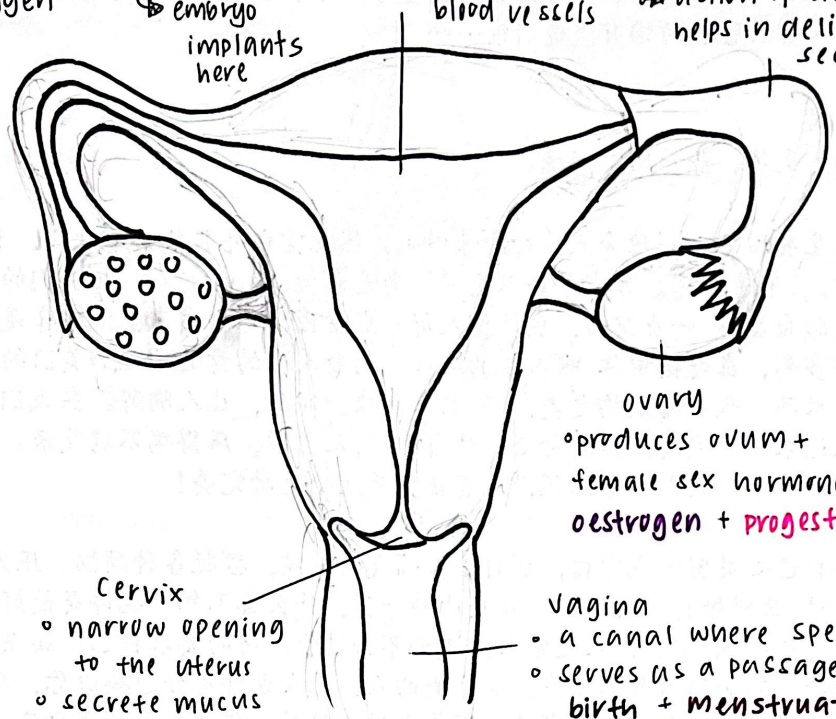
reproductive system



uterus
- thick muscular wall
- inner wall is lined w/ endometrium tissue → secrete mucus + rich in blood vessels
  - embryo implants here

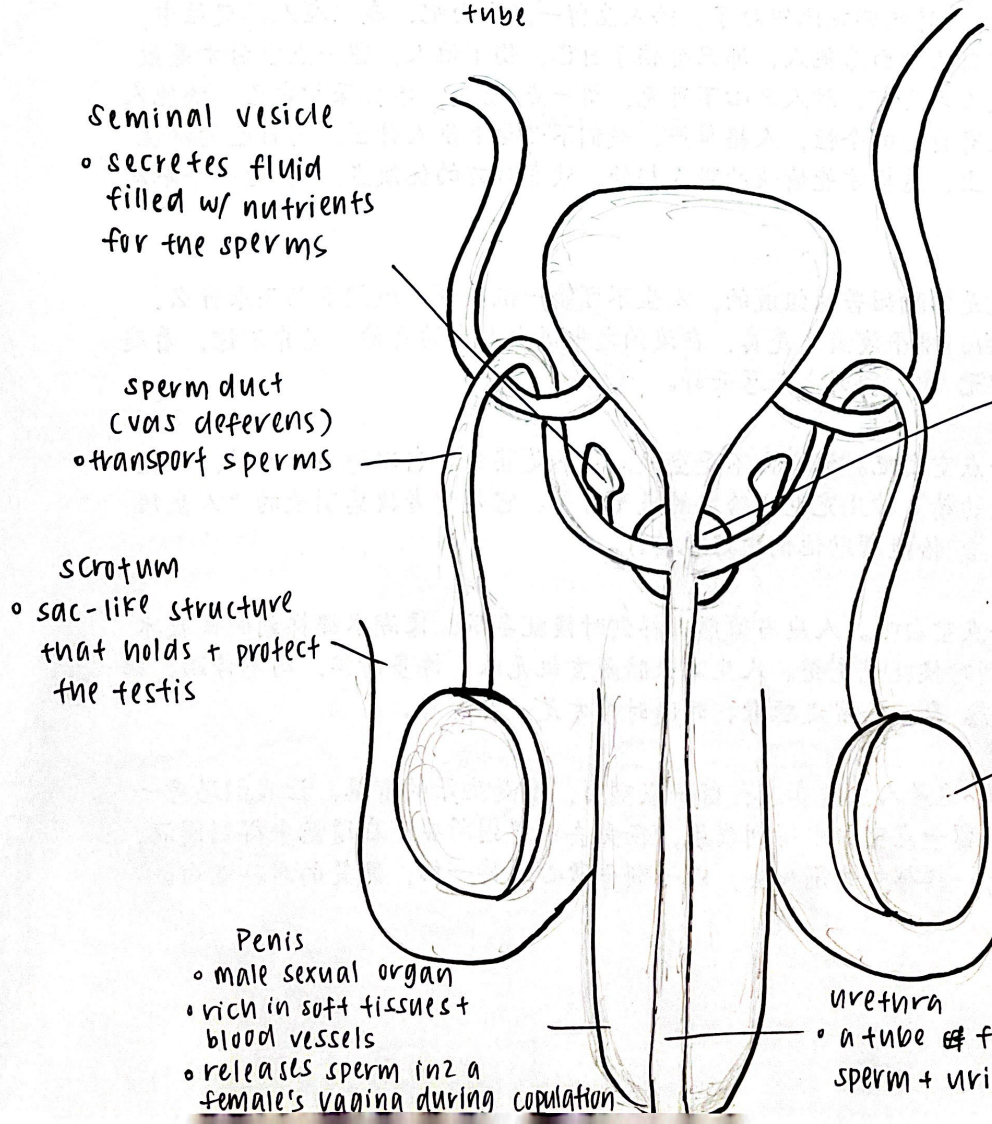
supplies the embryo w/ nutrients + oxygen ←

