REPRODUCTION IN HUMANS

Asexual Reproduction

⇒ without gametes / sex cells
⇒ single parent
⇒ mitosis
⇒ identical next generation

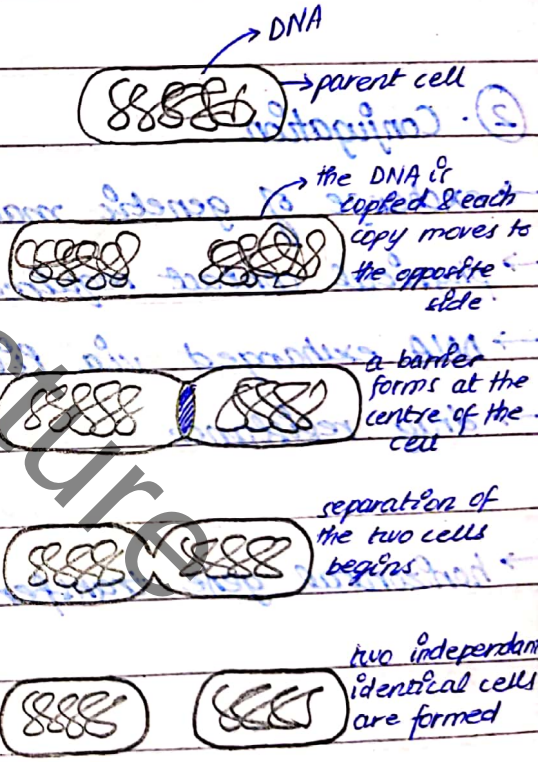
Sexual Reproduction

⇒ fusion of male & female gamete
⇒ two parents
⇒ meiosis for formation of gametes
⇒ genetic variation in next generation

MODES OF ASEXUAL REPRODUCTION

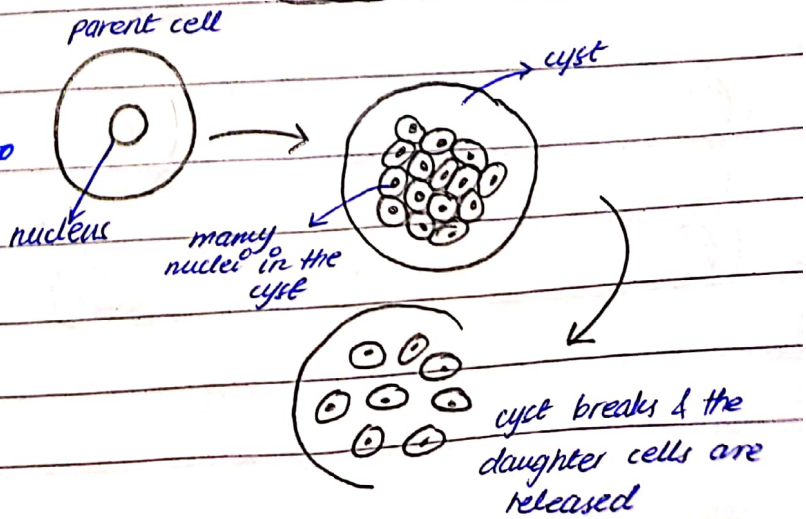
(1). Binary Fission

→ a parent cell splits into two identical individual daughter cells
→ daughter cells have identical genetic information
e.g/ bacteria



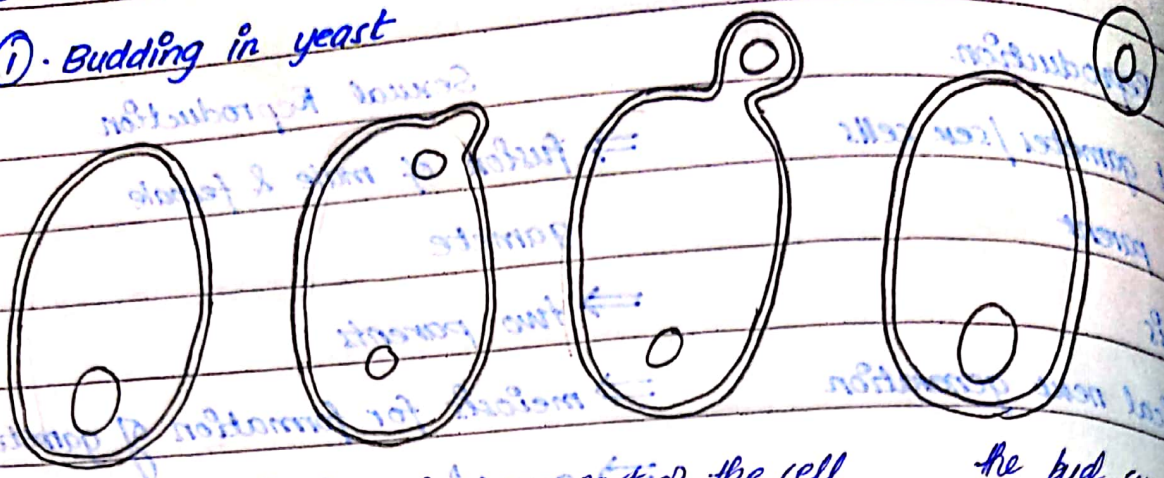
(2). Multiple Fission

→ a single cell divides into many daughter cells simultaneously
→ e.g/ plasmodium & amoeba



EXAMPLES OF ASEXUAL REPRODUCTION

① · Budding in yeast



nucleus replicates

nucleus migrates to one end

part of the cell grows into a bud

the bud separates creating a new cell

② · Conjugation

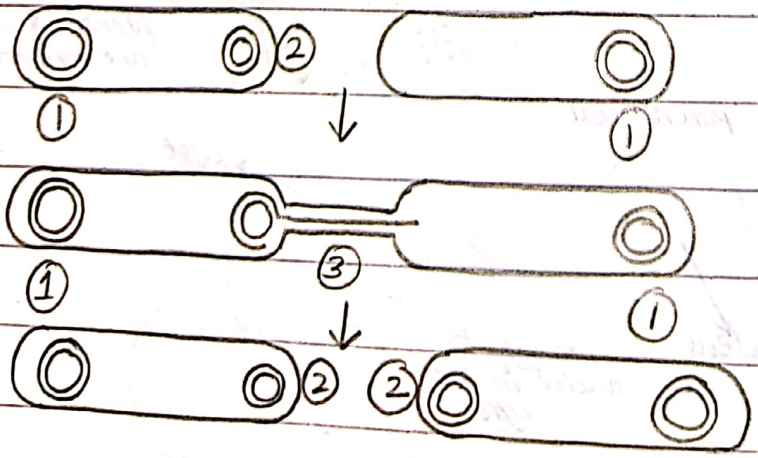
→ exchange of genetic material between bacteria

→ physical contact required

→ DNA exchanged via pilli

→ drug resistance

→ horizontal gene transfer



SEXUAL REPRODUCTION

→ fusion of male and female gametes to form next new generation by fertilization

Male gamete — SPERM

→ Haploid cells (1n)

→ formed by meiosis

→ inside male reproductive organs — testis

→ abundant in number to ensure fertilization

→ smaller in size — reduced cytoplasm

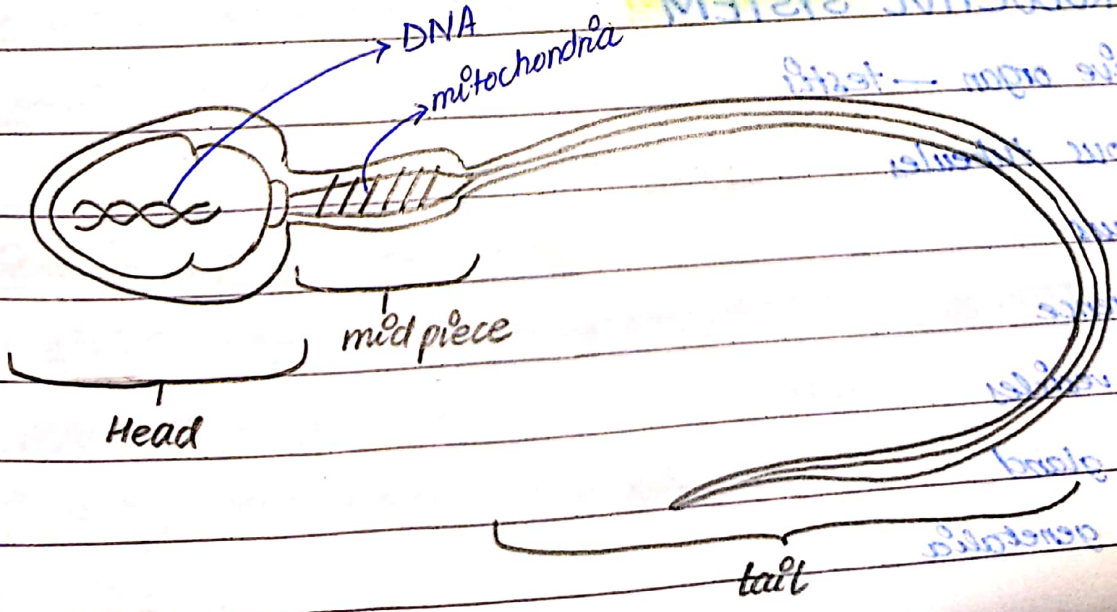
→ motile — can move towards female gamete

