23.7.23 30.7.23

Lecture-1, 2, 3

Biology

Make up → 4 oct

3:10 pm

Introduction

Why Biology in Engineering

Making the connection between Ecosystems & evolution.

- biodiversity
- socio-economics

Play with biology

- Bio-Robots
- Retinal Prosthetic
- Bio-sensor
- Commercial - Bio-sensor
- Bio-chips

P.T.O

- Biopesticide
- concrete self-heal
- Bio-filters
- Nano-particles

Scope for Engineers

- Tissue Engineering
- Brain & Neurcoscience
- Muscular Biopolymers
- Artificial Neural Network
-

3. 10.23

Lecture-4

~~Introduction~~

CELL

The Fundamental Unit of life

* An organism that is made up of only one cell is called as unicellular organism.
  - Euglena
  - Paramecium
  - Yeast

→ more than one cell.

* Multicellular organism
  - Plants
  - Animals
  - Fungus

P.T.O

Size of cells:

→ Smallest cell
- → Mycoplasma
- → 0.1 μm

→ Largest cell
- → Ostrich egg
- → 18 cm

Size of cells in Humans:

* Smallest cell
  - → Sperm cell
  - → 5 μm
* Largest cell
  - → Ovum cell
  - → 120 μm

* Longest cell
  - Nerve cell
  - 1 m

Animal cell (12)

- Nucleus
- Golgi body
- Vesicles
- Plasma membrane
- Mitochondria
- Cytoskeleton
- Centriole
- Lysosome
- Cytoplasm
- Rough endoplasmic reticulum
- Smooth "
- Nucleolus

Plant cell

- Chloroplast
- Cell wall
- Vacuole
- "
- "

Bacterial Cell

- Capsule
- cell-wall
- Plasma- membrane
- Cytoplasm
- Flagellum
- Food granule
- Plasmid (DNA)
- Ribosomes
- Nucleoid
- Pili

P.T.O

Structure of cell

- Plasma membrane
- Nucleus
- Cytoplasm
- Cytosol
- Cell Organelles
- Endoplasmic reticulum
- Golgi body
- Lysosomes
- Vacuole
- Mitochondria
- Plastids
- Centrosome
- Cytoskeleton

Plasma Membrane:

* Made up of two level of lipid molecules in which protien molecules are floating.
* Thickness varies from 75 - 110 A°.
* Maintain shape & size of the cell.
* Protects internal components of the cell.
* Maintain homeostasis

Cell wall:

* Made up cellulose, hemicellulose & pectin.
* Thickness varies from 50 - 1000 A°.

P.T.O

* provides definite shape, strength & rigidity.
* Helps in controlling cell expansion.
* Protect cell from external pathogens.

Nucleus:

* Diameter varies from 10-25 µm.
* Present in all cells, expects red blood cells & sieve tube cells.
* Control all the cell activities like metabolism, protein synthesis, growth & cell division.
* Nucleolus synthesizes (RNA) to constitute ribosomes.
* Store hereditary information in genes.

Cytoplasm:

* Jelly-like material formed by 80% of water.
* Present between plazma membrane & nucleous.
* Contains a clear liquid portion called cytosol.
* Contains proteins, carbohydrates, nucleic acids, lipids.

Endoplasmic Reticulum:

* Some parts are connected with nuclear membrane, while others are connected to the cell membrane.
* Two types — smooth (lacks ribosomes) & rough (studded with ribosomes).

P.T.O

* Gives internal support to cytoplasm.
* RER synthesize secretory proteins & membrane proteins.
* SER synthesize lipids for cell membrane.
* Regenerating cell membranes (Biogenesis) (cells post office)

Golgi body:

* two ends → cis face situated near the endoplasmic reticulum and trans face situated near the cell membrane.
* Produces vacuoles & secretory vesicles, (proteins, enzymes, carbohydrate
* forms plasma membrane & lysosomes

P.T.O

Lysosomes

* Found throughout the cytoplasm.
* Filled with hydrolytic enzymes.
* Help in digesting of large molecules.
* In dead cell perform autolysis.

Vacuoles

* In animal cells, vacuoles are temporary, small in size and few in numbers.
* In plant cells, vacuoles are larger & more in number.
* Store various substances including waste products, water, nutrients.

P.T.O

* maintain osmotic pressure in cell.
* store food particles in amoeba cells.

Mitochondria (power house of the cells)

* Bounded by two membranes - inner & outer.
* Outer membrane is smooth and encloses the contents of Mitochondria.
* Inner cavity is filled with matrix which contains many enzymes.
* Contain their own DNA which are responsible for many enzymatic actions.
* Synthesize energy rich compound ATP. that provide energy for vital activities of the cells.

P.T.O.

* ATP molecules provide energy for the vital activities of living cells.

Plastids

- Chromoplants
- ~~Chloroplants~~ Chloroplants
- Leucoplasts
  - Elaioplasts
  - Amyloplasts
  - ~~Proteinoplasts~~ (Proteinoplasts)

Chromoplasts

* Produce & store pigments
* responsible for different colors found in leaves, fruits, flowers & vegetables.

Pigments

- Carrot → carotene
- Mango → xanthophyll
- Tomato → lycopene.