Fallopian tube
- thin, muscular tube
- inner wall is lined w/ cilia
  - action of cilium + peristalsis helps in delivering the secondary oocyte / zygote to the uterus

ovary
- produces ovum + female sex hormones: **oestrogen** + **progesterone**

Cervix
- narrow opening to the uterus
- secrete mucus
  - help sperm swim up to the Fallopian tube

Vagina
- a canal where sperms enter
- serves as a passage for **birth** + **menstruation**



Seminal vesicle
- secretes fluid filled w/ nutrients for the sperms

sperm duct (vas deferens)
- transport sperms

prostate gland
- secretes a fluid that helps in sperm movement

scrotum
- sac-like structure that holds + protect the testis

Testis
- located within the scrotum
- produces sperm + male sex hormone: **testosterone**

Penis
- male sexual organ
- rich in soft tissues + blood vessels
- releases sperm in2 a female's vagina during copulation

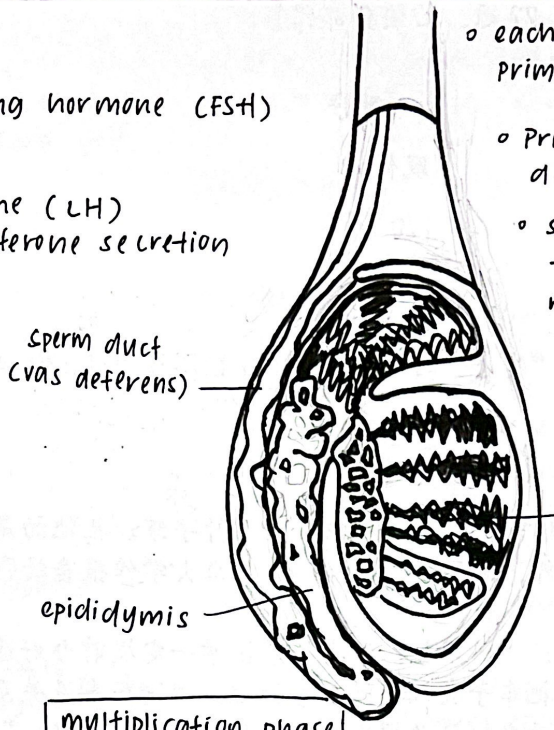
urethra
- a tube for the discharge of sperm + urine from the body

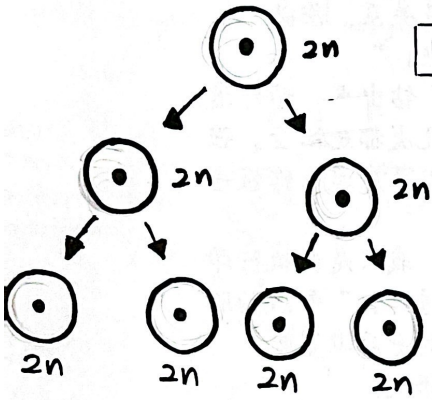
spermatogenesis

→ sperm production that take place in the seminiferous tubules

- Hormones involved :
  - → follicle-stimulating hormone (FSH)
  - → testosterone
  - → luteinizing hormone (LH)
    - ↳ stimulates testosterone secretion in the testes