HEAD — contains nucleus with minimum cytoplasm

NECK — contains mitochondria

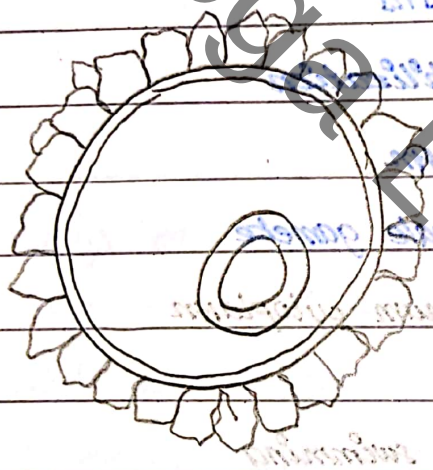
TAIL — cell membrane projection for swimming

ACROSOME — conical head containing enzyme to dissolve egg membrane at time of fertilization



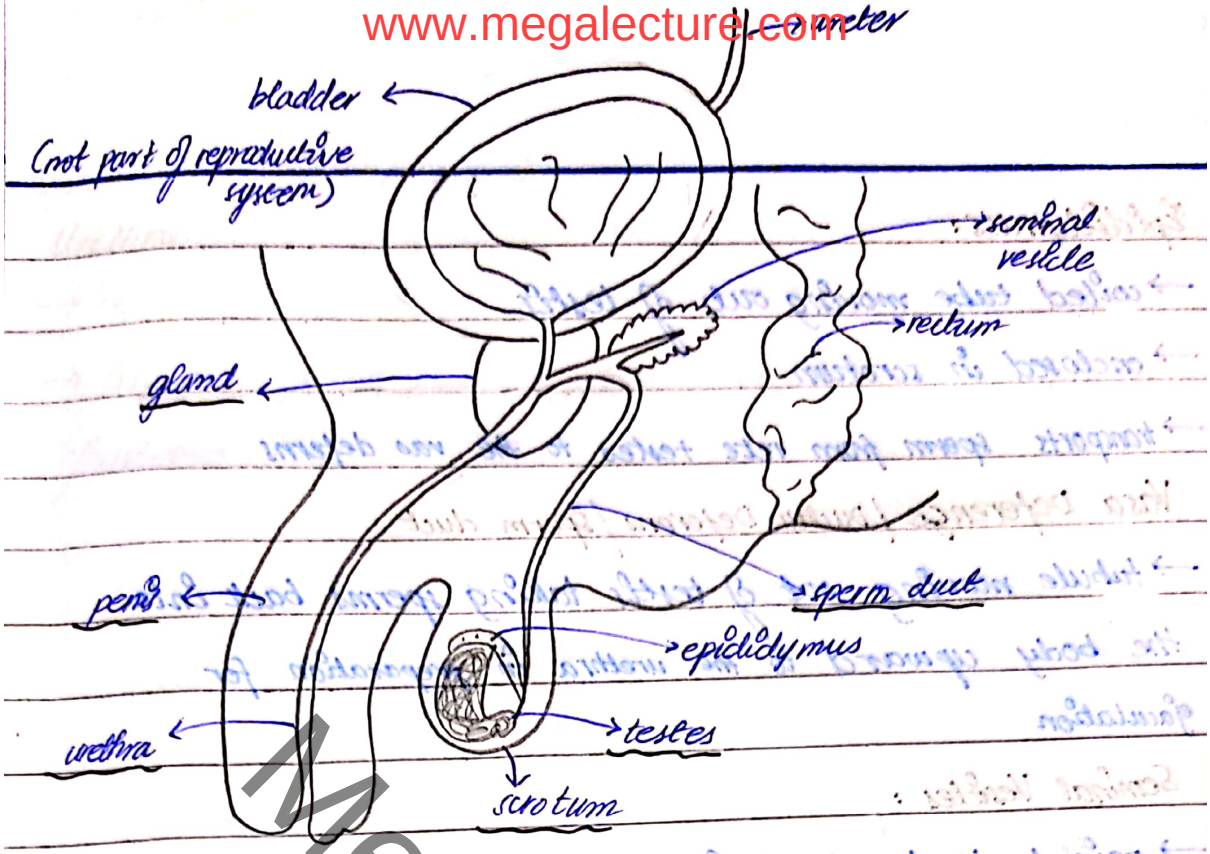
Female gamete – OVUM/EGG

→ Haploid cell (1n)
→ formed by meiosis
→ inside female reproductive organ – Ovary
→ large size – more cytoplasm
→ limited in number – one of the 4 daughter cells selected
→ non-motile – retained in reproductive organ



MALE REPRODUCTIVE SYSTEM

→ reproductive organ – testis
→ semniferous tubeules
→ epididymus
→ vas deference
→ seminal vesicles
→ prostate gland
→ external genetalia



~~~ : the male reproductive system

Testis : (singular for testes)

→ paired

→ in lower abdominal region outside the body (for temperature regulation)

→ enclosed in scrotum

→ acts as endocrine tissue

↳ producing testosterone/androgen

Seminiferous Tubules / Scrotum

→ ~~coiled system of tubules inside testis~~ that contains the testes

→ site of production of mature sperms

→ a bag that hangs below abdomen
~~~

Epididymus:

→ coiled tube moving out of testis
→ enclosed in scrotum
→ transports sperm from rete testes to the vas deferns

Vas Deferens / Ductus Deferens / Sperm duct

→ tubule moving out of testis taking sperms back into the body upward to the urethra in preparation for ejaculation

Seminal Vesicles:

→ paired gland — producing semen
→ fluid contain nurishment and lubrication of sperms for locomotion — swimming movements
(Seminal vesicles & prostrate glands both add their secretions to the sperm so that it is in a fluid easier to transport)

Prostate Gland:

→ single gland — behind urinary bladder producing secretions for improving mobility of sperms & providing nourishment
→ if enlarged can obstruct urination

External Genetailia — Penis:

→ contains opening as urethra for moving urine and sperms out of body
→ contains contractile muscles which respond to make organ stiff during sexual intercourse
→ blood vessels dilate and make muscles contract

Urethra:

