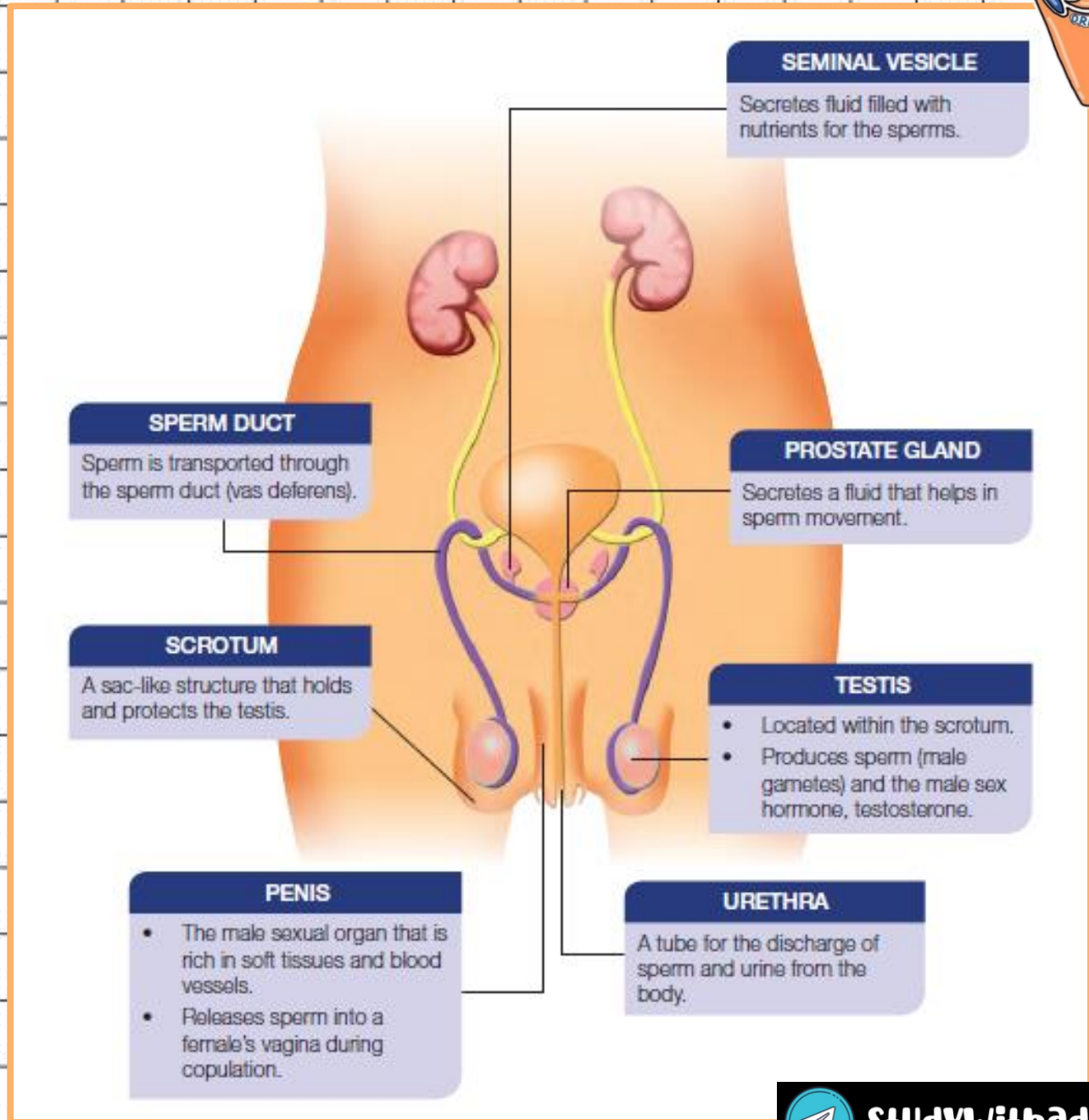


15.1 Reproductive System of Humans

Male Reproductive System



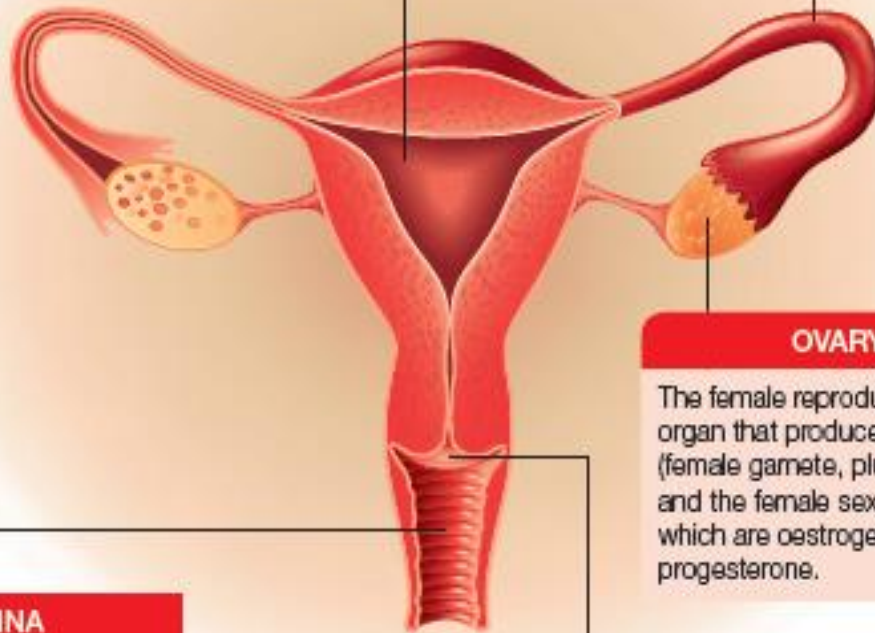
Female Reproductive System

UTERUS

- The uterus is an organ with thick muscular walls.
- The inner wall of the uterus is lined with endometrium tissue, which secretes mucus and is rich in blood vessels.
- Embryo implants in the endometrium.
- The endometrial tissue which is thick and rich in blood vessels supplies the embryo with nutrients and oxygen.