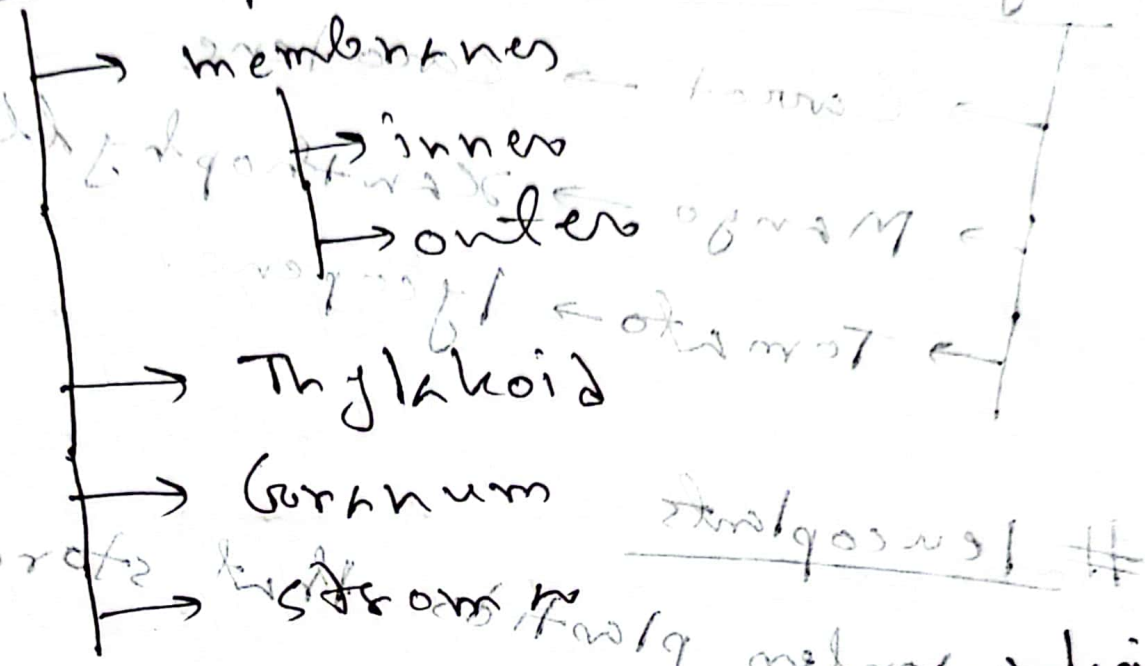
leucoplants

* colorless plastids that store food.

Food

- Potato tubers → starch
- Maize grains → protein
- Castor seeds → oil

Chloroplasts



* Granna are stacks of thylakoid.
* Thylakoid contain chlorophyll molecules which are responsible for photosynthesis.
* Stroma is a colorless dense fluid.
* Convert light energy into chemical energy in the form of food.

* provide green color to leaves, stems & vegetables.

Centrosome
- matrix
- microtubules
- centrioles
- centrosphere

* help in the movement of chromosomes during cell division.

* help in the formation of cilia & flagella.

Cytoskeleton
- cell membrane
- microtubules
- microfilaments.

P.T.O

* Determine the shapes of cell.
* Give structural strength to the cell.
* responsible for cellular movements.

Cell structure & function

Prokaryotic Cell

* have no nucleus.
* size ranges 0.1 to 0.5 μm.
* reproduce by ordinary fission, a form of asexual reproduction.

P.T.O

* Prokaryotic

- Nucleoid
- Ribosome
- Cell wall
- Cell membrane
- Capsule
- Fimbriae
- Pili
- Flagella

Differences:

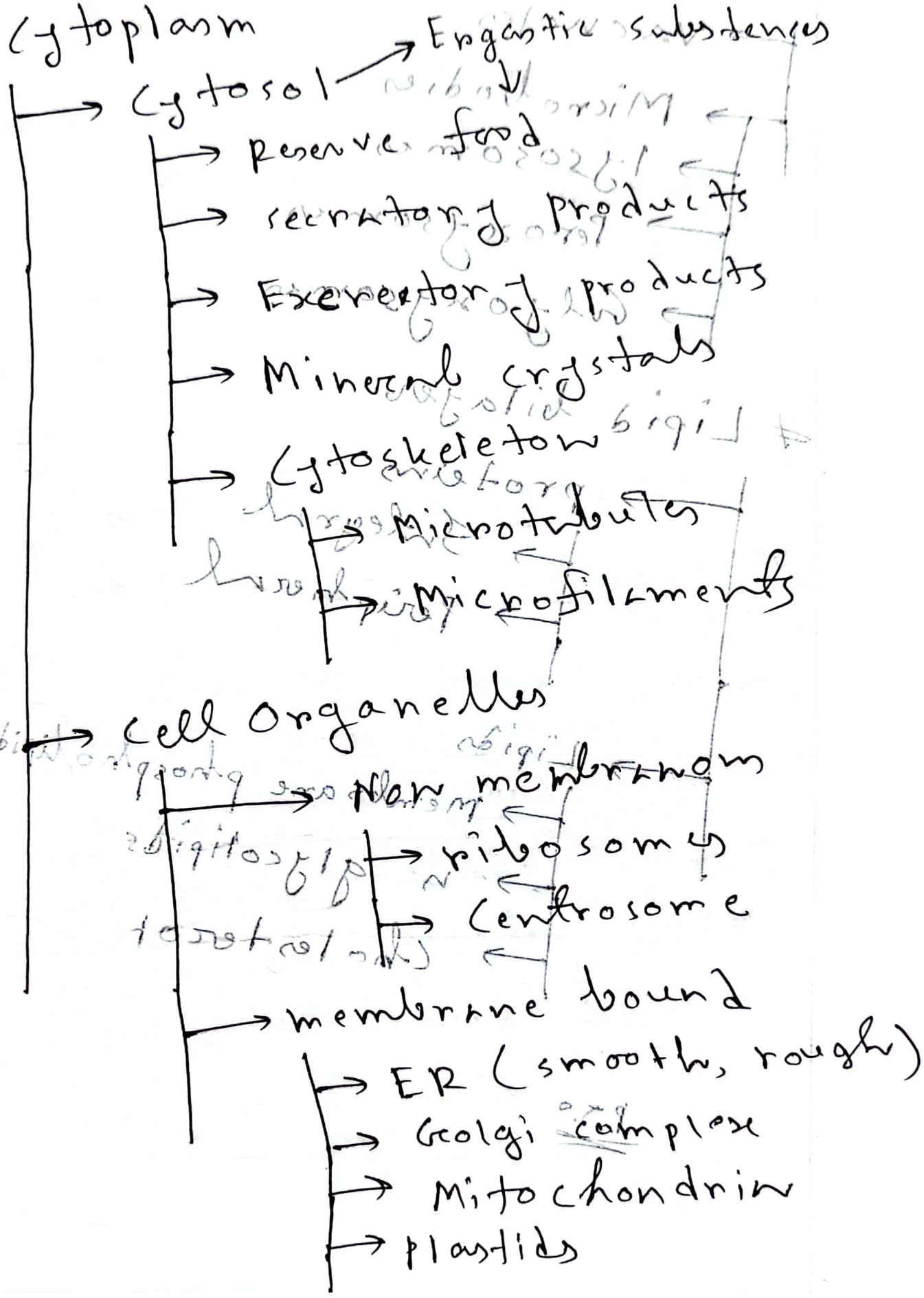
Prokaryotic	Eukaryotic
* Unit cell	* Multi cells
* Lysosomes absent Peroxisomes absent	* present
* Microtubules	*
* ER absent	* present.