→ serves a dual function

→ transports urine from the bladder and the semen is ejaculated from here

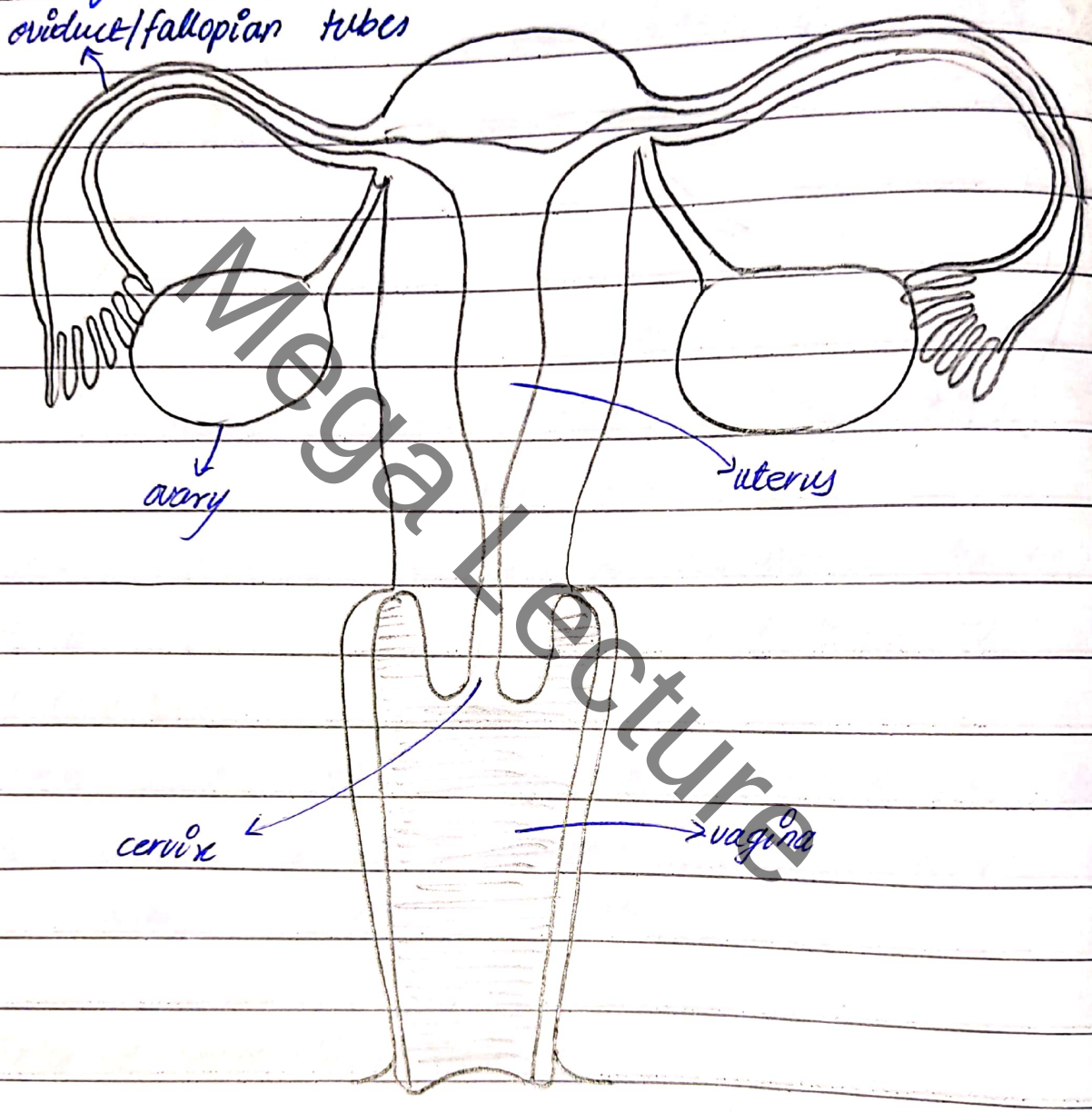
FEMALE REPRODUCTIVE SYSTEM

→ reproductive organ — Ovary

→ oviducts / fallopian tubes

→ uterus

→ vagina — birth canal



Ovary:

→ paired

→ present in abdominal region — well cushioned fats

→ site for production of mature Ovum

→ acts as endocrine tissue

Oestrogen & progesterone

Oviduct / Fallopian Tubes:

→ paired coiled tubules
→ receives ovum from ovaries
→ site of fertilization

Uterus:

→ site for development of embryo till birth
→ uterine walls — 3 walls for attachment of embryo
→ forms placenta
→ narrows down and forms cervix

Vagina / Birth canal:

→ site for receiving sperms
→ passage for fetus moving out of mother's body

Cervix:

→ facilitates the passage of sperm into the uterine cavity
→ by dilation
→ produces mucus to facilitate sperm entry

MATURATION OF GAMETES

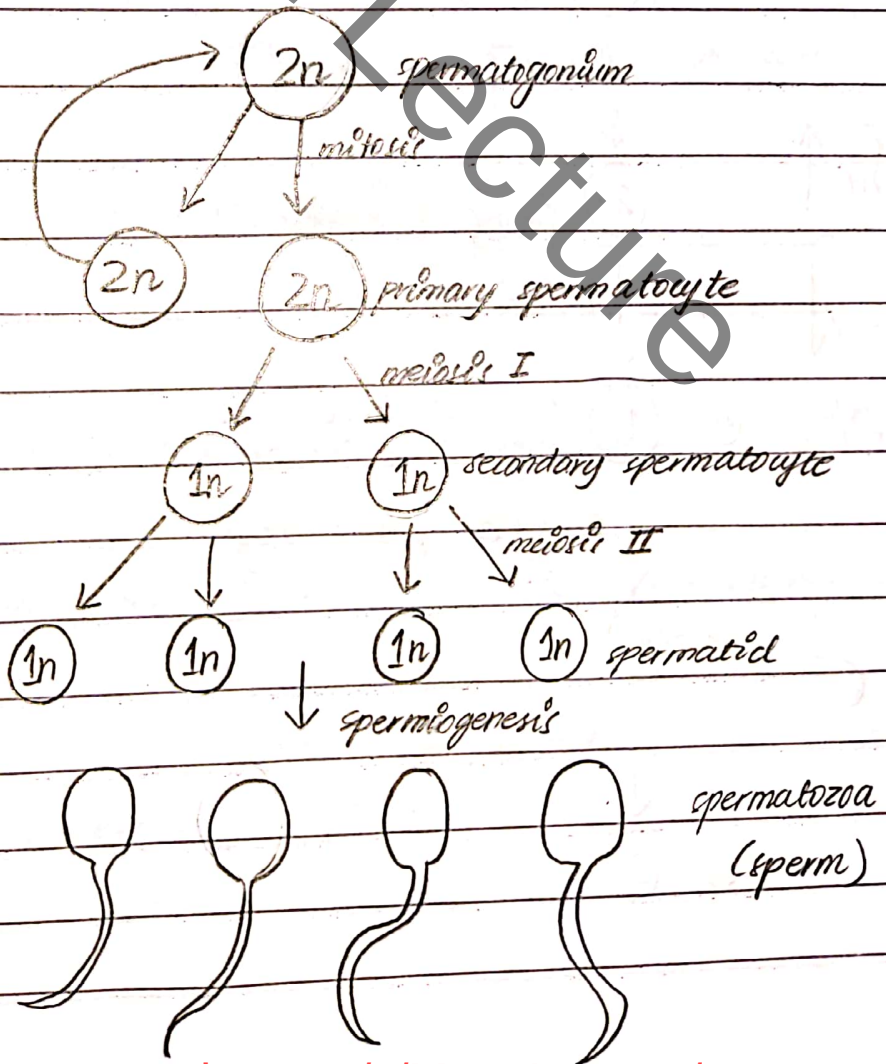
- Spermatogenesis
- Oogenesis

Spermatogenesis:

→ in seminiferous tubules by FSH (pituitary gland)

→ spermatocytes are present from birth till puberty — on set of reproductive age when meiosis starts (average 15 years)

- spermatocytes —mitosis→ primary spermatocytes
- primary spermatocytes —meiosis I→ secondary spermatocytes
- secondary spermatocytes —meiosis II→ spermatids
- spermatids —differentiation→ sperms