- each seminiferous tubule consists of primordial germ cells
- Primordial germ cells undergo cell division to produce sperm
- Sertoli cells within the walls of the seminiferous tubules provide nutrients throughout the process
- sperm is transported from the seminiferous tubules → epididymis + flows out thru sperm duct





multiplication phase

primordial germ cell

↓ repetitive mitotic divisions

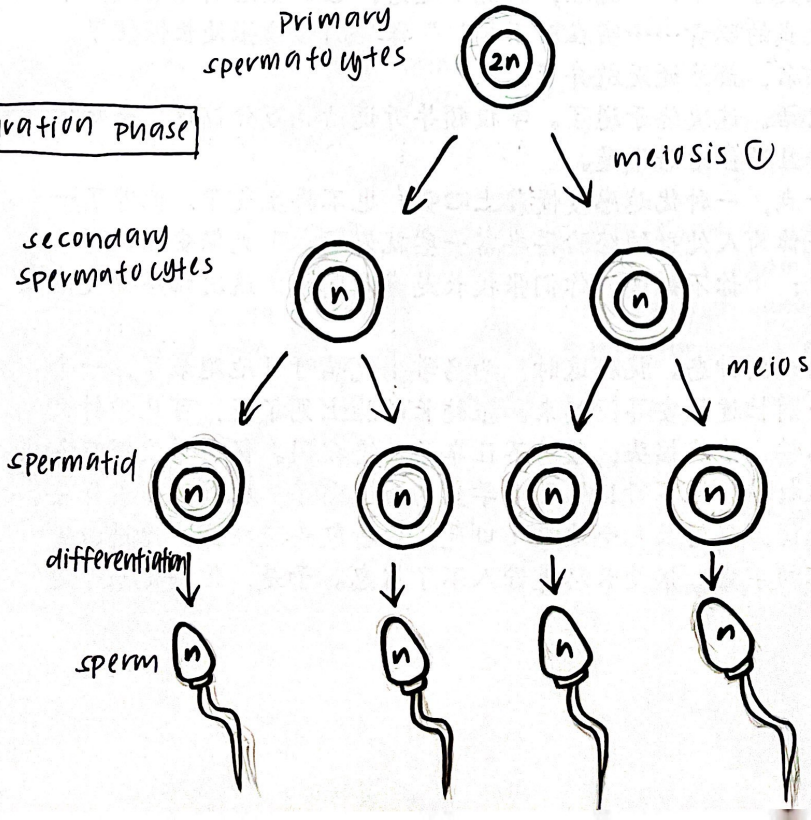
spermatogonium

↓ Development

growth phase

primary spermatocytes

maturation phase



Primordial germ cells divide mitotically to form diploid spermatogonium

↓

Spermatogonium expands to form primary spermatocytes (diploid)

↓

each primary spermatocyte undergoes meiosis I to form 2 secondary spermatocytes (haploid)

↓

each secondary spermatocyte undergoes meiosis II to produce 2 haploid spermatids

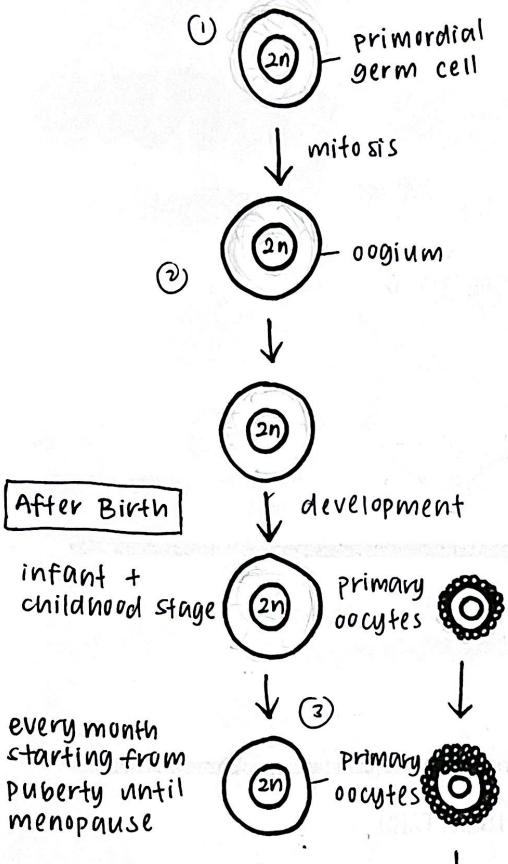
↓

Spermatids then undergo differentiation to form sperms

oogenesis

↳ the process of secondary oocyte / female gamete production

Before Birth



(1) Primordial germ cells undergo mitotic division multiple times to form oogium (diploid)