FALLOPIAN TUBE

- A thin, muscular tube.
- The inner wall is lined with cilia.
- The action of the cilium, combined with the peristalsis of the Fallopian tube, helps in delivering the secondary oocyte or embryo to the uterus.



OVARY

The female reproductive organ that produces ovum (female gamete, plural: ova) and the female sex hormones, which are oestrogen and progesterone.

VAGINA

A canal where sperms enter, and also serves as a passage for birth and menstruation.

CERVIX

Narrow opening to the uterus which secretes mucus to help sperm swim up to the Fallopian tubes.



15.2 GAMETOGENESIS IN HUMANS

1. Process of gamete formation is known as gametogenesis .
2. Gametogenesis that involved sperm formation is known as spermatogenesis , whereas those involved ovum formation is known as oogenesis

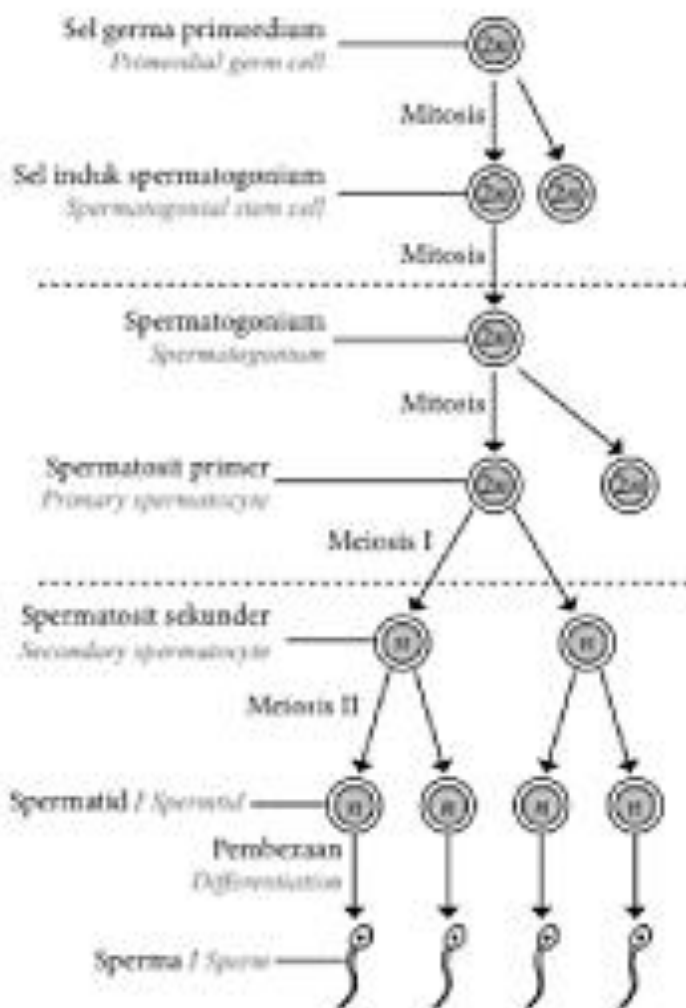
NECESSITY OF GAMETOGENESIS

- Produces gametes with haploid chromosomal number through meiosis.
- Produces genetic variation in gametes.
- Maintains diploid chromosomal number of zygote .
- Produces genetic variation in offspring .



SPERMATOGENESIS

1. During foetus development, primordial germ cells divide mitotically to form spermatogonia.



Each spermatogonium ($2n$) grows and develops into primary spermatocyte ($2n$)



Each primary spermatocyte ($2n$) divides by meiosis I to form two secondary spermatocytes (n).



Each secondary spermatocyte (n) divides by meiosis II to form two spermatids (n).



Each spermatid (n) undergoes differentiation to form sperm (n).

2. The sperms formed move to epididymis to be matured.
3. the structure of a mature sperm.



4. Head of sperm contains nucleus and acrosome. The nucleus contains chromosomes and the acrosome contains enzymes for fertilisation.
5. Midpiece of sperm contains abundant of mitochondria to produce more energy for movement.
6. The tail helps sperm to move.

OOGENESIS

1. During foetus development, primordial germ cells divide mitotically to form oogonia.
2. Polar body formed has size much smaller than secondary oocyte or ovum.
3. The three polar bodies will degenerate and do not take part in fertilisation.
4. At first, primary oocyte that surrounded by follicle cells is known as primary follicle .
5. At puberty, follicle stimulating hormone (FSH) secreted by pituitary gland stimulates the development of follicle in ovary.
6. Follicle cells start to divide by mitosis during development of follicle. The primary follicle developed into secondary follicle and then into a mature follicle, Graafian follicle .
7. During the follicle development, primary oocyte undergoes meiosis I to form secondary oocyte



diploid (2n). / At foetal stage, the primordial germ cells divide repeatedly by mitosis to form many diploid oogonia (2n).

Each oogonium grows and develops to form primary oocyte (2n). Each primary oocyte is surrounded by a layer of follicle cells to form a primary follicle.

Before birth, the primary oocytes undergo an incomplete meiosis I until prophase I.