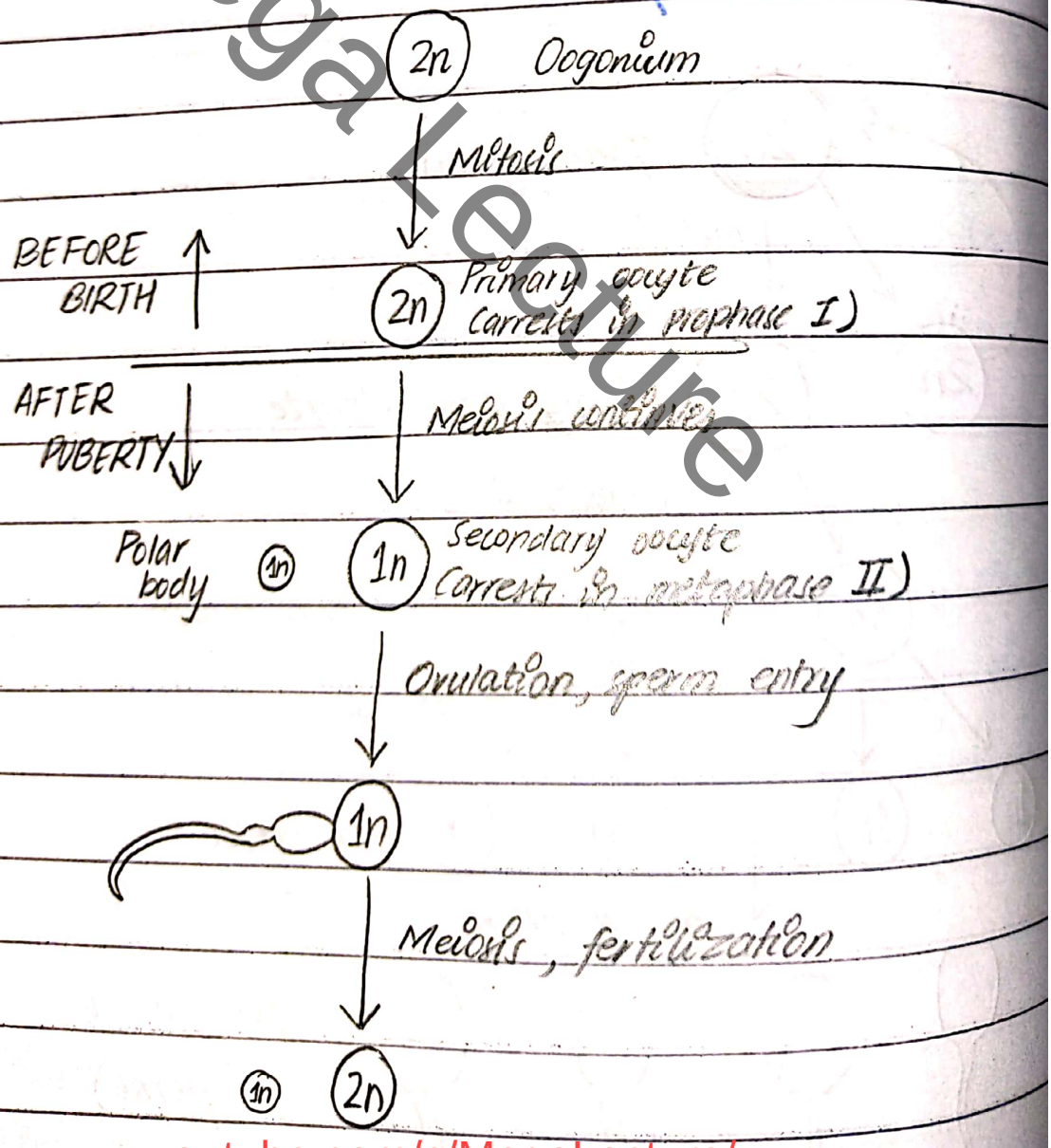
EXA

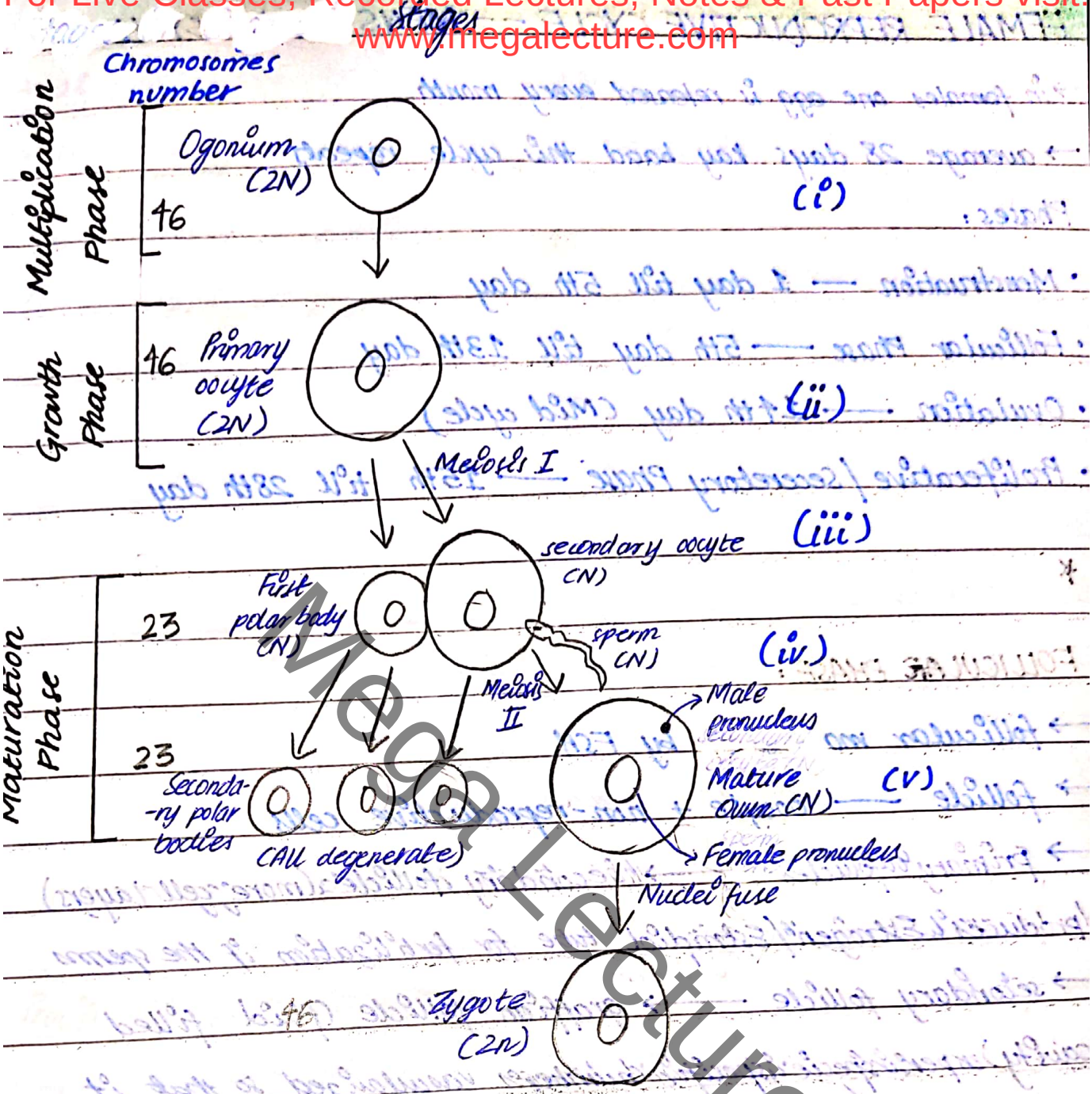
Hormones — Pituitary gland

(1). • FSH (Follicle stimulating Hormone)
– Gmaturation of sperms
– • LH (Leutinizing hormone)
– Gsecretion of testosterone
• Testosterone – by Leydig cells
Gsecondary sex characteristics & behaviour

Oogenesis:

(2)





→ multiplication takes place in ovaries of female foetus (unborn female body)

→ occurs each month in ovary of female after puberty

→ ovulation

→ fertilization

→ occurs as a result of fertilization

FEMALE REPRODUCTIVE CYCLE — MENSTRUAL CYCLE

→ in females one egg is released every month

→ average 28 days kay baad this cycle repeats

Phases:

- Menstruation — 1 day till 5th day
- Follicular Phase — 5th day till 13th day
- Ovulation — 14th day (Mid cycle)
- Proliferative / Secceretory Phase — 15th till 28th day

FOLLICULAR PHASE:

→ follicular maturation by FSH

→ follicle — oocyte + non-reproductive cells

→ griffin follicle develops, which bursts and releases egg ready to be available in the fallopian tube (oviduct) for fertilization if the sperms are set in

→ the uterus lining thickens and becomes vasculaized so that it can conceive the embryo

Menstruation :

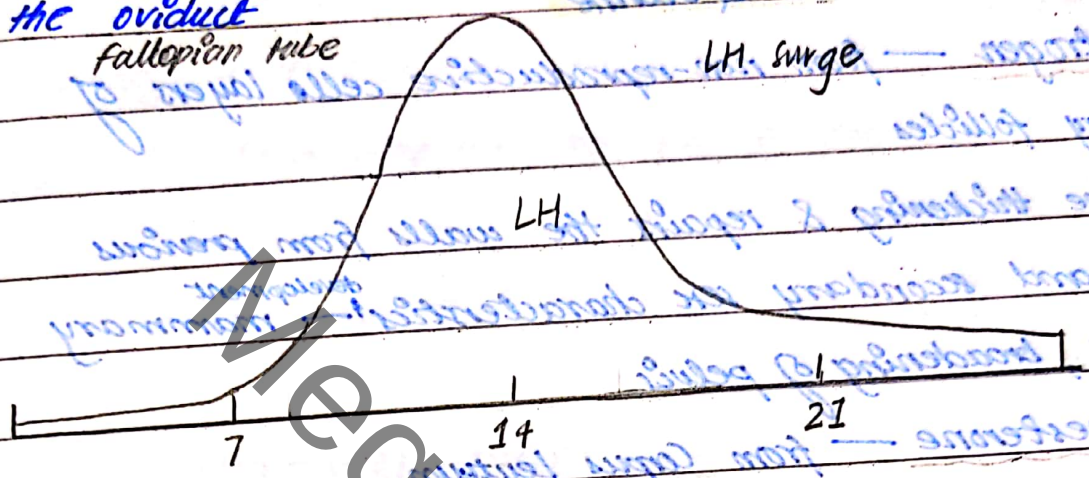
→ the corpus luteum disintegrates and progesterone secretion reduces

→ the uterus lining disintegrates

→ during this phase, dead egg cells, disintegrated lining, blood & mucus are lost through the vagina as menstrual flow

Ovulation:

→ at mid cycle 14th day on average
→ Leutinizing Hormone (LH) — surges from pituitary gland
→ influence rupturing of GF and release of ovum from ovary (graffian follicle)
into the oviduct
fallopian tube



Proliferative / Secretory Phase:

→ from 15th day till 28th day (2 weeks)
→ formation of Corpus Leutem by non-reproductive cell layers of graffin follicle after ovulation
→ Corpus Leutem produces progesterone for next two weeks to support uterine thickening so that uterus can hold / provide nutrients to the growing embryo
→ If fertilization does not occur the corpus luteum disintegrates and the uterus lining becomes thin

Hormones — Pituitary Gland

→ FSH — maturation of follicles to graffian follicle eggs in the ovaries

→ LH — Ovulation/release of egg on day 14

Hormones — Ovarian & Uterine

→ Estrogen (oestrogen) — from non-reproductive cells layers of secondary follicles

↳ uterine thickening & repairs the walls from previous cycle and secondary sex characteristics development — mammary glands, broadening of pelvis