Eukaryotic Cells

* size → (10-100) μm
* The plasma membrane is responsible for monitoring the transport of nutrients & electrolytes in & out of the cell. It is also responsible for cell to cell communication.

Cell

- Cell wall
- Protoplast
  - Cell membrane
  - Protoplasm
    - Cytoplasm
    - Nucleus
      - membrane
      - Nucleoplasm
      - Chromatin
      - Nucleolus


Cytoplasm
Cytosol
Ergastic substances
Reserve food
secretory products
Excretory products
Mineral crystals
Cytoskeleton
Microtubules
Microfilaments
Cell Organelles
Non membranous
ribosomes
Centrosome
membrane bound
ER (smooth, rough)
Golgi complex
Mitochondrion
plastids

- Vacuoles
- Microbodies
  - lysosomes
  - Peroxysomes
  - Glyoxysomes

Lipid bilayer

- proteins
  - integral
  - peripheral
- Lipids
  - membrane phospholipids
  - glycolipids
  - Cholestercol

* Integral proteins

→ They are involved in the cell signaling pathways, defense mechanisms, facilitated diffusion and active transport.

* Peripheral Proteins

→ linked at the cytoplasmic surface

→ external cell

* membrane phospolipids

→ have a polar head group and two H-C of tails.

→ It is connected by glycerol to two fatty acid tails.

I.J.O

* Glycolipids

→ protective, insulators & sites of receptor binding.

* Cholesterol

→ plasma membranes have 1:1 cholesterol per phospholipid molecule.

→ others have not.

→ This makes the lipid bilayer less deformable.

→ Also keeps the cell membrane from becoming too stiff.

P.T.O

* Cell membrane → (phospholipids, proteins, carbohydrates, cholesterol)

→ It is a semi permeable membrane present in all cell.

→ It allows the outward & inward movement of molecules accross it.

→ diffusion, osmosis, phagocytosis (cell eating), pinocytosis (cell drinking.).

Piffusion

→ Requires no energy (ATP)

→ Moves from an area of high concentration → low concentration until dynamic equilibrium is reached.

Osmosis

→ A type of diffusion.

→ Allow water molecules to pass easily through the selectively permeable membrane.

→ Solution = solute + solvent

Solute = sugars
(can't go through membrane)
(TA)

Solvent = water
(can go through)

Osmotic Pressure

→ Isotonic = equal.

→ Hypotonic = less sugar more water.

→ Hypertonic = more sugar less water.

* Cytoplasm (Already noted)
* ER (Already noted)

* Facilitated diffusion
→ Diffusion with the help of transport proteins
→ No energy required.

Protoplasm
→ It is a living substance of the cell that possesses all vital products made up of inorganic & organic molecules.
→ Huxley called "physical basis of life"

Golgi bodies
→ They (dictyosome) stacked one above the others like pancakes
→ "Packaging Centres" of the cell.
→ "cell's post office" (More info previous)

* Mitochondria (noted)
* Plastid (noted) * Vacuoles (noted)

Cell : Microbodies

* Autolysosomes:
  - → suicidal bags of cell
  - → Time bombs of the cell
  - → Recycling centres.

→ They are concerned with the intracellular digestion.
→ They distroy old & non-functional cells (Autolysis).

* Peroxysomes:
→ Produce hydrogen peroxide involved in photorespiration.

* Lysosomes (cell's recycle centre)
  - → Primary
  - → Secondary (Phagolysosome)
  - → Residual

Pg.

* Centrosome (noted)

* Glyoxysomes

→ store fat & convert it into carbohydrate.

* Non membranous cell

- → Ribosomes
- → Centrosome

* Ribosomes

→ present in the cytoplasm, chloroplast & mitochondria. Also found in RER & nuclear membrane.

→ These are the sites of Polypeptide or protein synthesis.

P.T.O.

Cell - Nucleus

*Prokaryotic

→ have incipient or primitive nucleus

→ nucleus doesn't contains nuclear membrane.

→ It is
- → genetic DNA
- → Genophore
- → Nucleoid
- → prochromosome

→ Bacteria, Blue green algae.

*Eucaryotic

→ having the nucleus with double layered nuclear membrane.

Fun:
- → controlling center of cell
- → Contain DNA as genetic

→ Nucleus has chromatin composed of DNA & Histones.

Chromosome (human cell → 23 pairs)

→ The nucleus of a normal or non dividing cell has a loosened indistinct network of nucleoprotein fibers called chromatin.