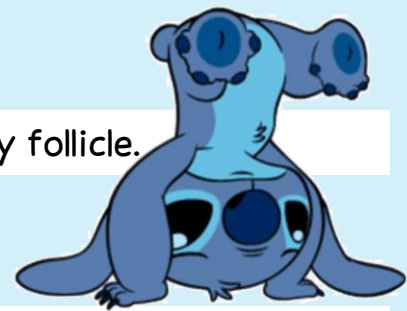
At puberty, one primary oocyte completes meiosis I to form a secondary oocyte (n) and a polar body (n). The haploid polar body formed also undergoes meiosis II to form another two haploid polar bodies.

Secondary oocyte is surrounded by follicle cells known as secondary follicle.

Secondary follicle grows and matures to form graafian follicle which then moves to the surface of the ovarian wall.

Ovulation: The Graafian follicle bursts and releases the secondary oocyte into Fallopian tube.

If fertilisation occurs, secondary oocyte completes meiosis II to form a polar body (n) and an ovum (n). All 3 polar bodies will degenerate.



COMPARISON BETWEEN SPERMATOGENESIS AND OOGENESIS

Similarities

- Occur in reproductive organs
- Produce haploid gametes
- Involved in fertilisation



difference

SPERMATOGENESIS	ASPECT	O OGENESIS
Testis	Organ of gamete formation	Ovary
Sperm	Gamete formed	Ovum
Has a head, midpiece and tail	Structure of gamete	Spherical shape
Can move with tail	Ability to move	Assists by cilia in the Fallopian tube
No follicle cells surround the gamete	Presence of follicle cell	Follicle cells surrounding the gamete
four	Number of gamete formed from one parent cell	One
None	Formation of polar body	One or three
Small	Size of gamete	large
Occurs throughout life after puberty	Mitotic division on parent cell	Only occurs during foetal development Stage
Occurs continuously without break	Meiotic division during gamete formation	Occurs by stages regarding to foetal, puberty and after fertilisation stages
Involves differentiation	Differentiation	Does not involve differentiation



15.3 MENSTRUAL CYCLE

1. Menstruation
 - Breakdown of the lining of uterine wall and its discharge through the vagina, with small amount of blood and cells.
2. Menstrual cycle
 - A monthly cycle, consisting of follicle development, ovulation, thickening of the endometrium and menstruation.
 - 28 days for each cycle..
3. Importance of menstrual cycle
 - Prepares the uterine lining for the implantation of an embryo
 - Controls the development of ovum and ovulation
4. The hormones involved in controlling menstrual cycle are:



HORMON	FUNGSI	KESAN
Follicle stimulating hormone (FSH)	<ul style="list-style-type: none"> • Stimulates follicle development in the ovaries • Stimulates oestrogen secretion by the follicles 	Control changes in the ovaries
Hormon peluteinan (LH)	<ul style="list-style-type: none"> • Stimulates ovulation • Causes the formation of corpus luteum • Promotes the secretion of progesterone 	
Oestrogen	<ul style="list-style-type: none"> • Repair and revival of endometrium after menstruation • Stimulates FSH and LH secretion before ovulation 	Control changes in the uterus
Progesterone	<ul style="list-style-type: none"> • Stimulates the endometrium to become thick, folded and highly vasculated for embryo implantation • Inhibits FSH and LH secretion 	

EVENTS OF THE MENSTRUAL CYCLE

TIME (DAYS)	IN THE OVARY	IN THE UTERUS
0 - 5	Follicle develops	Menstruation
6 - 13	Follicle matures	Endometrium repaired, thickens
14	Ovulation	Endometrium continues to thicken
15 - 24	Corpus luteum develops	Tissue and blood vessels develop in endometrium
25 - 28	Corpus luteum degenerates as no fertilisation Occur	Endometrium will begin to disintegrate after 28th day

THE RELATIONSHIP BETWEEN HORMONE LEVELS, FOLLICLE DEVELOPMENT AND THE THICKNESS OF ENDOMETRIUM IN THE MENSTRUAL CYCLE

DAYS	HORMONE LEVEL	FOLLICLE DEVELOPMENT	THICKNESS OF ENDOMETRIUM
1 - 5	FSH is secreted and begins to increase	Stimulates the development of primary oocyte and follicle..	Endometrium of uterus breaks down.
6 - 14	<ul style="list-style-type: none"> FSH begins to decrease. The follicle cells secrete oestrogen. The level of oestrogen increases . The secretion of luteinising hormone (LH) also increases. 	<ul style="list-style-type: none"> The follicle continues to develop until it becomes a mature Graafian follicle. The mature Graafian follicle bursts on the 14th day and releases the secondary oocyte . The remaining Graafian follicle in the ovary becomes the corpus luteum.. 	The endometrium is repaired and begins to thicken
14 - 28	Progesterone begins to increase on the 14th day until 25th day. The high level of progesterone inhibits the secretion of FSH and LH. It decreases after the 25th day if fertilisation does not occur.	Corpus luteum remains but begins to degenerate on the 25 th day if fertilisation does not occur.	Endometrium begins to break as menstrual blood if no fertilisation occur.




5. the functions of hormones involved in menstrual cycle.

HORMONE	FUNCTIONS
Oestrogen	<ul style="list-style-type: none"> • Repair endometrium after menstruation. • Thicken endometrium . • Stimulate secretion of FSH and LH before ovulation
Progesterone	<ul style="list-style-type: none"> • Stimulates thickening of endometrium. • Inhibit secretion of FSH and LH to inhibit follicle development and prevent ovulation.