→ Progesterone — from Corpus Leutum

↳ maintains uterine thickening for 14 days (2 weeks) & inhibits FSH for next cycle

DAYS OF THE AVERAGE MENSTRUAL CYCLE:

1 – 5 : Your period (lining of uterus sheds)

6 – 12 : New egg matures (lining of uterus begins to thicken)

13 – 15 : Ovulation (egg released)

16 – 28 : Egg travels to uterus if not fertilized and dissolves

Lining of the uterus continues to thicken

→ Ovum in oviduct has life span of 72 hours

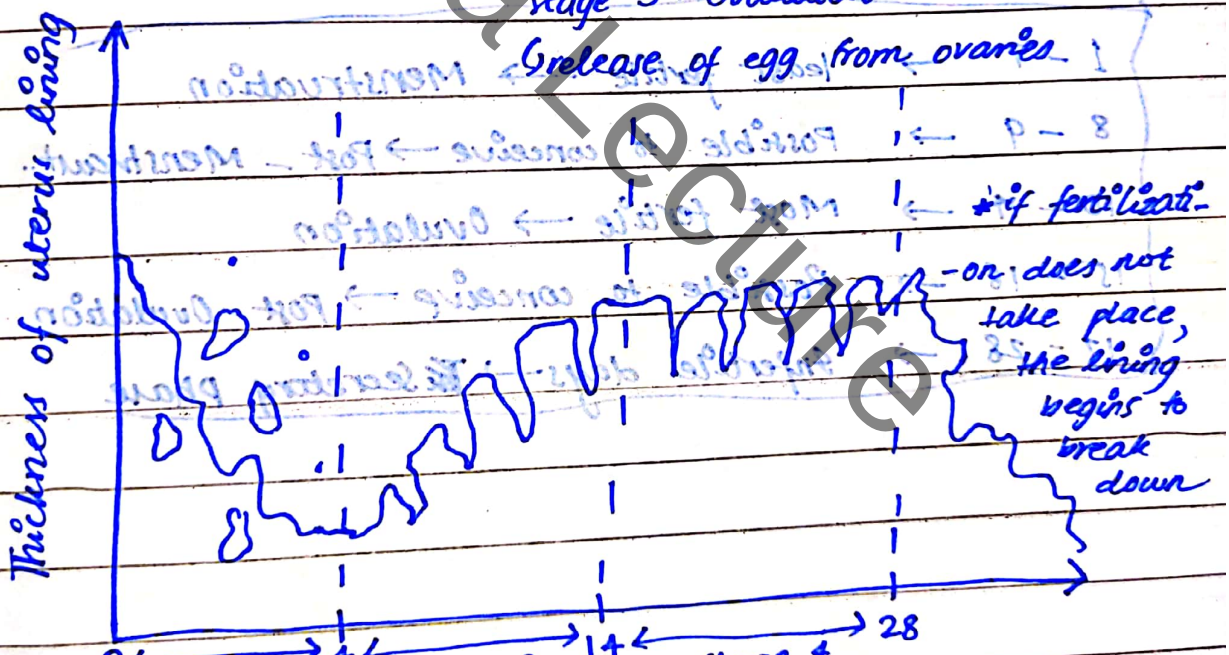
→ Sperm after ejaculation has life span of 72 hours

Fertile Days:

* Ovulation 14th day — 15, 16, 17 day
* Ovulation 13th day — 14, 15, 16 day
* Ovulation 15th day — 16, 17, 18 day

fertile time of cycle — 13th day to 18th day

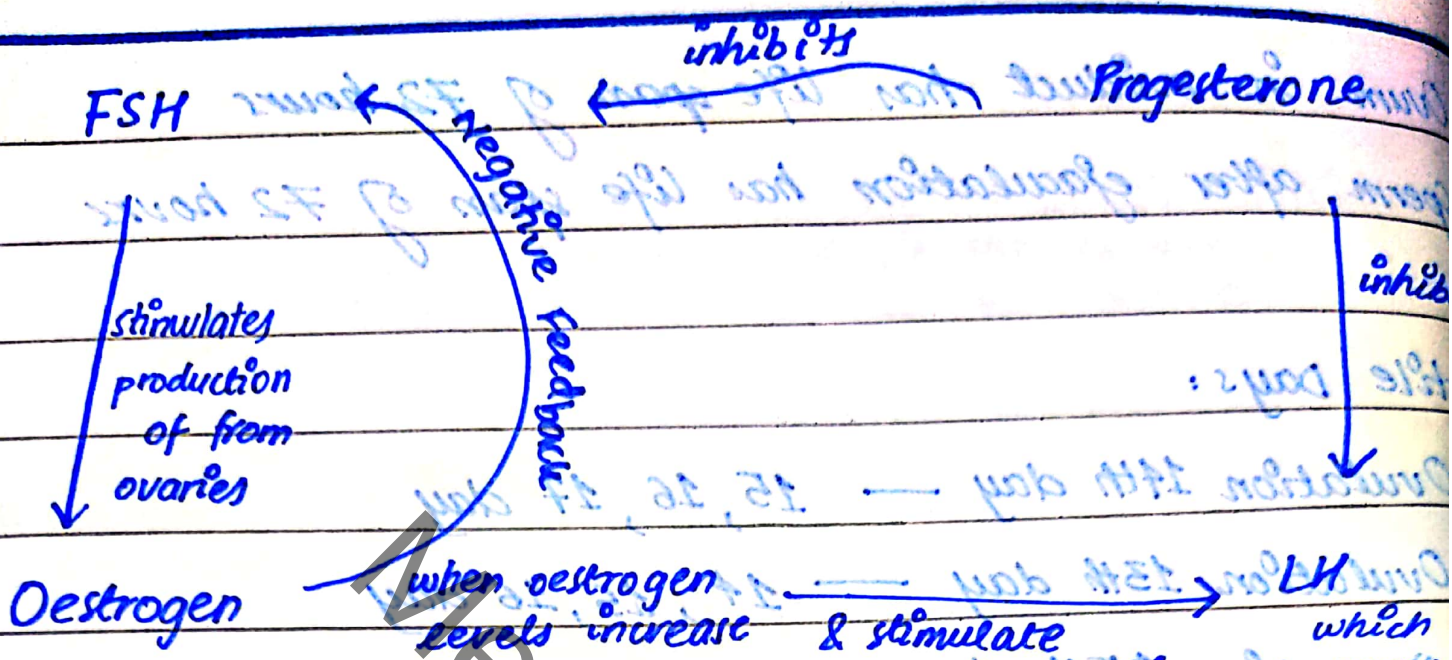
MENSTRUAL CYCLE



Stage 1
'Menstruation'
'Bleeding'
↳ breakdown of uterus lining

Stage 2
↳ lining starts to build up
↳ ↑ oestrogen b/c it helps develop uterus lining

Stage 4
↳ maintaining the lining of the uterus
↳ ↑ progesterone b/c it maintains uterus lining
↳ when its levels drop, the lining breaks down restarting the cycle