(2) oogium develops into primary oocytes
↓
encapsulated w/ 1 / more layers of follicular cells
the growth is stimulated by ← forming primary follicles
the follicle-stimulating hormone (FSH)
- primary oocyte then undergoes meiosis I but the process stops @ prophase I during foetal development

(3) - at birth, a baby girl has millions of primary oocytes that remain dormant in prophase I meiosis I
- no. of oocytes will ↓ during puberty

After Birth

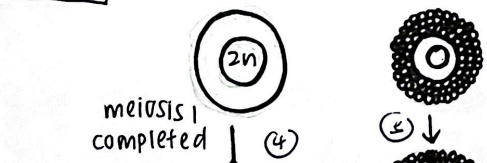
infant + childhood stage

(4) - Upon reaching puberty, the primary oocytes will continue meiosis I to form secondary oocytes + a first polar body
- secondary oocyte will begin meiosis II which is then halted @ metaphase II
- 1st polar body will complete meiosis II and form second primary polar body x 2

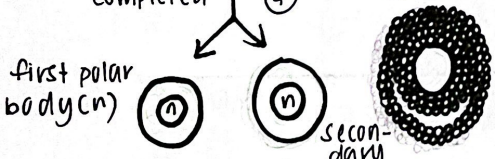
every month starting from puberty until menopause

(5) - a layer of follicular cells envelops the secondary oocyte
↳ secondary follicle
- then develop into the Graafian follicle, which releases oestrogen

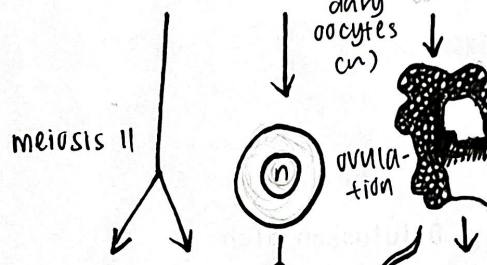
Puberty



(6) a mature Graafian follicle will approach the surface of the ovary
↳ release a secondary oocyte into the Fallopian tube
⇒ ovulation
⇒ immature ovum



(7) the secondary oocyte will complete meiosis II once a sperm penetrates it ⇒ fertilisation
- meiosis II produces — ovum (n)
— 1 polar body (n)
- Fertilisation takes place when:
- sperm + ovum's nucleuses fuse together + produces a diploid zygote (2n)
- the polar bodies will die + will be disintegrated by ovary

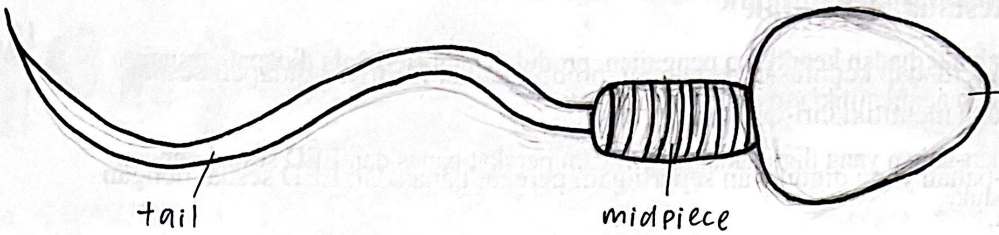


(8) after ovulation, remaining follicle forms corpus luteum

✓ f. → continues to grow + secretes oestrogen + progesterone

✗ f. → cp. + se. oo. degenerate + dies + removed thru menstruation

sperm

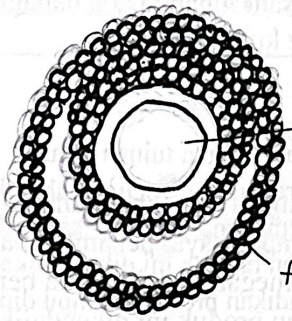


head
- contains nucleus

tail

midpiece
- packed w/ mitochondria
  - generates energy for the sperm to swim to the Fallopian tube

graafian follicle



a large cell
- surrounded by a gel-like substance + follicular cells

secondary oocyte

Graafian follicle

follicular cell

comparison

takes place in the testis

spermatogonium (2n) produces 4 sperms (n) after meiosis

sperms are smaller + made up of head, midpiece + tail

spermatogenesis

- takes place in the reproductive organs

2 secondary spermatocytes are produced after meiosis I

meiosis is completed

Spermatids undergo differentiation to become sperms

millions of sperms are formed every day

The production of sperm is continuous from puberty until old age

- produce gametes that are haploid which are involved in fertilisation

takes place in the ovaries

oogium (2n) only produces 1 functional secondary oocyte (n) + 3 non-functioning polar bodies