1. Premenstrual syndrome is the sign or symptoms that frequently experienced by a woman before menstruation.
2. The signs of the premenstrual syndrome that experienced by a woman are different from one cycle to another.

premenstrual syndrome (PMS)

PHYSICAL	EMOTION
<ul style="list-style-type: none"> • Headache • Breast swelling and pain • Stomach pain • Muscle or joint pain • / Feeling tired • Sleep problems • Bloating • Food cravings • Constipation 	<ul style="list-style-type: none"> • Trouble with concentration or memory • Anxiety • Irritability • Tension • Depression • Crying spells • Mood swings 

3. Menopausal syndrome is the sign or symptoms that experienced by a woman when the menstruation stops permanently.

menopause syndrome



FACTORS	PHYSICAL	EMOTION
<ul style="list-style-type: none"> • Occurs between 46 till 54 year-olds • Ovary is less sensitive to the stimulation of FSH and LH • No follicle developed and no ovum Formed • Low production of progesterone and oestrogen 	<ul style="list-style-type: none"> • Hot flashes • Sleep problems • Urinary problems • Vaginal problems and infections • Osteoporosis • Irregular periods • Night sweats • Weight gains 	<ul style="list-style-type: none"> • Memory problems • Mood swings • Depression • Anxiety

15.4 DEVELOPMENT OF HUMAN FOETUS

EARLY DEVELOPMENT OF A HUMAN ZYGOTE

fertilisation



StudyWithAdmin

1. Definition: The union of sperm nucleus and ovum nucleus to form a zygote.
2. Fertilisation occurs at the Fallopian tube .
3. Ovum is surrounded by millions of sperms , but only one will successfully penetrate the ovum wall.
4. When the penetration is successful, a barrier known as the fertilisation membrane is formed to prevent the penetration of other sperms.

SPERM (N)

OVUM (N)

Persenyawaan

Zygote (2n)

Two cells embryo

Morula (2n)

Blastocyst (2n)

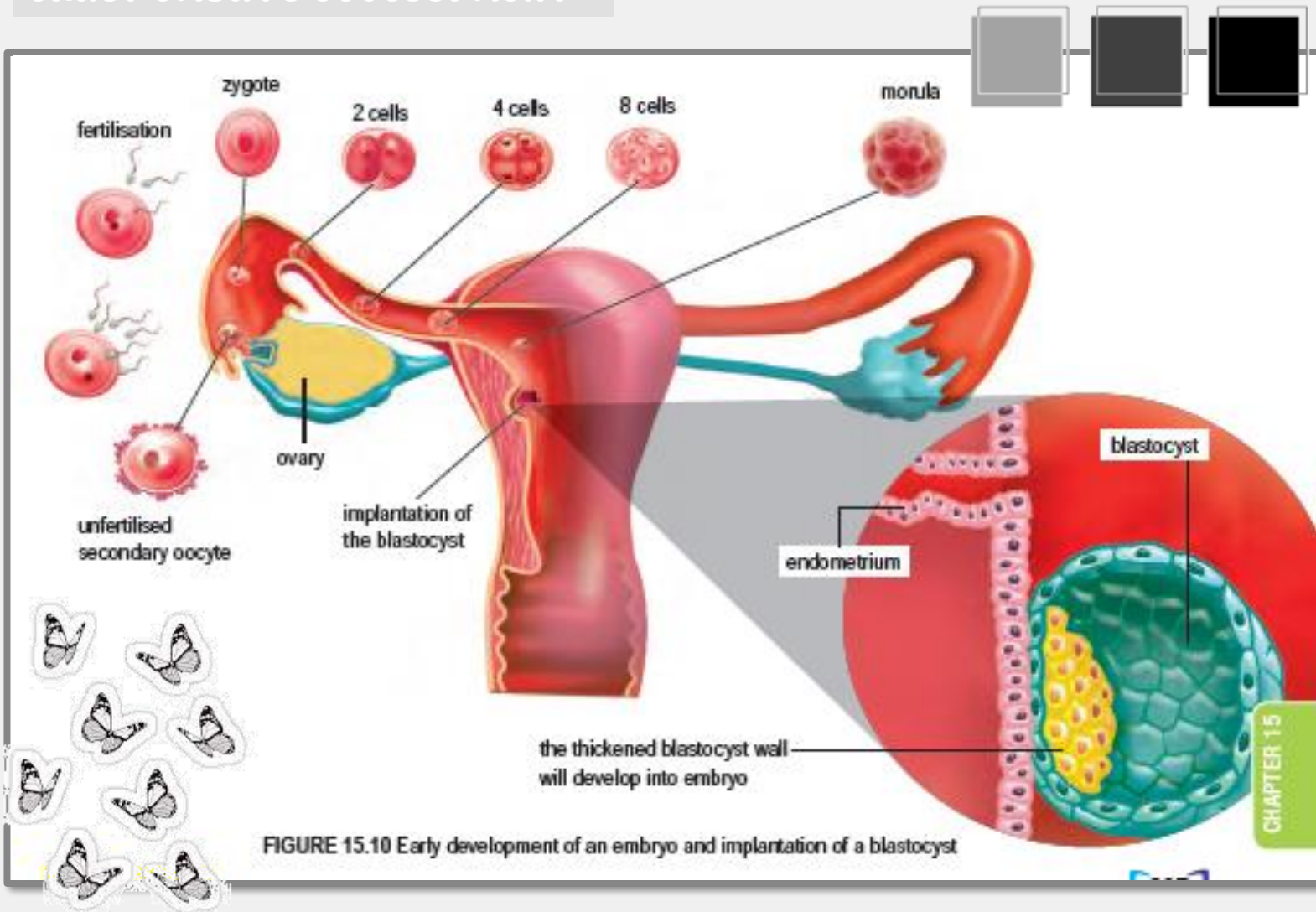
Embryo (2n)

Foetus (2n)

Baby (2n)



EARLY EMBRYO DEVELOPMENT



role of human chorionic gonadotropin (hcg) during pregnancy process

1. If fertilisation is occurred, zygote formed divides into embryo.
 - (a) The embryo begins to produce human chorionic gonadotropin (HCG) hormone for maintaining the function of corpus luteum .
 - (b) The corpus luteum continue to function by secreting progesterone and oestrogen in the first two months of pregnancy.
 - (c) The function of corpus luteum will be taken over by placenta at the 4th month of pregnancy.

function of placenta and umbilical cord in the development of foetus

1. During foetus development, blastocyst forms chorionic villi into endometrium to obtain nutrients and oxygen from maternal blood.
2. Chorionic villi will form placenta in the 4th week of pregnancy.
3. Placenta is the site of substances exchange between foetal blood and maternal blood.
4. structures of placenta and umbilical cord.