day 1 - 7 : infertile days

day 8 - 19 : fertile days

day 20 - 28 : infertile days

1 - 7 → least fertile → Menstruation

8 - 9 → Possible to conceive → Post - Menstrual

10 - 14 → Most fertile → Ovulation

15 - 16 → Possible to conceive → Post - Ovulation

17 - 28 → Infertile days → Secretory phase

FERTILIZATION

→ egg membrane has multiple receptors for attachment of sperms

→ large no. of sperms around egg at one time

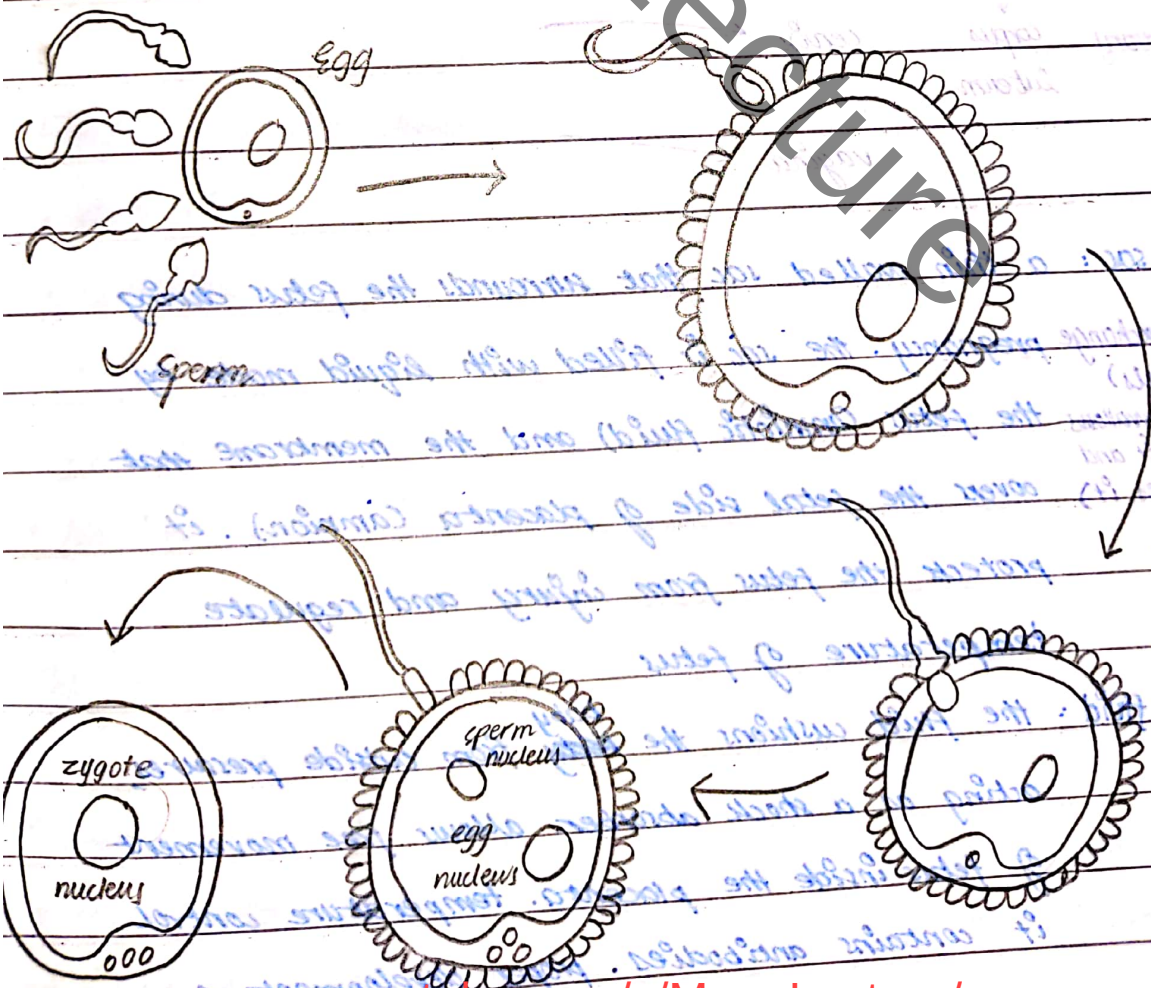
→ when one gets attached, the other receptors shed-off

→ Meiosis II in ovum restarts forming second polar bodies

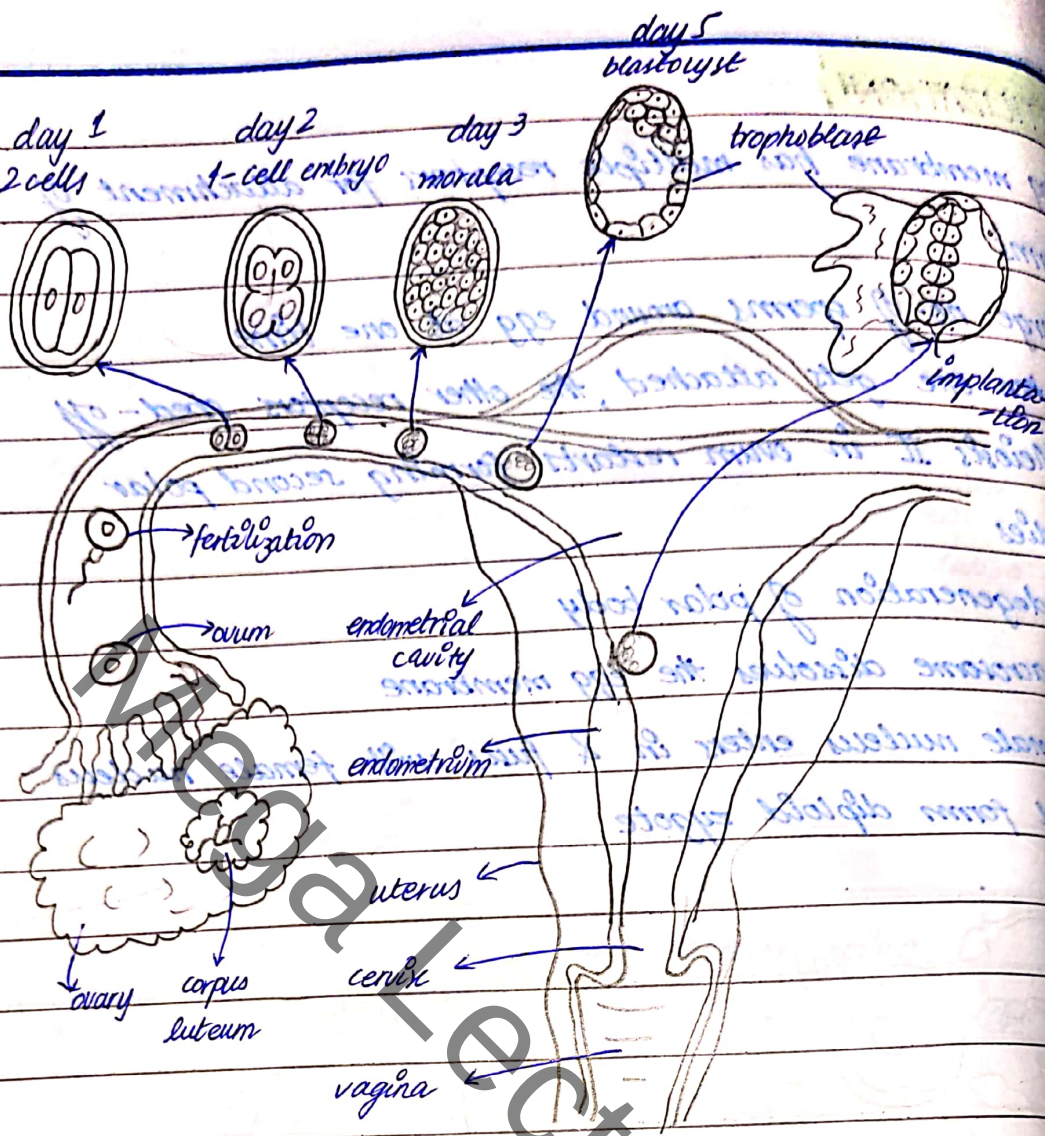
→ degeneration of polar body

→ acrosome dissolves the egg membrane

→ male nucleus enters in & fuses with female nucleus and form diploid zygote



2-zygote performs mitosis



amniotic sac: a thin walled sac that surrounds the fetus during pregnancy. the sac is filled with liquid made by the fetus (amniotic fluid) and the membrane that covers the fetal side of placenta (amnion). it protects the fetus from injury and regulate temperature of fetus

(site of exchange of materials)

(the baby swallows and inhales it and then releases it)

amniotic fluid: the fluid cushions the baby from outside pressures acting as a shock absorber. allows free movement of fetus inside the placenta. temperature control. it contains antibodies. proper development of the baby. cushions fetus from injury & prevents pressure on umbilical cord

IMPLANTATION

→ attachment of embryo with uterine walls by forming placenta

(no structural details required here)

Placenta:

→ it is a fetomaternal organ

→ it has two components:

* Fetal part — develops from the chorion sac
* Maternal part — derived from endometrium

→ the placenta and umbilical cord are a transport system for substances b/w the mother & the fetus

↳ vessels in umbilical cord

Function of the Placenta:

- Protection
- Nutrition
- Respiration
- Excretion
- Hormone production → hCG, Oestrogen, Progesteron

Role of the placenta:

→ supporting fetus till birth

→ shock absorber

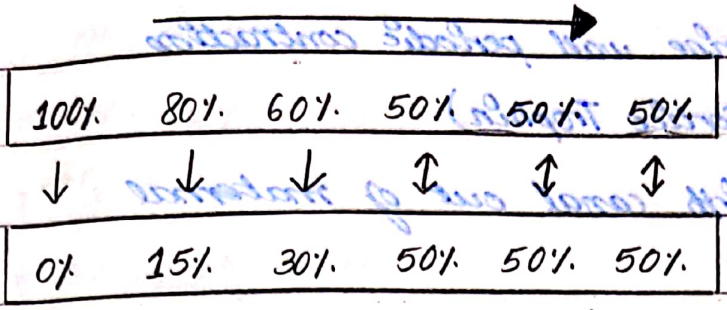
→ tissue for exchange of materials b/w fetus & mother by umbilical cord (arteries & veins from fetus till chronic villi in placenta)

- arteries — deoxygenated from fetus to placenta
- veins — oxygenated from placenta to fetus
→ no mixing of blood from mother and fetus b/c of blood group incompatibilities
-

→ counter-current flow mechanism of exchange
→ as endocrine tissue — produces HCG (progesterone like hormone / pregnancy hormone)
→ acts as barrier for all blood cells, plasma proteins, ~~hormones~~
→ but no barrier for antibodies, microorganisms and drugs (medicinal & abusive), hormones
→ carbon dioxide and other waste products pass through the umbilical chord and into the placenta
- put back into mother's blood where her system gets rid of them