→ "Vehicles of heredity" → TH Morgan

* A metaphase chromosome:
  - chromatids → chromonema → DNA & Histones
  - centromere
    - kinetochores
    - microtubules

Chromonema
- chromomeres
- heterochromatin
- euchromatin

Cell function

→ Provide support & structure
→ Facilitate Growth Mitosis
→ Allow transport of substances
→ Energy production
→ Aids in reproduction
→ Mitosis meiosis
↓
asexual
reproduction

Cell theory

→ All living species on Earth are composed of cell.
→ A cell is the basic unit of life.

→ All cells arise from pre-existing cells.
→ Energy flows within the cells.
→ Genetic information is passed on from one cell to the other.
→ The chemical composition of all the cells is the same.

Overview

* Nucleolus

→ The nucleolus is the site of ribosome synthesis. Also it is involved in controlling cellular activities & cellular reproduction.

P.T.O

* Nuclear membrane

→ The nuclear membrane protects the nucleus by forming a boundary between the nucleus & other cell organelles.

* Chromosomes

→ Determining the sex of an individual.

* ER

→ involved in the transportation of substances throughout the cell.

→ metabolism of carbohydrate, synthesis of lipids, steroids & protein.

Chart

Cell type	Life Span	Cell division
Lining of esophagus	2-3 days	can divide
Lining of small intestine	1-2 days	
Lining of large intestine	6 days	
RBC	less than 120 days	Can not divide
WBC	10 hours to decades	
Smooth muscle	Long-lived	Can divide
Cardiac (heart) muscle	Long-lived	Can't divide
skeletal muscle		
Neuron (nerve cells)		mostly do not divide

21 October

CW 14.10.23

Biology

Mitosis cell division

- prophase
- Metaphase
- Anaphase
- Telophase

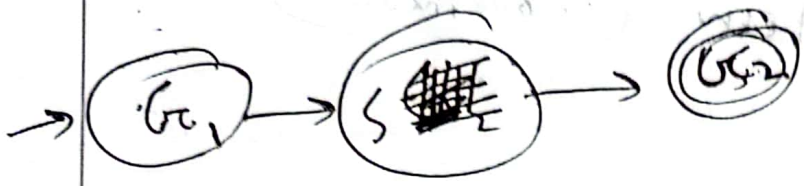
C } Cap
W

S } Synthesize

Replication → polymerase
Enzyme

Prophase

G_2 → more cytoplasm



(Interphase)

* (hromosome number = centromere number

MTOC
(Microtubules organalles center)

Metaphase

- Chromatin
  - DNA
  - Histone
    (protein formation)
- Kinetochore (Metaphase plate)

P.T.O

* Anaphase

→ motor protein (movement)

Telophase

→ cleavage

→ Actin, misin filament

→ Cytokynesis

* miosis

→ 1

→ 2 (kind of mitosis)

chan mod

slide 26, 52

Biology

* Mitosis
  - → interphase
  - → prophase
  - → metaphase
  - → anaphase
  - → telophase

* Interphase (G0 → G1 → G2)
  - → first gap phase (G1)
  - → synthesis phase
  - → 2nd gap phase (G2)

→ cells spend most of their lives in the S-phase where genetic material must be copied.

→ G1 phase:
- → cell grows & carries biochemical functions
- → protein synthesis.

→ End of interphase
- → made up of mitosis & cytokinesis
- → leads to the formation of two daughter cell.

G1 → cell growth
↓
S → DNA synthesis
↓
G2 → cell growth

Prophase

→ Nucleolus dissappears
→ Chromatin condenses into Chromosomes
→ separation of centrosomes
→ formation of the mitotic spindle.

Prometaphase

→ nuclear envelope is fully broken down.
→ Nuclear envelope ~~disassembles~~ disassembles.
→ Chromosome forms two kinetochores at the centromere.

P.T.O

→ Microtubules attach to the chromosomes.

Metaphase

→ all the chromosomes are aligned in a plane called metaphase plate.

Anaphase

→ sister chromatids separate at the centromere.

→ unattached microtubules push against each other to elongate cells.

→ chromatids separate towards opposite poles.

* Telophase

→ New nuclear envelope forms.

→ Chromosomes unfold back into chromatin.

→ Nucleoli reapear.

→ Cell continues to elongate.

* Replication cycle

G_1 → (6-12 hours) DNA = 2n

S → (6-8 hours) DNA = 2n → 4n

G_2 → (3-4 hours) DNA = 4N

M → (1 hour) DNA = 4n → 2n

G_0 = Resting phase

G_1 = Growth & metabolism

S = DNA Replication

G_2 = Growth of structural elements.

M = mitosis

* Uncontrolled cell growth

---

* Health cell
↓
cell division
↓
normal cell development
↓
Healthy tissue

* Healthy cell
↓
genetic changes
↓
Cancer cell
↓
Doubling of the cancer cell
↓
Abnormal cell growth
↓
Cancerous cell division
↓
Malignant tumour

* Neoplasia ⇒ Abnormal excessive growth of cells.

* Dysplasia ⇒ Abnormality of development and differentiation.

* Meiosis (I, II)

Meiosis I

Prophase-1

→ As the nuclear envelope begins to break down, the protein associated with homologous chromosomes bring the pair close to each other.

→ The tight pairing of the homologous chromosomes is called synapsis.

P.T.O

→ The synaptonemal complex supports the exchange of chromosomal segements between non-sister chromatids, a process called crossing over.

→ Crossing over occurs at chiasmata

→ end of prophase-(1) tetrads happens because the four sister chromatids of each pair of homologous chromosomes are now visible.