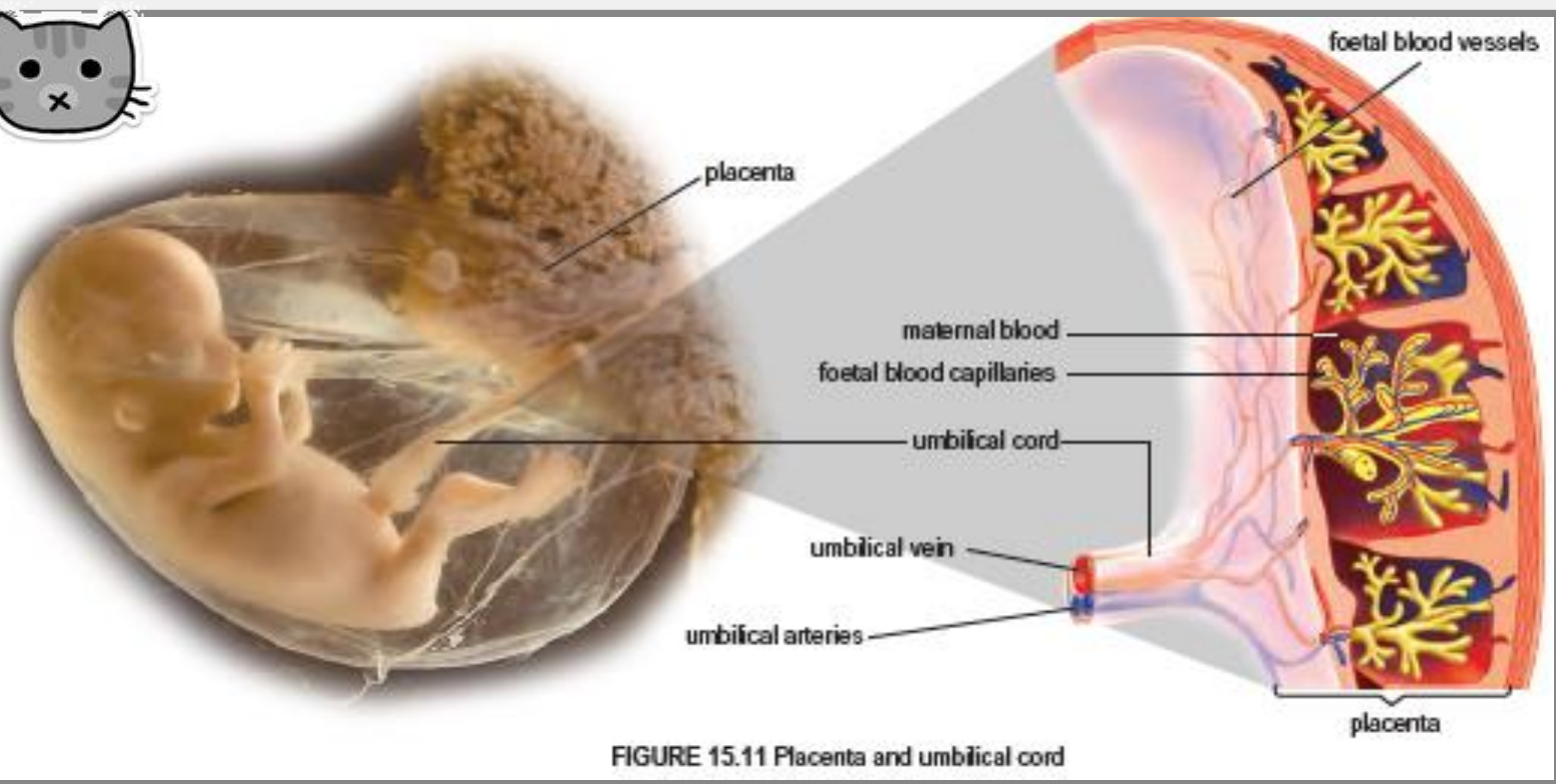


FIGURE 15.11 Placenta and umbilical cord

- Useful substances such as nutrients, oxygen and antibodies are transported from maternal blood to foetal blood through placenta and umbilical cord.
- While, waste substances such as urea and carbon dioxide are transported from foetal blood to maternal blood through placenta and umbilical cord.
- Umbilical cord has umbilical arteries and umbilical vein .
 - The umbilical arteries transport foetal blood towards placenta .
 - Umbilical vein transports foetal blood from placenta towards foetus.
- Placenta has functions other than as the site of substance exchange.
 - Placenta filters certain pathogens and harmful substances into the foetus.
 - Placenta attaches foetus to uterus wall.
 - Placenta secretes hormone progesterone and oestrogen to maintain thickness of endometrium during pregnancy.
 - Placenta separates maternal blood circulatory system with those in foetus to protect foetus.

necessity of having separate foetal and maternal circulatory system

- Protects foetus' fine blood vessels from being damaged by high maternal blood pressure .
- Prevents agglutination if blood group of foetus is incompatible to maternal blood group.
- Filters certain pathogens and harmful substances from entering foetal blood.