oogenesis

secondary oocytes are large + spherical in shape

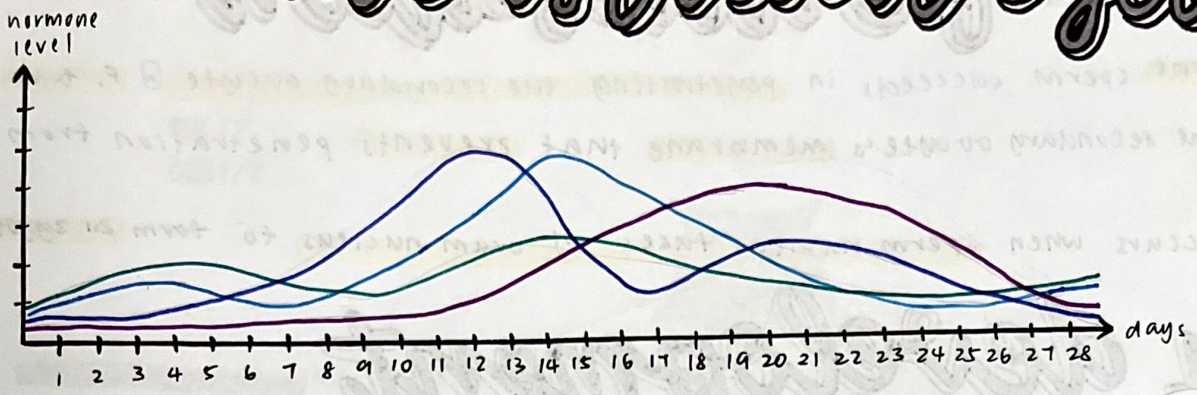
1 secondary oocyte is produced after meiosis I + 1 polar body

meiosis II only completes when fertilisation occurs

only 1 secondary oocyte is released from the ovaries at every menstrual cycle

- production ✕ continuous
- starts : female foetus
  - remains dormant when the baby is born
- cont. when reaches puberty → menopause

menstrual cycle



FSH -
LH -
- oestrogen
- progesterone

Progesterone:
· stimulates thickening of the endometrium, making it thick, folded + rich in blood ves.
Follicle-stimulating hormone (FSH): · stimulates follicle growth in the ovary
pituitary · stimulates the release of oestrogen
Luteinizing hormone (LH):
· stimulates ovulation + release of prog.
· causes the formation of corpus luteum
oestrogen: · repairs + stimulates the thickening of the endometrium
· stimulates follicle growth until it matures · stimulate FSH + LH release prior to ovulation
Progesterone: inhibits FSH + LH

Day 0 - 5

- the hypothalamus releases gonadotrophin-releasing hormone (GnRH) a day before menstruation → stimulate pituitary gland to release FSH + LH into the blood
- level of hormone ↓
  - absence of stimulation of oestrogen + progesterone
    - endometrium will shed + menstruation begins
- FSH stimulates follicle growth in ovary → contained in Graafian follicle
  - → within the primary follicle, oocyte grows into secondary oocyte
  - → growing follicle releases oestrogen
    - encourages follicle maturation + endometrial wall repair
- when the follicles grow,
  - more oestrogen is released into the bloodstream
    - exerts -ve feedback mechanism → pituitary gland ⇒ release prevent the growth of new follicle ⇐ less FSH + LH

Day 6 - 14

- follicle w/ the most FSH receptors = dominant follicle (usually only 1 / month)
- the maturing follicle
  - elarges + secretes oestrogen
- oestrogen level ↑ + peaks on day 12
  - stimulating the hypothalamus to secrete GnRH via a +ve feedback mechanism
- ↑ GnRH → stimulate pituitary gland to secrete more FSH + LH
- LH peaks on day 13
  - ovulation + release of secondary oocyte on day 14
- LH → stimulates the follicular tissue left behind to transform into the corpus luteum

Day 15 - 21

- LH stimulates the corpus luteum to secrete oestrogen + progesterone
- oestrogen + progesterone inhibits the release of FSH + LH from hypothalamus via -ve feedback mechanism → stop the growth of new follicle
- progesterone stimulates endometrial wall thickening
  - enriching it w/ blood vessels → prepare for embryo implantation