C.W
18.10.23

Yasmata

Biology

(structure of DNA)

* DNA
* ds DNA → double standard DNA
* Double Helix DNA
* Nucleotide
  - sugar → 3 carbon
  - phosphate → 5 carbon
  - nitrogen base
    - Adenine
    - Guanine
    - Thiamine
    - Cytosine

* A-T (1 H-bond)
* G-C (2 H-bond)

(A-G) Purines

(C-T) Pyrimidines

P.T.O

* backbone- sugars phosphate
* The pitch of helix 3.4nm

**

RNA

*

6.2
21.10.23

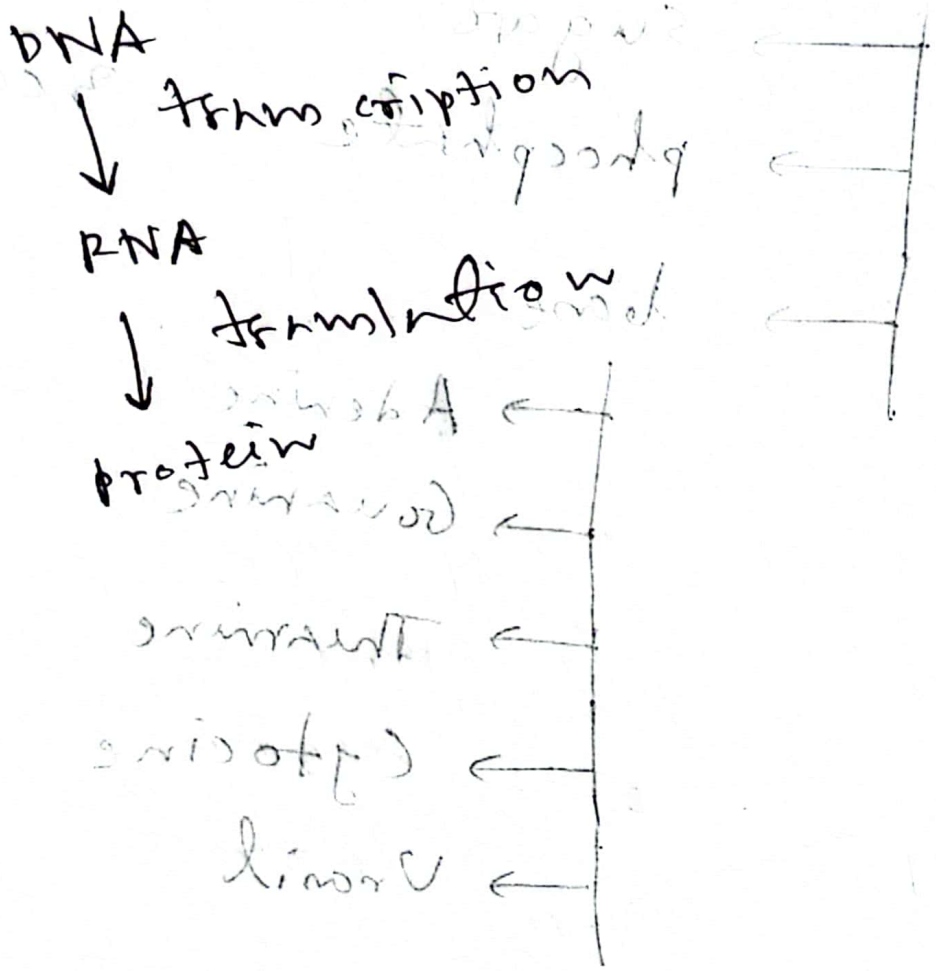
Biology

* DNA

- Sugars → one sugar → 5 carbon
- phosphate
- base
  - Adenine
  - Guanine
  - Thiamine
  - Cytocine
  - Uracil

* base pair ⇒ H-bond
* 1 helix ⇒ 10 base pair
* major, minor groove (Protein)
  (Specific) (non-specific)

✱ Central dogma



Question Bank mid Biology

Define biological engineering?

⇒ → Reproduction & genetics

→ Genes are found in DNA, which is found in chromosomes.

→ making the connection between Ecosystems & evolution.

Clearly state the value of biology for CSE students?

⇒ → Bio-robotics are inspired by biological entities or the use of biological components in robots.

→ Bio-sensors are used for analysis, toxicology, medical diagnosis, environmental monitoring etc.

P.T.O

→ Bio-chips are useful for disease studies or safety studies.

Ecosystems & evolution connection

⇒

* Evolution: The process by which different kinds of living organisms are belived to have developed from earlier forms during the history of the earth.

* Ecosystems: the biological community of living beings, communicating with the

P.T.O

physical environment and other non living components.