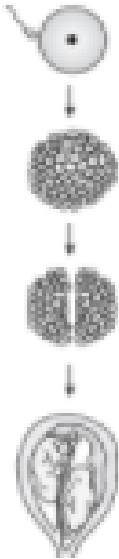
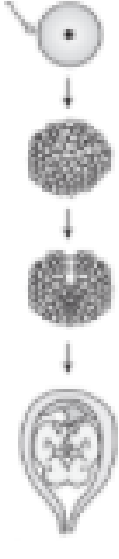
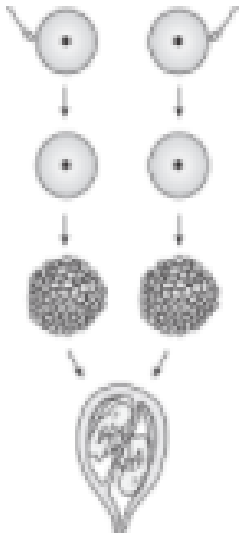


15. 5 FORMATION OF TWINS



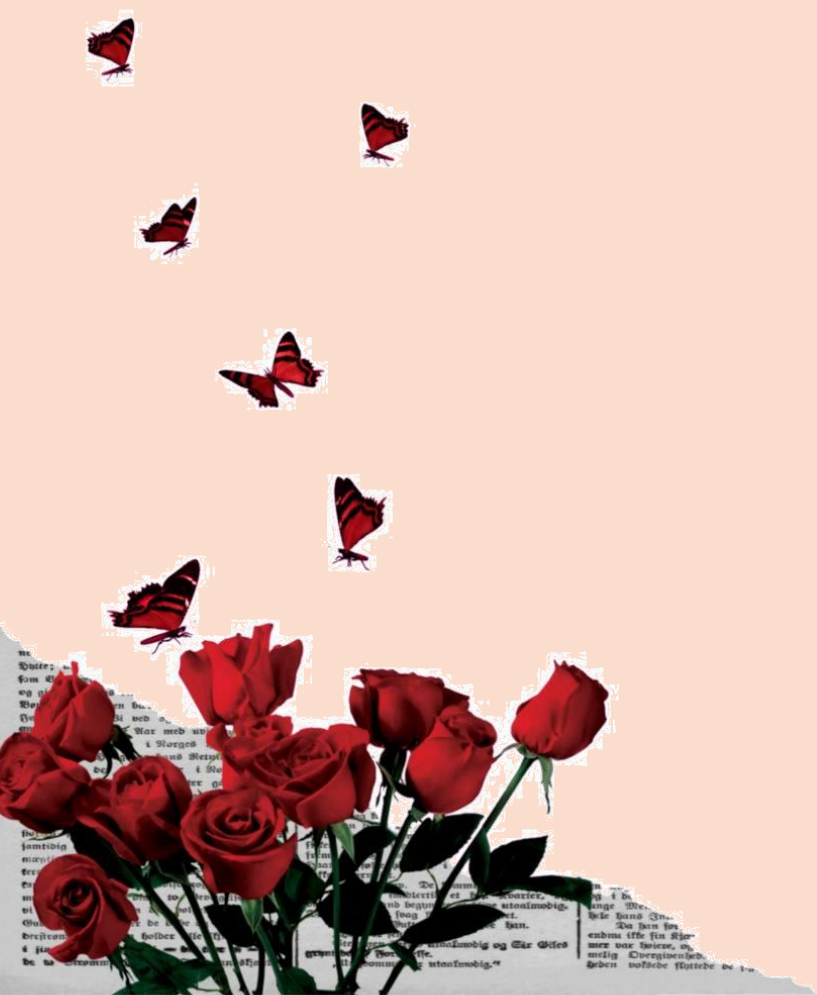
THE FORMATION OF TWINS

differences between identical twins, siamese twins and fraternal twins

TYPES OF TWINS	IDENTICAL TWINS	SIAMESE TWINS	FRATERNAL TWINS
FORMATION PROCESS	 <p>Two foetuses share one placenta</p>	 <p>Two foetuses share one placenta</p>	 <p>Each foetus has its own placenta</p>
FERTILISATION	1 ovum fertilised by 1 sperm	1 ovum fertilised by 1 sperm	2 ova fertilised by 2 sperms
ZYGOTE FORMATION	Formed from 1 zygote	Formed from 1 zygote	Formed from 2 different zygote
PLACENTA	Share one placenta but have their own umbilical cords	Share one placenta but have their own umbilical cords	Each has their own placenta and umbilical cords
EMBRYO DIVISION	Divide into two	Incomplete division	Not divide into two
UMBILICAL CORDS	2	2	2
GENDER	Same sex	Same sex	Same or different sex




GENETIC CONSTITUTION	Identical	Identical	Different
PHYSICAL CHARACTERISTICS	Identical	Identical	Different
FINGERPRINTS	Unique (different)	Unique (different)	Unique (different)



15. 5 HEALTH ISSUES RELATED TO THE HUMAN REPRODUCTIVE SYSTEM

1. Infertility is the inability of a couple having offspring after marriage more than 12 months and without the use of contraceptive technique.
2. The table below shows infertility in male and female.

TIME (DAYS)	CAUSES OF INFERTILITY	DESCRIPTION
MALE 	Less sperm count	Probability of fertilisation to occur is lower
	Abnormal structure of sperm	Sperms do not function and fertilisation does not occur
	Blockage of sperm ducts	No sperm found in semen
	Inactive sperm	Sperm unable to move to Fallopian tube for fertilisation
	Infection in testis	No sperm formed or abnormal sperm formed
	Impotence	Sexual reproduction does not occur
FEMALE	Ovum tidak dihasilkan	Persenyawaan tidak berlaku
	Tiada ovulasi	Ovum tidak dibebaskan dan persenyawaan tidak Berlaku
	Tiub Falopio tersumbat	Ovum yang dibebaskan tidak dapat dipersenyawa dengan sperma
	Masalah uterus (struktur tidak normal, ketumbuhan)	Penempelan susah atau tidak berlaku
	Kitar haid tidak normal	Penghasilan ovum dan ovulasi terganggu

infertility

Overcoming infertility in male

a) Sperm bank

- Donor's sperms are collected and stored frozen in liquid nitrogen at a temperature of -196°C . The sperms chosen by the couple will be injected into the woman's Fallopian tube during ovulation.

