 from oocyte)
Secondary (preantral)	≈ 120–200 µm	Multilayered granulosa; theca interna/externa acquired; FSH receptors appear	Gonadotrophin-responsive
Antral (tertiary)	2–10 mm	Fluid-filled antrum; cumulus oophorus	FSH-dependent from ≈ 2–5 mm
Pre-ovulatory (Graafian)	18–25 mm	LH receptors on granulosa; maximal oestradiol	LH surge → ovulation

Recruitment: cohort of antral follicles rescued by intercycle FSH rise → **Selection** (≈ day 5–7): follicle with most FSH receptors/aromatase → **Dominance**: ↑ E2 + inhibin B ↓ FSH ('FSH window' closes) → Others undergo **atresia** (apoptosis); dominant follicle survives via ↑ LH receptors, IGFs → Ovulation of a **single** follicle

143.4 Steroidogenesis: two cells, two gonadotrophins

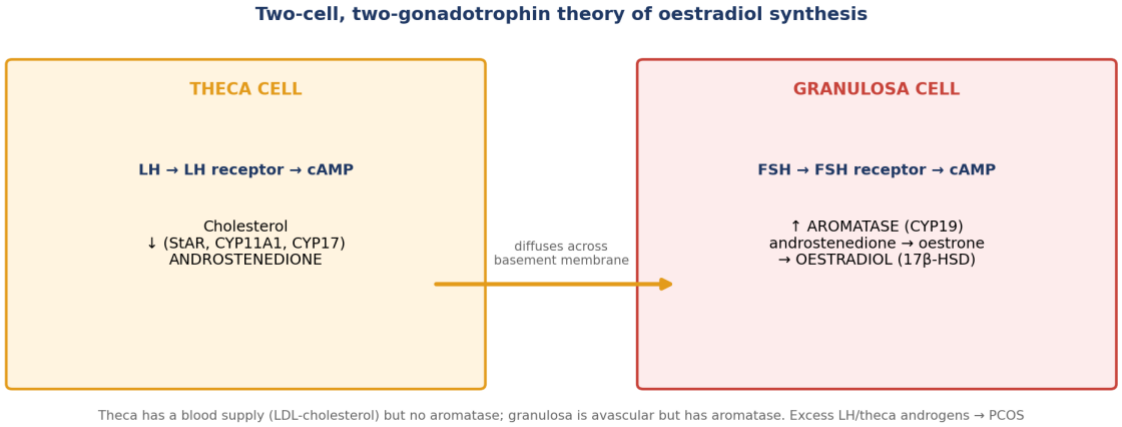


Figure 143.4 — Theca and granulosa cooperation

Granulosa product	Role	Clinical use
AMH	From granulosa of preantral and small antral follicles; inhibits primordial recruitment and FSH sensitivity	Ovarian reserve marker (cycle-independent); predicts IVF response; ↑↑ in PCOS, ↓ with age/POI
Inhibin B	Follicular phase; ↓ FSH	Falls early in ovarian ageing → rising early-follicular FSH
Inhibin A	Corpus luteum (and placenta)	Part of quadruple test (↑ in trisomy 21)
Oestradiol	Endometrial proliferation, feedback, LH surge	Monitoring IVF stimulation; OHSS risk if very high

143.5 Ovulation and the corpus luteum

LH surge (onset → ovulation ≈ 36 h; peak → ovulation ≈ 10–12 h) → Meiosis I resumes; granulosa **luteinise** (→ progesterone) → **Cumulus expansion** (hyaluronan); PGs, proteases (plasmin, MMPs) weaken follicle wall → Rupture at stigma → oocyte–cumulus complex picked up by fimbriae → **Corpus luteum**: progesterone, E2, inhibin A; lifespan ≈ 14 days unless rescued by **hCG**

143.6 Clinical correlations

Condition	Physiology
Ovarian reserve tests	AMH and antral follicle count (AFC) best; early-follicular FSH (> 10 IU/L suggests ↓ reserve) less reliable
PCOS	↑ LH pulse frequency → theca hyperandrogenism; arrest of antral follicles (2–9 mm) — 'polycystic' morphology (≥ 20 follicles per ovary on TVS, Rotterdam/2023 criteria); ↑ AMH; insulin resistance amplifies theca androgen production

Condition	Physiology
Premature ovarian insufficiency	Loss of function < 40 years: oligo/amenorrhoea ≥ 4 months + FSH > 25 IU/L on two occasions ≥ 4 weeks apart (ESHRE). Causes: idiopathic, Turner, FMR1 premutation, autoimmune, chemotherapy/radiotherapy, surgery
IVF	Exogenous FSH recruits multiple follicles; GnRH analogue/antagonist prevents premature LH surge; hCG or GnRH-agonist trigger → egg collection 34–36 h later; OHSS risk ↑ with high AMH/PCOS
Fertility preservation	Oocyte/embryo vitrification; ovarian tissue cryopreservation (prepubertal); GnRH agonist during chemotherapy (limited evidence)

143.7 Must-know summary

■ EXAM TIP

- Peak oocyte number **6–7 million at 20 weeks**; 1–2 million at birth; ≈ 400–500 ovulate.
- Arrest 1 = **prophase I (diplotene)** until LH surge; arrest 2 = **metaphase II** until fertilisation.
- Zona pellucida appears at the **primary** follicle stage; theca at the **secondary**; FSH-dependence from **early antral**.
- **Theca: LH → androgens; granulosa: FSH → aromatase → oestradiol**.
- **AMH** = ovarian reserve; ovulation ≈ **36 h after LH surge onset**.

■ MNEMONIC / MEMORY AID

Follicle order — 'Please Pass Some Antral Grapes': Primordial, Primary, Secondary, Antral, Graafian. **'Theca = Testosterone; Granulosa = Gets oestrogen'**.