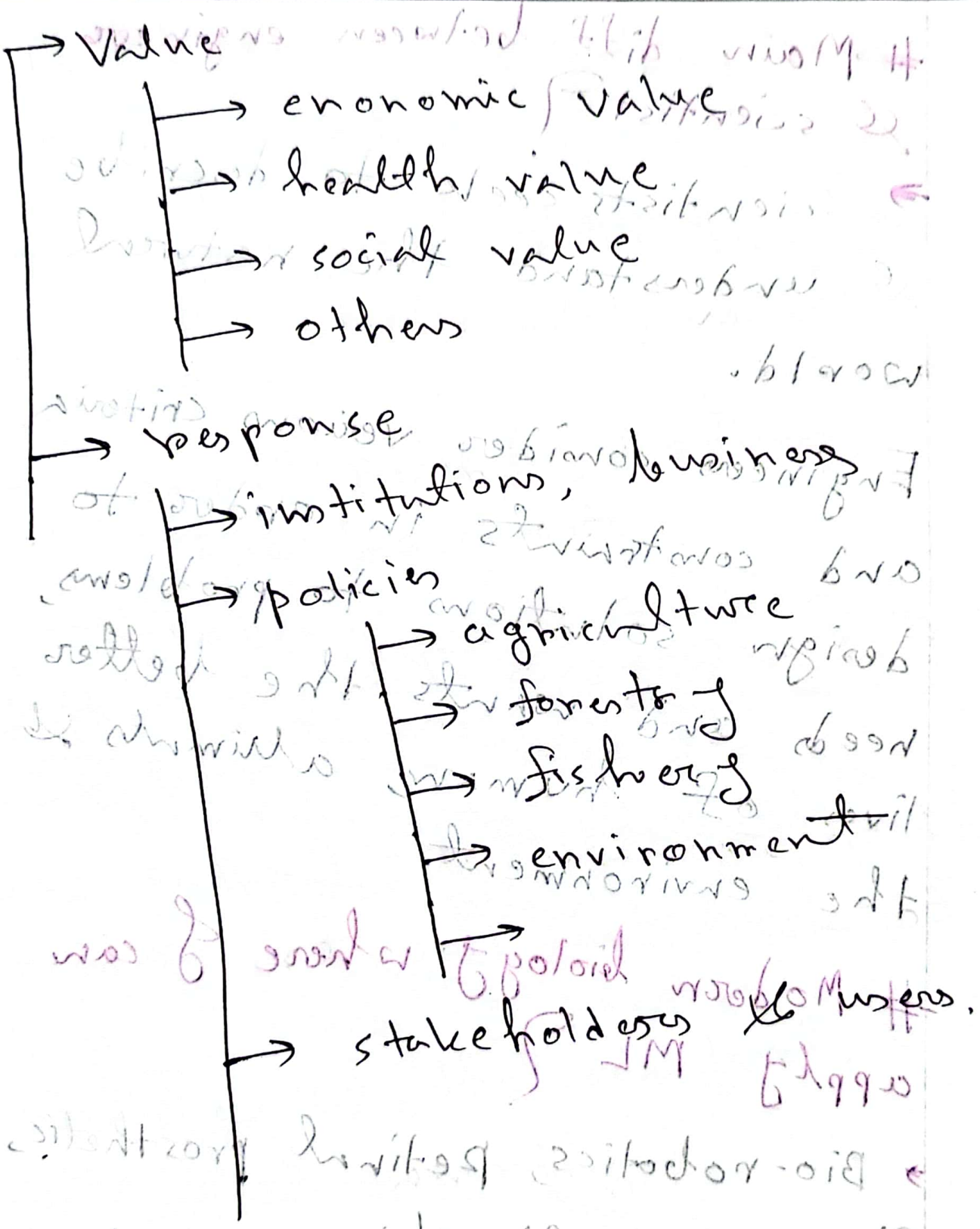
* Ecosystem Core:

- Natural ecosystem
  - structure unchanged
  - No investment or less investment
- Evolved ecosystem
  - Increase investment
- Degraded ecosystem
  - structure weakened
- Artificial reconstruction ecosystem
  - structure changed
  - Increase investment for the economic purpose.

* ecosystems function
  - biodiversity
    - genetic diversity
    - species richness
    - biotic interactions
    - biophysical structure
    - functional traits
    - ecological processes.

Ecosystem services ⇌ drivers of change

* human-wellbeing
  - benifits
    - nutritions, clean water, air
    - health, safety, security
    - enjoyment


Value
economic value
health value
social value
others
response
institutions, business
policies
agriculture
forests
fishery
environment
stakeholders

Main diff between engineers & scientist?

→ Scientists seek to describe & understand the natural world.

Engineers consider various criteria and constraints in order to design solutions to problems, needs and wants the better lives of human, animals & the environment.

Modern biology where I can apply ML?

→ Bio-robotics, Retinal prosthetic, Bio-sensors, Bio-chips, Bio-pesticides,

P.T.O

Biofilters, Nanoparticles, Organ-on-a chip.

3 enviroment friendly ideas that can be implemented as business models?

→ Retinal Prosthetic, Bio filters, soft bio robots.

How degraded ecosystem affects the ecosystem?

→ Increased flooding due to the erosion of soil and lack of trees.

→ Rising of the sea level, caused by global warming.

P.T.O

→ drinking water shortage
→ loss of biodiversity
→ pollution
→ Rising temperatures.

Tissue engineering

⇒ Identify tissue cell sources:

- Reprogrammed cells
- cell culture
- Bioreactors
- Growth factors
- Transcription factors

P.T.O

Implementation

- Tissue architecture techniques
- 3D bioprinting
- Decellularized organ
- Engineered tissue
- Mechanical stimulus

Muscular Bio-polymers

Patient → cell isolation → cell expansion → 3D scaffold → Tissue development

growth factor, cell

DNA - RNA

Mention the diff & similarities between DNA & RNA.

→ *DNA:

→ double helical structure that carries all the genetic information.

→ acidic substances

→ Nucleotide
  - → phosphate group
  - → sugars
  - → Nitrogenous base (A, G, T, C) (A = T, G ≡ C)

→ 6 molecular structure
  - → 1 phosphate
  - → 5 carbon sugar termed (deoxyribose)

P.T.O

→ 2 polynucleotide chain
- → purine base (A, G)
- → pyrimidine base (C, T)

→ two chain → anti-parallel polarity
5' to 3' & 3' to 5'

→ Adenine forms two H-bonds with Thymine
Guanine forms three H-bonds with Cytosine

→ The pitch of the helix 3.4 nm
(10 bp)

one bp = 0.34 nm

distance between two consecutive bp.
(6.6×10^{9} m bp $\times$ 0.34×10^{-9} m/bp)
= 2.2 m → dimension of typical nucleus = 10^{-6} m.