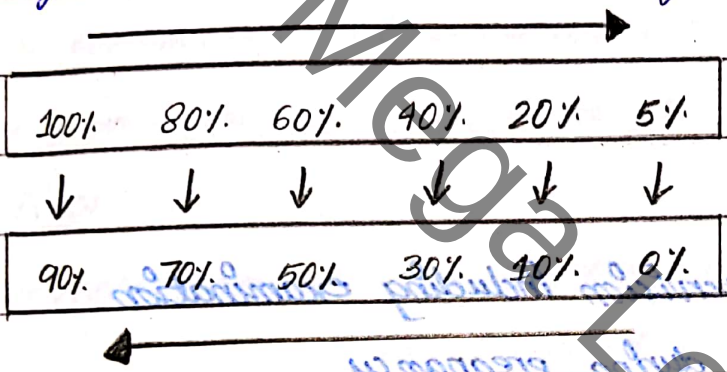
- umbilical chord: narrow tube-like structure that connects the developing baby to the placenta

How Countercurrent Flow works : (NOT REQUIRED)



Concurrent Flow

* systems reach equilibrium and no further exchange taken place



Countercurrent Flow

* systems do not reach equilibrium and exchange takes place along entire length. More of the exchanged substance is transferred than in previous example

BIRTH – LABOUR:

→ maternal oxytocin – uterine wall periodic contraction
→ fetal ACTH (Adrenal Cortico Trophin)
→ pushing baby through birth canal out of maternal body
→ detachment of placenta – decline of HCG and menstruation starts by loss of inhibition

Antenatal Care:

→ periodic and regular supervision including examination and advice of a woman during pregnancy
→ the supervision should be of periodic nature & regular in accordance with need of the individual

* Importance:

→ to ensure that the pregnant woman and fetus are in the best possible health
→ to detect early and properly treat complications
→ offering education for parenthood
→ to prepare the women for labor, lactation and care of her infant

Foods to avoid during pregnancy:

→ smoking (active or passive) →junk food with a lot sugar
→ alcohol, caffeine

Diet :

why ? : * to provide adequate well-balanced diet to meet the extra needs of pregnancy and for the promotion of optimum health of the mother & her baby

* nutritious
* balanced
* light
* easily digestible
* rich in protein, mineral & vitamin
* with woman's choice
* carbohydrates (constant energy & calories for wait gain & growth)
* protein (structural features development)

Neonatal Care :

neonatal period : first 4 weeks of life after birth
- the 1st week : 'immediate or early neonatal period'
- the next 3 weeks : 'late neonatal period'

perinatal period : the period from 20th week of gestational life through 28th day after birth

* foods to avoid during pregnancy :
- smoking (active or passive)
- alcohol, caffeine, heavily processed foods
- junk food with a lot of sugar

→ stumping of umbilical cord
→ cleaning of respiratory track
→ mother feed
→

Colostrum :

→ colostrum (or first milk) is the first form of milk produced by the mammary glands of mammals (including human) immediately following delivery of the newborn
→ most species will generate colostrum just prior to giving birth
→ it contains antibodies to protect the newborn from any disease
→ they receive no passive transfer of immunity via the placenta before birth, so any antibodies that they need have to digested
→ the newborn animal must receive colostrum within 6 hours of being born for maximal absorption of colostral antibodies to occur
→ protein & fat concentration in colostrum is substantially higher than in milk
→ newborns have very immature and small digestive systems, and colostrum delivers its nutrients in a very concentrated low-volume form

Neonatal Feeding:

- Mother feed — breast feeding
- Formula feed — bottle feeding

BREAST FEEDING:

Advantages:

→ has antibodies, no bacteria
→ foodstuffs in correct proportions
→ no risk of allergic reactions
→ correct temperature
→ no additives / preservatives
→ builds mother-child bond
→ no cost; no preparation
→ breast-feeding triggers reduction of uterus size

Disadvantages:

→ may be painful
→ mother needs to be present
→ damage beauty

Dietary needs of a breast-feeding mother:

* proteins, calcium, phosphate + Vitn
* foods rich in vitamin C & B complex
* ↑ fluids
* decrease intake of saturated fat, alcohol, caffeine
* during lactation mother should consult doctor for supplements & dietary plan.

BOTTLE FEEDING:

Advantages:

→ less painful

→ other people can feed baby

→ may contain supplement vitamins, minerals

→ allows bonds to be created with more than just the mother

→ easier to keep track of how much your baby is eating

→ easier for mother & baby in public

→ more freedom for the mother

- no diet restrictions
- no schedule restrictions

→ can be done with breast milk or formula

Disadvantages:

→ more likely to develop illness (diarrhoea, urine infection. etc.)

→ risk of wrong mixture

→ expensive

→ bottles, nipples, brushes to clean the bottle, formula

→ takes longer to prepare

→ formula milk does not contain antibodies present in breast milk

→ formula milk is harder for baby to digest

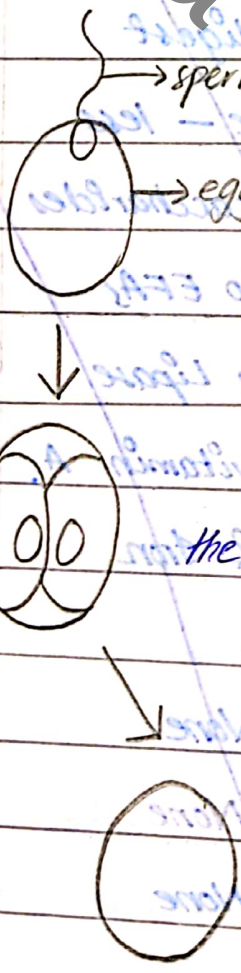
TWINS :

* Identical Twin — identical to each other
* Faternal Twins — non-identical, same or different gender

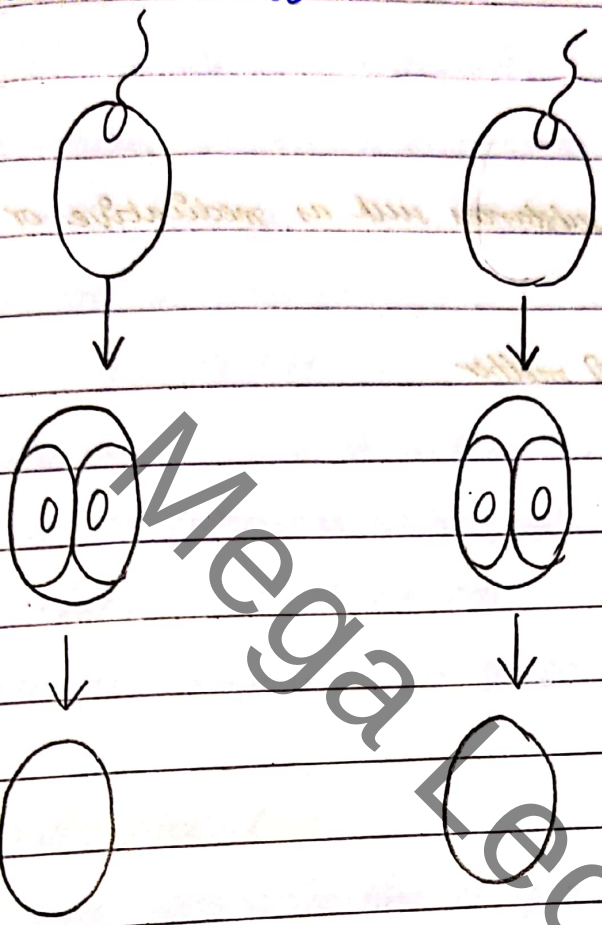
→ 2eggs, 2 sperm = 2 zygote with different genetic material forms fraternal (dizygotic) twins

→ 1 egg, 1 sperm = 1 zygote, this divides into 2 and each forms a baby : identical (monozygotic) twins

a). Identical (Monozygotic) Twins



b) Fraternal (Dizygotic) Twins



Conditions under which breast-feeding is not recommended:

→ specific infection or disease in mother & could be transmitted into the baby

→ specific illness in baby

→ breast milk contains toxic substances such as medicative or addictive drugs

→ long periods of absence of mother

→ choice of mother

REPRODUCTION PART II

Contraception / Birth Control:

→ avoiding conception / fertilization

→ birth control methods include options that prevent sperm from reaching an egg

→ there are 5 methods:

1. Natural Method
2. Long-acting reversible contraception
3. Hormonal / Chemical contraception
4. Barriar / Mechanical methods
5. Permanent / surgical contraception

1. Natural Method

→ tracking fertile time of cycle by temperature tracking

→ breast feeding

Basal Body Temperature Method:

- BBT = body temperature in resting state on waking
- slight drop immediately before ovulation
- after ovulation, release in progesterone causes slight increase in temperature.