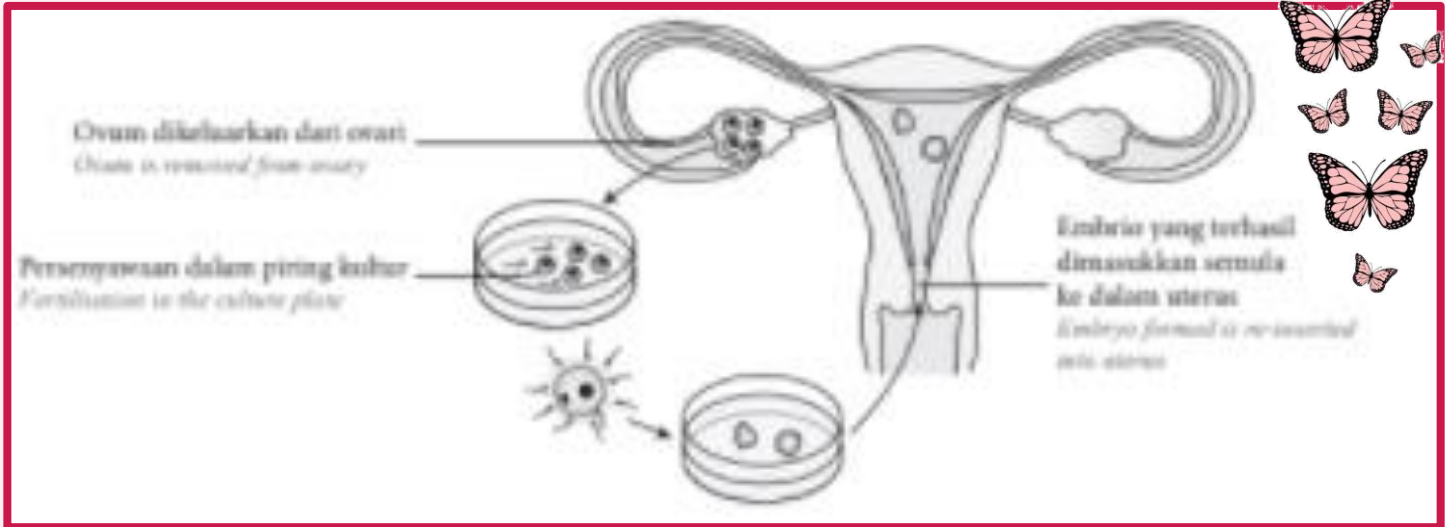
b) Artificial insemination (AI)

- Due to the small amount of sperm, this technique will accumulate sperms over a certain period of time to achieve a large quantity.
- Sperms are injected into the Fallopian tube during ovulation.



INFERTILITY TREATMENT

in vitro fertilisation (ivf)



- A mature ovum is removed from the ovary and is fertilised by the sperm in a culture plate in the laboratory.
- Fertilisation occurs after 5-6 hours.
- The fertilised ovum is re-inserted into the uterus for the embryo implantation process.
- The baby born is known as a test tube baby.



15. 7 GROWTH IN HUMANS AND ANIMALS

1. Growth in multicellular organism such as humans and animals is an irreversible process which involve the increase in quantitative parameters such as size (height or length), body mass , volume and number of cells.
2. Quantitative parameters can be used to measure the growth of humans and animals.

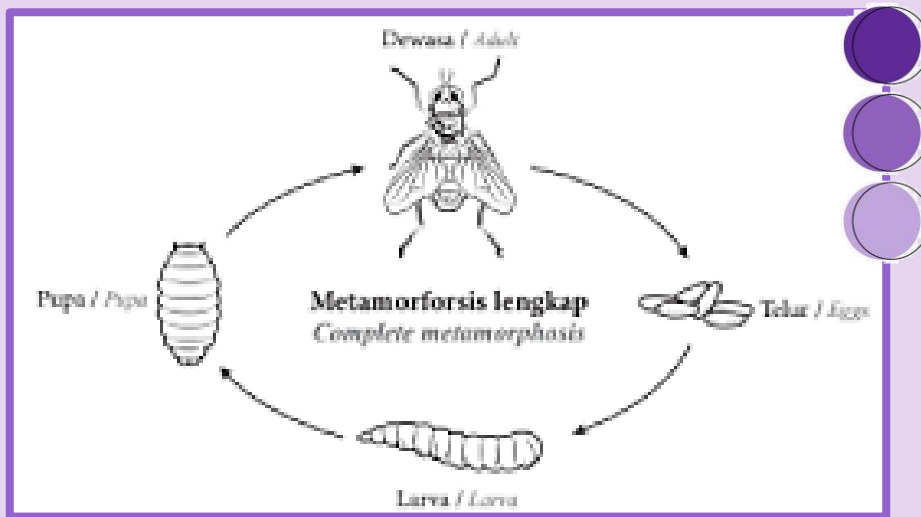
Parameters for the growth of humans and animals