→ Deoxyribose Sugare
Carbon's:
- → (3, 5) → phosphate
- → base → (1)

* RNA:

→ two types:
- → genetic
- → non-genetic

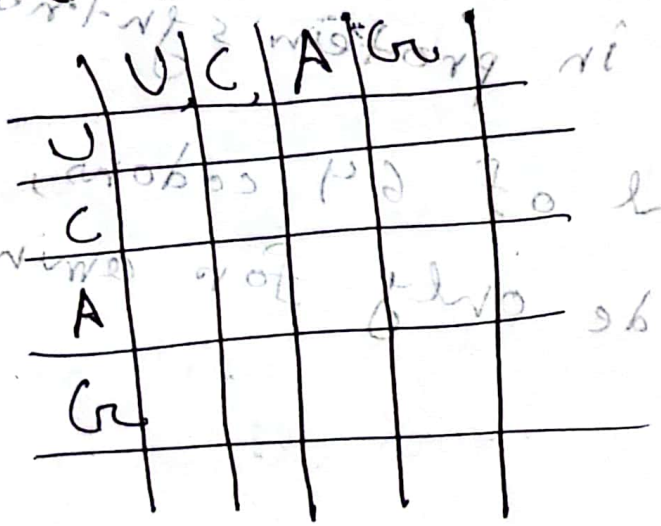
→ Thymine replaced as Uracil

→ Ribose sugare

Genetic Code:

→ The genetic code can be difined as a set of rules where in the information encoded in genetic materials are translated into proteins by living cells.

→ Sequence of genetic code in rows and columns.



and each of the sequence have 4 parts. If I comider the row & column (U):

→ U U U
→ U U C
→ U U A
→ U U G

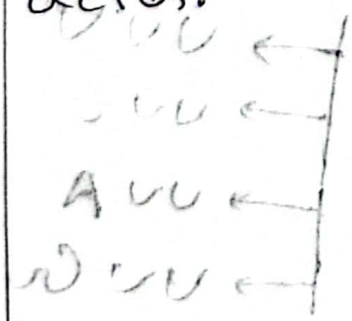
the first two position will be same as the base.

→ code specify which amino acids will be added next during protein synthesis.

→ relationship between the sequence of nucleotide chain of mRNA and amino acid in a polypeptide chain.

→ 20 types of amino acids participate in protein synthesis.

→ in total of 64 codons, 61 codons code only for amino acids.



P.T.O

* Characteristics of genetic code:

→ Degeneracy of genetic code.
→ Non-overlapping.
→ Universality.
→ Triplet in nature.
→ Comma-less.
→ Non-ambiguous.

How do you think a DNA of some meters can be fitted inside a cell of nm to scale?

→ It's like squeeze a big rope into a tiny small box.
→ We can also compared it with arranging and stacking books into a big massive bookself in a room.

Central Dogma

DNA —transcription→ mRNA —translation→ protein

Replication

Significance of nucleotide

→ Basic units of DNA molecule.

→ transmitting genetic information.

→ development, functioning and maintainance of all living organisms.

→ synthesis of proteins.

→ helps DNA replication.

→ inheritance, evolution and diversity of life on earth.

How many bp of a 2.2 m long DNA has?

1 bp = 0.34×10^{-9} m

0.34×10^{-9} m → 1 bp

1 m → $\frac{1}{0.34 \times 10^{-9}}$ bp

2.2 m → $\frac{2.2}{0.34 \times 10^{-9}}$ bp

= 6470588235 bp

= 6497 core.

(Approximate)

Transcription, Translation

Transcription:

→ genetic info from DNA is med to synthesize RNA molecule, (mRNA). MRNA carries genetic code from DNA to ribosomes where protein synthesis occurs.

Translation:

→ process where mRNA used to build polypeptide chain (protein).

→ It takes place on ribosomes, serves as the site for protein synthesis.

P.T.O

MRNA, TRNA

mRNA (messenger RNA):

→ carries genetic information from DNA to ribosomes.
→ serves protein synthesis during translation.

tRNA (transfer RNA):

→ carries amino acids to ribosome.
→ create polypeptide chain according to the information encoded in mRNA.

P.T.O

Importance of Human Genom project (HGP):

- Identify all the genes in human DNA {(20-25) k}.
- Determine the sequence of 3 billions chemical bp that make up human DNA.
- Store the information in databases.
- Improve tools for data analysis.
- Transfer related technologies to other sectors.
- Address the, ethical, legal & social issues that may arise from the project.

Rules to be the genetic material:

→ It should be able to generate its replica. (Replication)

→ It should be stable chemically & structurally.

→ It should provide the scope for slow changes (mutation) that are required for evolution.

→ Mendelian characters.

Cell-division

Meiosis-1

→ G_1, S, G_2 phase

→ S-phase ⇒ DNA of the chromosome is replicated.

→ G_1 → focus on cell growth

→ G_2 ⟹ final preparation for meiosis

Prophase-1:

→ Homologus chromosomes bring the pair

→ this pairing is called synapsis

→ exchange the chromosomal segments between non-sister chromatids called (Crossing Over). It occurs at chaiasmata. (the point of contact between non-sister chromosomes.)

P.T.O

→ end of prophase-1, held tetrads. (four sister chromatids are visible.)

Metaphase-1:

→ the homologus chromosomes are arranged in the center of the cell.

→ There are two possibilities for orientation at the metaphase plate, possible number of alignments (2^n).

→ 23 chromosomes pair, 2^{23} (8 millions) possible genetically distinct gaments.

→ two haploid cells will have same genetic composition (might possible).

Prometaphase-I:

→ Homologus chromosomes are held togethers at chaiasmata.

→ microtubules are attached with the fused kinetochores of the sister chromatids.

Anaphase-I:

→ Homologus chromosomes are pulled by microtubules.

→ sister chromatids remain attached at the centromere.

Telophase-I:

→ seperated chromosomes arrive at opposite poles.

→ nuclear envelope forms around the chromatids.

Cytokinesis:

→ physical seperation of the cytoplasmic components into two daughter cells.

→ In animal cells - seperates the cell contents via cleavage furrow.