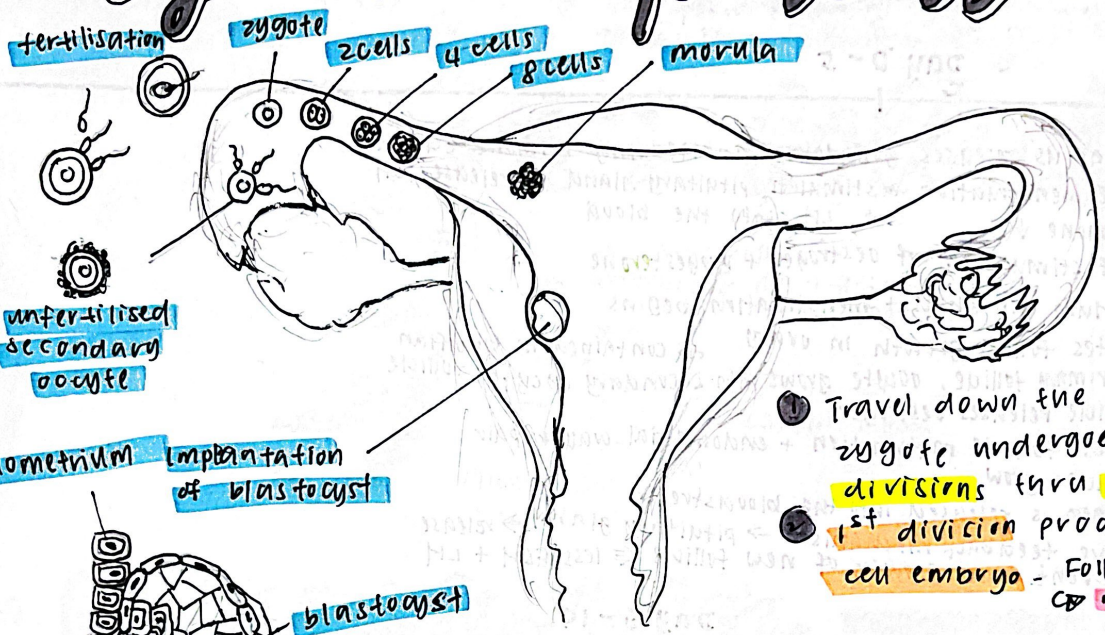
Day 22 - 28

- if x fertilisation, decreasing LH will cause the corpus luteum to degenerate
  - stops the secretion of oestrogen + progesterone
- w/out oes. + pro. the endometrium ~~wall~~ sheds + menstruation begins
- ↓ oes. + pro. x longer inhibit the hypothalamus + pituitary gland → GnRH is secreted again → new cycle ← FSH + LH
- if fertilisation occurs, the corpus luteum will continue to grow + secrete pro. + oes.
  - endometrium continues to thicken → support foetal growth

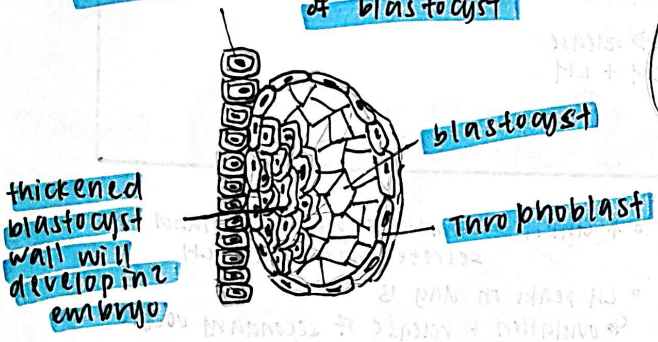
fertilisation

- 1 out of millions sperm succeeds in penetrating the secondary oocyte @ F. tube
- changes to the secondary oocyte's membrane that prevents penetration from other sperms
- Fertilisation occurs when sperm nucleus fuses w/ ovum nucleus to form 2n zygote

early development



1. Travel down the F. tube, zygote undergoes multiple divisions thru mitosis
2. 1st division produces a two-cell embryo - Following cell div. ↪ morula
3. morula trasforms into a blastocyst



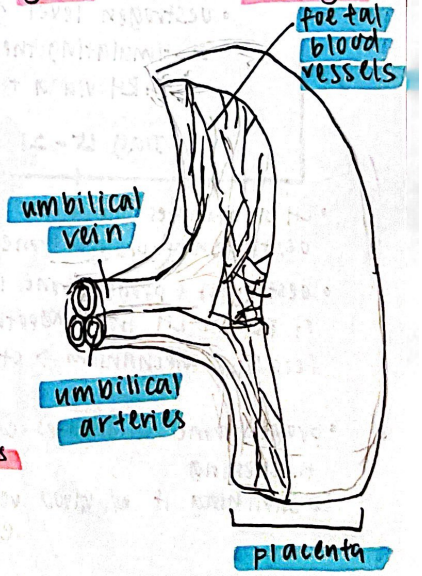
- Blastocyst implants in the endometrium ↪ implantation
- Blastocyst continues to grow into an embryo.

