strategies of life

multiply
make a lot of individuals

make them different

DNA
 genetic code

gametes
 carry DNA

ovum

sperrn

primary sex organs (gonads)
 produce sex cells

produce hormones

ovaries

testes

DNA

chromosome
 1 molecule of DNA ~ 1000 genes

humans have 23 different chromosomes

haploid # = 23

humans have homologous chromosome pairs

diploid # = 46 (23 pairs)

sister chromatids
duplicates of each chromosome

during mitosis and meiosis

mitosis
 1 diploid cell ➔ 2 identical diploid cell

meiosis
 1 diploid cell ➔ 4 different haploid cells

haploid cells = gametes

meiosis that produces sperm
 spermatogenesis

meiosis that produces ovum
 oogenesis

zygote
 united ovum and sperm (diploid)

spermatogonia
 stem cells

primary spermatocyte
during meiosis I

secondary spermatocyte
during meiosis II

spermatids
 after meiosis II

spermatozoa
 developed flagella

male structures

testes

seminiferous tubules
 spermatogenesis

spermatocytes

sustentacular (sertoli)cells
  androgen binding protein

inhibin

interstitial (Leydig) cells
  testosterone

epididymis
  sperm maturation

GnRH
 hypothalamic - pituitary - gonadal axis

hypothalamus

FSH
 anterior pituitary

LH

gonads

follicle growth
 hormone secretion

maintain glands

meiosis

ovum
  progesterone, estrogen

sperm
  testosterone
GnRH
FSH
ICSH (LH)
testosterone + ABP
testosterone
inhibin

hormones - male

FSH
ICSH
sustentacular cells
interstitial cells
ABP
testosterone

spermatogenesis

increased # sperm
inhibin

steroid hormone
stimulates:

spermatogenesis
growth of sex organs
secondary sex characteristics (hair, voice, bone growth, muscle growth)
sex drive (libido)

oogonia
stem cells

primary oocytes
meiosis I
pauses at birth
resume meiosis I at puberty
secondary oocyte + 1st polar body
meiosis II
ovulation
completes meiosis II only if fertilized
ovum + 3 polar bodies
gamete
haploid

developing ovum

primary follicle
resumes meiosis
primary oocyte
granulosa cells
estrogen
secondary (Graafian) follicle
secondary oocyte
ovum
gamete
corpus luteum
after ovulation
progesterone

other female structures

fallopian tubes
between ovary and uterus
site of fertilization
uterus
site of implantation
endometrium
functional layer
menstrual changes
maternal placenta
basal layer
myometrium
vagina = birth canal
female reproductive hormones

GnRH  stim FSH and LH
FSH  stim meiosis
     stim estrogen
estrogen  stim uterus growth
         stim mammary development
         increases LH
AMH  prevents multiple follicles from meiosis
LH  stim ovulation
     stim progesterone
progesterone  stim uterus growth and secretions
             stim mammary development
             inhibits GnRH and LH

hormones - female

GnRH
FSH
     follicle growth
     oogenesis
     ovum
LH
     corpus luteum
     estrogen
     progesterone, estrogen

ovarian cycle

follicular phase  day 1 - 14
   FSH stimulates primary follicle to resume meiosis
   follicle (granulosa cells) produces estrogen
   follicle (granulosa cells) produces anti-Mullerian hormone
ovulation  2° oocyte released
   stim by LH
luteal phase  day 15 – 28
   LH stim formation of corpus luteum
   corpus luteum  produces progesterone
   corpus albicans  degenerated corpus luteum

uterine cycle

ovarian hormones control the uterus
menstrual phase  day 1 – 5
   loss of functional layer
   due to decreased progesterone
proliferative phase  day 5 – 14
   new functional layer
   stim by estrogen
secretory phase  day 15 – 28
   growth and secretions of functional layer
   stim by progesterone

basic cycle:

hypothalamus  anterior pituitary  ovary  uterus

GnRH  →  FSH  →  follicle - meiosis
         estrogen
         →  LH  →  ovulation
         →  corpus luteum - progesterone
         ↑ endometrium
w/o fertilization

progesterone ➔ ↓ LH
w/o LH corpus luteum degenerates into corpus albicans
stops making progesterone

↓ progesterone functional layer dies
menstruation

↓ progesterone and estrogen ➔ ↑ GnRH, FSH, LH
new cycle starts

**w/o pregnancy:**

<table>
<thead>
<tr>
<th>hypothalamus</th>
<th>anterior pituitary</th>
<th>ovary</th>
<th>uterus</th>
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</thead>
<tbody>
<tr>
<td><strong>GnRH</strong> ➔ <strong>FSH</strong> ➔ <strong>follicle - meiosis</strong></td>
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**new cycle**

| **↑ GnRH** | | | |
| **low LH** ➔ **decrease progesterone** ➔ **↓ endometrium** | | | |

**additional hormonal effects**

- high progesterone inhibit GnRH, LH - prevents new cycle
  prevents uterine contractions
- low progesterone if not pregnant – menstruation
  stim GnRH and new cycle
  if pregnant – allows 1st uterine contractions
- low estrogen stim GnRH
- inhibin inhibit FSH

**mammary glands**

- modified sweat glands
- alveolar glands produce milk
- lactiferous ducts transport milk - gland to nipple

- progesterone development of glands
- estrogen development of ducts
- prolactin stim milk production
- oxytocin stim milk release
human sexual responses

arousal/excitement
tactile or psychological reflex – spinal cord and brain
visual, thoughts, smell
REM also stim reflex
erotion P-ANS vascular changes
orgasm S-ANS muscle contraction (ejaculation)

puberty
GnRH inhibited since birth
inhibition decreases ~ age 9 increases GnRH levels
increased FSH and LH stim meiosis
estrogen and testosterone secondary sex characteristics
menarche 1st menstrual cycle

aging
menopause reproductive cycles ceases ~ age 46 – 54
gradual ↓ ovary sensitivity to FSH and LH
gradual ↓ estrogen levels
vasodilation “hot flashes”
uterus, vaginal wall atrophy
osteoporosis
HRT hormone replacement therapy
SERM selective estrogen receptor modulators
andropause decreased reproductive functions in males

birth control
medications prevent ovulation
estrogen + progesterone
inhibin ?
tubal ligation
vasectomy
rhythm