2. Long acting reversible contraception

→ the intra uine device (IUD) that lasts for 3, 5 or 10 years

→ the implant lasts for 5 years

→ its a T-shaped device made from material containing progest

→ plastic & copper is fitted inside a woman's uterus by a trained healthcare provider

→ IUDs containing copper are 99% effective

→ irregular bleeding & spotting occurs in the first 6 months

3. Hormonal Contraception

→ combined oral contraceptive pill

→ chemicals — spermicides

→ progesterone — only contraceptive pill

→ combined pill contains estrogen and progestin

→ highly effective when used correctly; permits sexual spontane and doesn't interrupt sex; some pills may even reduce heavy & painful periods and/or may have +ve effect on acne

→ won't be effective if forgoton & can only be used by women

4. Barrier Methods

→ condoms

→ internal condom / diaphragm

→ male condoms act as a barrier (physical), preventing sexual fluids from passing b/w people during sex

→ best protection against STIs; can be used on demand & hormone free

→ can tear or come off during sex if not used properly &

5. Permanent Contraception

→ sometimes also called sterilization prevents all future pregnancies
→ very difficult or impossible to reverse
→ vasectomy
→ tubal ligation
→ sterilization is the process of completely taking away the body's ability to reproduce through open or minimal invasion surgery
→ surgical sterilization is a form of permanent birth control available for both women (tubal ligation) and women (vasectomy)

... Barrier Methods continued

some people are allergic to latex condoms
→ a diaphragm is a small, soft silicon dome placed inside the vagina to stop sperm from entering the uterus
→ can be used more than once & lasts upto 2 years
→ using it can take practice & requires keeping track of the hours inserted

6. Contraceptive

→ a small, flexible rod is placed under the skin in a woman's upper arm releasing a form of the hormone progesterone
→ the hormone stops the ovary releasing the egg & thickens the cervical mucus making it difficult for the sperm to

enter the womb

→ the implant requires a small procedure using local anesthetic to fit & remove the rod and needs to be replaced after 3 years

→ highly effective & does not interupt sex

→ long-lasting & reversible

→ requires a trained healthcare provider for insertion & removal; sometimes there can be irregular bleeding

TRANSMITTED DISEASES — STDs

→ STD is used to refer to a condition passed from one person to another through sexual contact

→ types of STDs: ① Syphilis
② AIDS — HIV
③ Gonorrhea
④ Herpes

Symptoms

Symptoms in men	Symptoms in women
• pain or discomfort during sex or urination	• pain or discomfort during sex or urination
• sores, bumps or rashes on or around the penis, testicles, anus, buttocks, thighs or mouth	• sores, bumps or rashes on or around the anus, vagina, buttocks, thighs or mouth
• unusual discharge or bleeding from the penis	• unusual discharge or bleeding from the vagina
• painful or swollen testicles	• itchiness in or around the vagina

Treatment

Bacterial STDs	Viral STDs
• antibiotics can easily treat bacterial infections	• antibiotics can't treat viral STDs
• its important to take all antibiotics as prescribed	• treatment can help stop the progression of HIV
	• antiviral drugs can lower your risk of transmitting HIV to someone else

① Syphilis

→ most common route of transmission is through contact with an infected person's sore during sexual activity

→ the bacteria enter your body through minor cuts or abrasions in your skin or mucous membranes

→ less commonly, it may spread through direct unprotected close contact with an active lesion or through infected mothers to their babies during pregnancy or childbirth

Stages of Syphilis:

i. Primary Syphilis

→ a person generally has a sore or sores at the original site of infection

→ these sores usually occur on or around the genitals, anus, rectum or the mouth

→ they are usually (but not always) firm, round and painless

ii. Secondary syphilis

→ include skin rash, swollen lymph nodes and fever

→ the symptomes of first & second stage may be mild and might not be noticed

iii. Latent stage

→ no signs or symptoms

iv. Tertiary syphilis

→ is associated with severe medical problems

→ a doctor can usually diagnose with the help of multiple tests

→ it can affect the brain, heart and or the organs of the body

→ is very serious and would occur 10–30 years after your infection began

→ the disease damages your internal organs & can lead to death

Prevention & Cure:

→ use a latex condom

→ avoid recreational drugs

→ can be cured with right antibiotics from your health care provider; however, the the treatment might not undo the damage already done

(2). AIDS or HIV

→ is a viral infection that progressively damages/destroys certain types of WBCs called CD4+ lymphocytes

→ it raises the risk of contracting other viruses or bacteria and certain cancers

→ it can cause Acquired Immunodeficiency Syndrome (AIDS) which is the most severe form of HIV infection

H — Human : b/c this virus can only effect humans

I — Immuno-deficiency : b/c the effect of the virus is to create a deficiency, or a failure to work properly, within the body's immune system

V — Virus : b/c it is a virus and is incapable of reproducing by itself. It reproduces by taking over the machinery of the human cell

Symptoms of HIV

Early symptoms	Late symptoms
• fever	• recurrent fatigue
• chills	• fever
• aches & pains & rashes	• headaches
• swollen lymph nodes	• stomach issues
• sore throat	
• headache	
• nausea	

STD prevention :

→ avoid sexual contact

→ protective sex — condoms

→ regular STD screening

→ avoiding hypodermic surgeries

→ blood screening before transfusions

→ use of sterilized surgical instruments during surgical procedures

IN-VITRO FERTILIZATION:

→ it means 'in glass' and is used b/c early biological experiments involving cultivation of tissues outside the living organism were carried out in glass containers such as beakers, test tubes or petri dishes

→ an in-vitro procedure is one where the tissue remains inside the living organism in which it is normally found

→ it is a type of assisted reproductive technology used for infertility treatment

→ in IVF, an egg is combined with sperm outside the body, in vitro

→ the process involves monitoring and stimulating a woman's ovulatory process, removing an ovum or ova (egg or eggs) from the woman's ovaries and letting the sperm fertilize them in a liquid in a laboratory

→ after the fertilized egg (zygote) undergoes embryo culture for 2-6 days, it is implanted in the same or another woman's uterus with the intention of establishing a successful pregnancy

- Ovarian hyperstimulation
- Final maturation induction
- egg retrieval
- egg & sperm preparation

> co-incubation
> embryo selection
> embryo transfer

* Complications:

→ multiple births
→ sex ratio distortions — more female births than male
→ spread of infectious diseases
→ birth defects
→ single & unmarried parents
→ pregnancy after menopause
→ anonymous donors

Alcohol for Pregnant Women / Nicotine / Tobacco:

- It is strongly advised to avoid alcohol totally as it causes fetal abnormalities even if it is taken in a small amount
- Nicotine & tobacco narrow blood vessels in placenta

GENETIC ENGINEERING

→ manipulate genetic molecule according to own desires and let them multiply in lab conditions

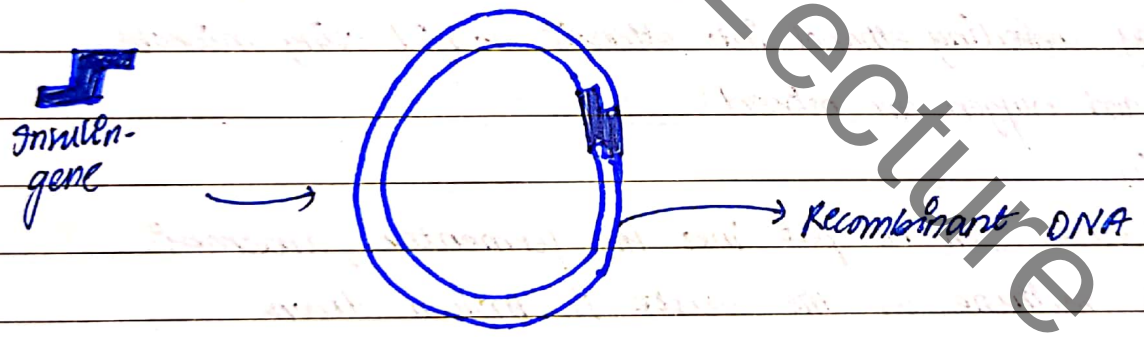
- transgenic organisms

∫ genetically modified end result

→ a gene is cut from the DNA of one cell and can be pasted into the DNA of another cell ⟷ gene transfer

INSULIN

- cut from chromosome 11 in humans using restriction enzymes (or from pancreas)
  ∫ used to cut open genes
- ~~gene for insulin~~ plasmid cut open using the same restriction enzymes
- the r.e leaves sticky ends where one end is slightly longer than the other



- b/c the same r.e was used to cut DNA & plasmid, the sticky ends are complementary
- joining takes place — DNA ligase (an enzyme) is used to complete the joining
- reinsert the modified plasmid into the bacteria
- bacterial cell is placed in a fermenter to allow rapid asexual reproduction
- ∫ A.R ki waja say all offsprings are clones - identical recombinant DNA