human gonadotropin (HCG) hormone

- produced by placenta
- level ↑ @ early stages of preg.
  - ↪ 2x every 2-3 days
  - © first 4 weeks
- Function :
  - → ensure corpus luteum con. to secrete oestrogen + progesterone in early stages of preg.
- can be detected in urine

umbilical cord

- a tube that connects the umbilical vein + umbilical arteries.
  - carries blood rich in O_2 + nutrients from placenta to foetus
  - carry deoxygenated blood (rich in CO_2) ~~from~~ nitrogenous waste: urea from foetus to placenta



placenta

- exchange site of subs. btw mom + foetus
  - → glucose, amino acids, hormones, antibodies + O_2 are absorbed from mom's blood in2 foetal blood capillaries
  - → CO_2 + nitrogenous waste are absorbed from foetal blood caps. in2 mom's blood circ.
- endocrine organ that secretes hormones during preg.
  - → 4th month, corp. lut. degenerates
  - → placenta replace corp. lut. to produce progesterone + oestrogen needed to maintain endometrial thickness

twins

identical

1. 1 sperm fertilises 1 ovum
2. embryo divides in2 2
3. 1 placenta is shared between two foetus
4. genetic makeup + physical appearances are similar as they are from the zygote
5. sex = same

fraternal

2 sperms fertilise 2 ova

embryo x divide

Each foetus has its own placenta

Genetic makeup + physical appearances are different → 2 diff. zygotes

sex may be same / diff.

impotency

male

Testes x produce sperm

Erectile dysfunction

Low quality sperm/ abnormal sperm

Low sperm count

Hormonal imbalance

female

ovaries x produce secondary oocyte

Blocked Fallopian tuyes

Abnormal uterus

Growth in uterus

Hormonal imbalance

treatment

1. hormonal therapy
   - FSH + LH
2. surgery to unblock sperm ducts / Fallopian tubes
3. in-vitro fertilisation (IVF)

growth in human + animal

→ important for the dev. + maturation of bodily syst.

↳ irreversible, permanent process that involves ~~in~~ the increase in the no. of cells, size, vol. + weight of the organism's body

↳ also involves the differentiation + cell specialisation as well as specialising the shapes + functions of cells

measuring growth

- The parameters :

① increase in size / vol.

→ changes in ~~size~~ height / length of an organism

② changes in fresh weight / dry weight

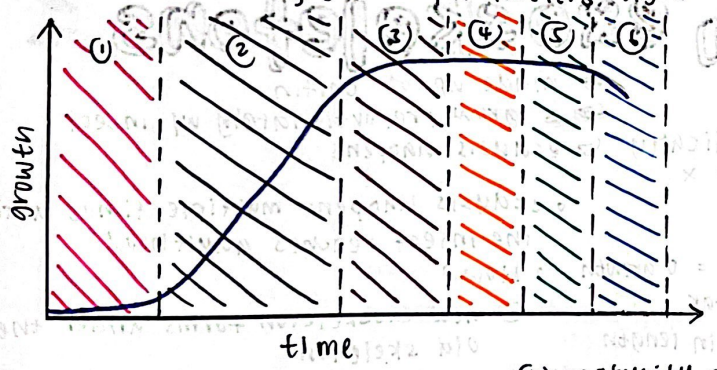
→ dry weight
- weight of an organism after all the fluid is removed from its body
- done by weighing the organism after it has been dried in the oven at 100°C repeatedly until the weight remains the same
- weakness : organism has to be killed
- suitable for plants

→ fresh weight
- adv. : can be taken whenever + organisms × need to be killed
- measured for a certain amount of time
- less accurate bc the amount of fluid in the body is dependent on the organism's fluid intake

Growth phases

sigmoid curve (S-shaped)

- achieved by plotting growth parameters against time.



① lag phase
- ② infant
  - low growth rate
  - lil' cell division + cell elongation
  - phase of adjusment to new sources available in the environment

② exponential phase
- ③ childhood
  - highest growth rate
  - cell division + cell elongation occurs actively
  - organism's size increases rapidly

③ stationary phase
- ④ adolescent
  - growth rate slows down + occurs at constant rate.
  - cells reach max. size
  - cells undergo differentiation to form specialised cells.