- Body size
- Height
- Length
- Body mass
- Fresh mass
- Dry mass

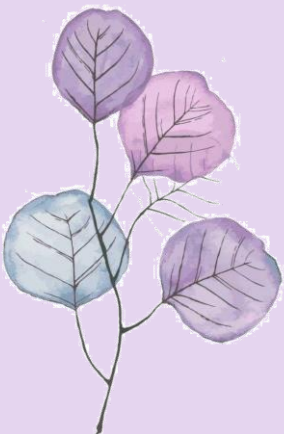
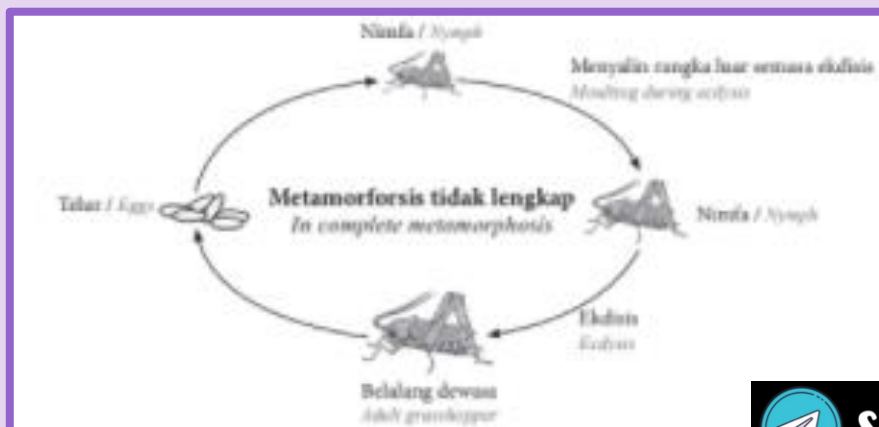
GOOD VIBES

Growth in insect

1. undergo growth by either complete metamorphosis or incomplete metamorphosis.
2. In development of exoskeletal organisms, metamorphosis is a developmental process from larval stage to adult stage.
3. During developmental stage, organism undergoes a moulting process known as ecdysis.
4. In complete metamorphosis , the growth of organisms involves four stages starts from egg to larva, larva to pupa and from pupa to adult.



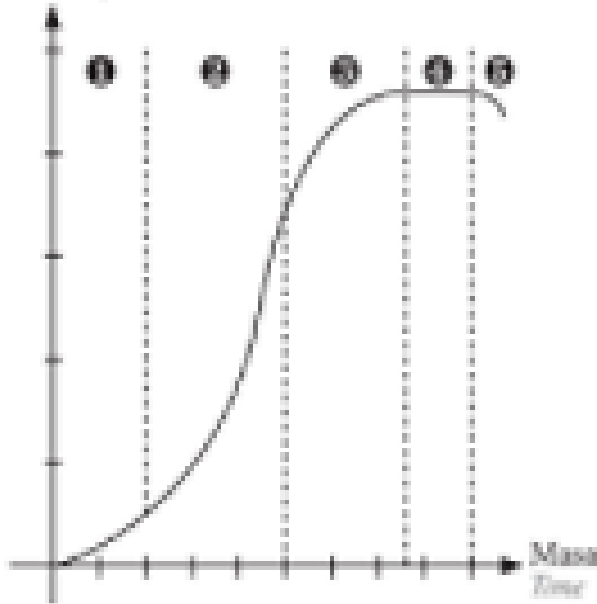
5. In incomplete metamorphosis , the growth of organisms only involves three stages starts from egg to larva and from larva to adult.



Sigmoid growth curve of an organism

1. In general, all growth in humans and animals show S-shaped sigmoid growth curves
2. The sigmoid growth curve can be divided into five phases:

Parameter pertumbuhan
Growth parameters



1. Lag phase : Slow growth
 - Less cell division
 - Organism is adapting to environment and food sources.

2. Rapid growth phase: Fastest growth rate
 - Active cell division and elongation
 - Adequate growth factors

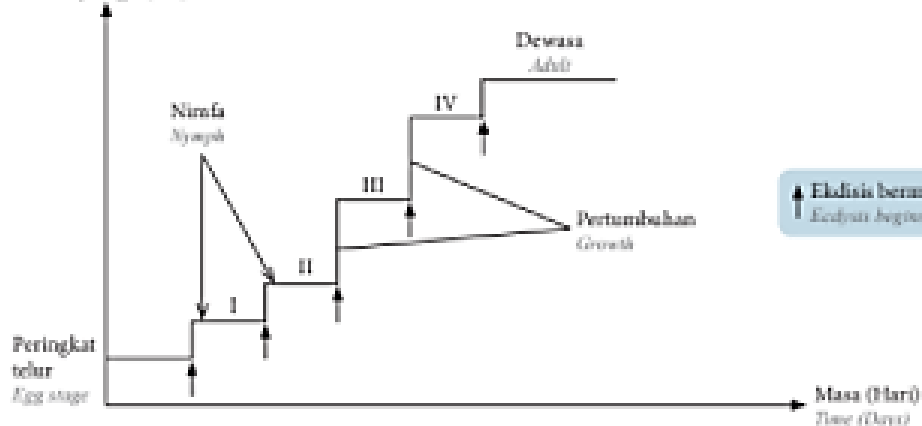
3. Slow growth phase : Slow growth rate
 - Cells reach maximum size
 - Growth factors limit the growth rate
 - External factors (example: food shortage)
 - Internal factors (example: hormone)

4. Maturity phase: Zero growth rate
 - Cell division occurs only to replace dead or damaged tissues

5. Senescence and death phase : Growth rate is negative
 - Organism starts ageing and dying
 - Due to lack of nutrients and growth factors

3. Growth curve in animal with exoskeleton by using parameter length is staircase shaped

Panjang badan (mm)
Body length (mm)



- Insects have a hard exoskeleton made of chitin .
- In order to grow in size, insects must undergo a moulting process known as ecdysis .
- The horizontal lines show zero growth periods known as instars

during ecdysis:

- An insect breathes in a lot of air to expand the body
- The old exoskeleton breaks
- The insect expands by breathing in more air, before the new exoskeleton hardens
- Ecdysis is repeated several times until the adult phase