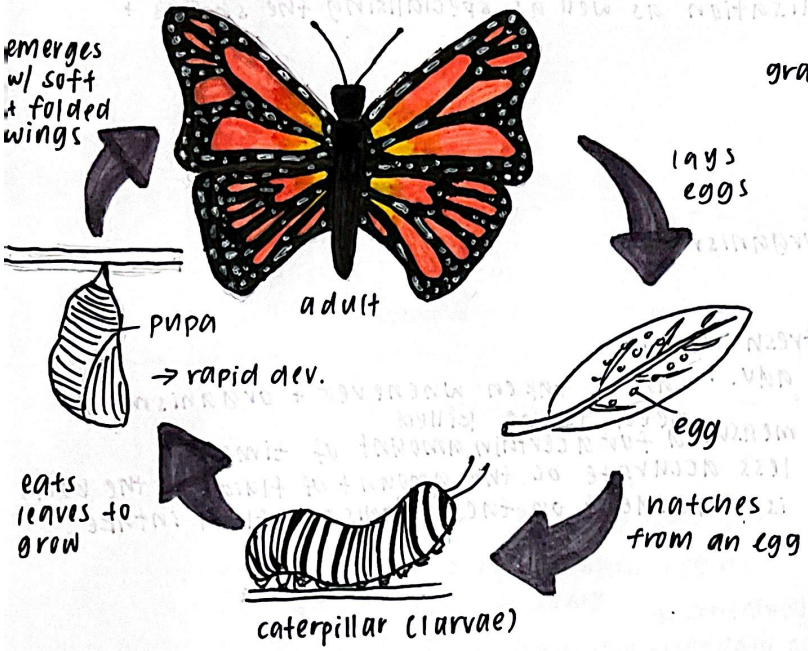
④ maturity phase
- ⑤ adult
  - zero growth rate
  - organism reaches maturity
  - cell division only happens to replace impaired / dead tissues

⑤ senescene phase
- -ve growth rate
- organisms go thru ageing

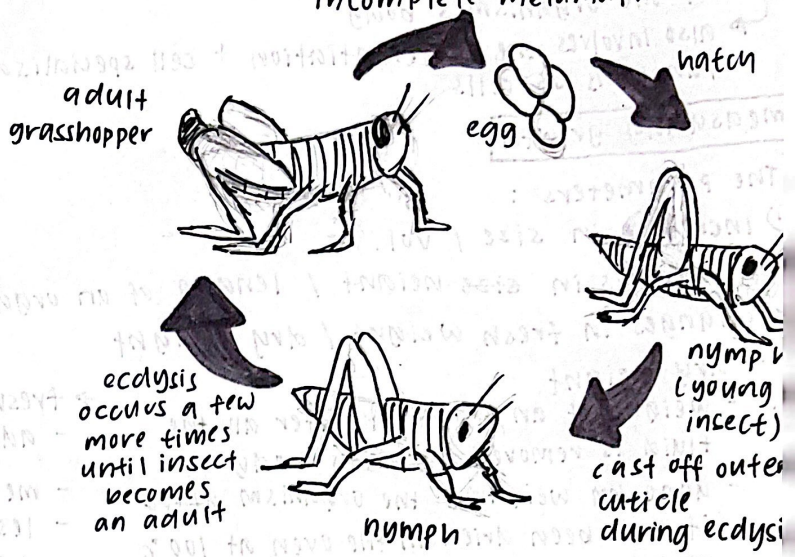
⑥ death phase
- ageing, illness, lack of nutrients / space eventually leads to death of an organism

growth of insects

complete metamorphosis

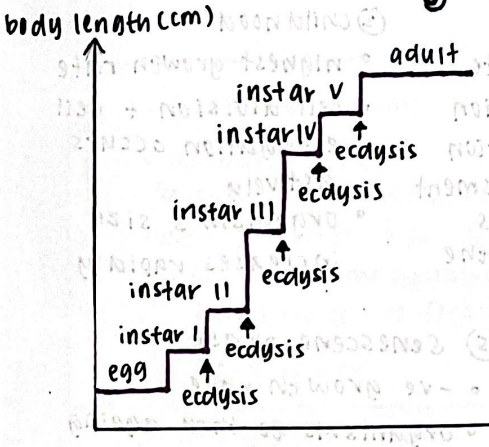


incomplete metamorphosis



ecdysis = the moulting process of the exoskeleton that allows growth + development of insects
→ controlled by hormones

intermittent growth curve of animals with exoskeletons



ecdysis

- happens periodically
  - polar growth is x continuous + is intermittent
- horizontal part = 0 growth
  - known as instar
  - x increasing in length
- vertical line = rapid growth
  - nymph undergoes ecdysis + size increases rapidly

- made up of chitin
- x grow proportionately w/ insect
- ecdysis happens

- ecdysis happens multiple times until the insect reaches adulthood
- How?
  1. new exoskeleton forms under the old skeleton
  2. Before new exoskeleton hardens, the insect will suck in air to expand its body, increasing its volume
  3. The old skeleton breaks, insect w/ new exoskeleton emerges
  4. The insect will expand its body one more time before the new exoskeleton hardens