→ In plant cells, a cell plate is formed by Golgi vesicles fusing at the metaphase plate.

Meiosis-2:

→ Interphase lacks an S-phase.

→ Meiosis 1 go through the event of Meiosis-2.

→ the sister chromatids within the two daughter cells seperate, forming four new haploid gametes.

→ Similer to Mitosis.

Prophase - 2:

→ The centrosomes moved away to the opposite poles and new spindles are formed.

→ The nuclear envelopes are completely broken down.

→ Chromosomes move middle of the cell.

Metaphase - 2:

→ Chromosomes are aligned at the equatorial plate.

Prometaphase - 2:

→ Sister chromatids are held together at centromere.

→ Microtubules are attached to the kinetochor of the sister chromatids.

Anaphase-2:

→ Sister chromatids seperate & moves opposite poles as individual chromosomes.

→ Sister chromatids are pulled by microtubules.

Cytokinesis-2

→ seperates two cells into four unique haploid cells.

→ occurs during crossover.

Karyotypes

→ A karyotype is the number and appearance of chromosomes, and include their length, banding pattern and centromere position.

→ The simplest use of karyotype (karyogram images) is to identify abnormal chromosomal numbers.

→ Chromosome 21 is shorter than chromosome 22.

Common disorders

→ non disjunction
→ sister chromatids fails to seperate during meiosis
→ incomplete synapsis.

Aneuploidy

→ It is the presence of abnormal number of chromosomes in a cell. For example 45 or 47 chromosomes.

→ Trisomy is the most common aneuploidy.
- → Down syndrome (trisomy 21)
- → Patau syndrome (trisomy 13)
- → Edwards syndrome (trisomy 18)

(gain of an extra chromosome)

→ monosomy (loss of one chromosome)

Polyploidy

→ An individual with more than the correct number of chromosome sets.

Phenotypes & Genotypes

Phenotypes

→ physical characteristics.

Genotypes

→ For the pair of genes (human of plants) get the physical characteristic.

Some concepts:

I'm using here T to (wing)

*Mendelian characteristic

- → TT → Large
- → tt → small
- → Tt → Hybrid large.

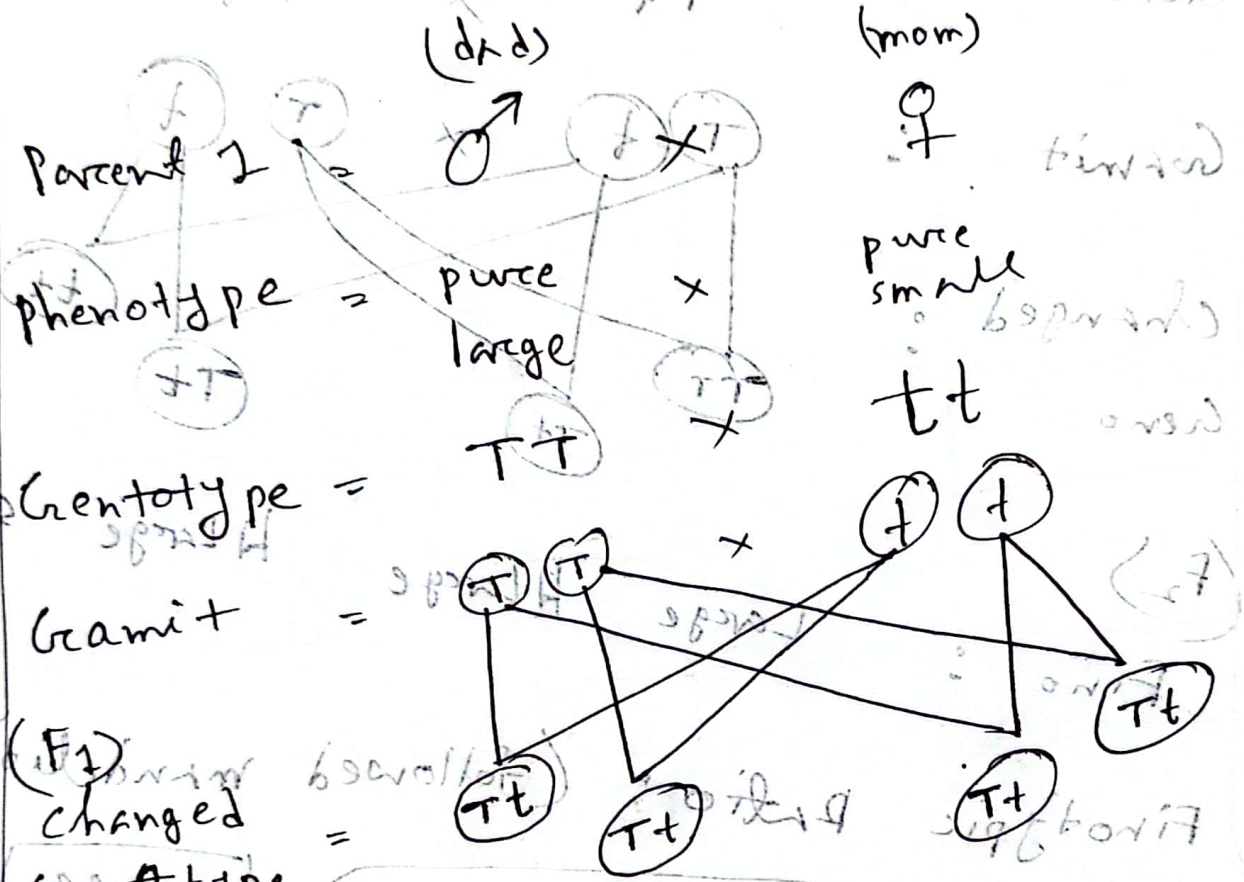
Assume,

Pure large = TT

Genotype = TT

Pure small tt

Genotype tt

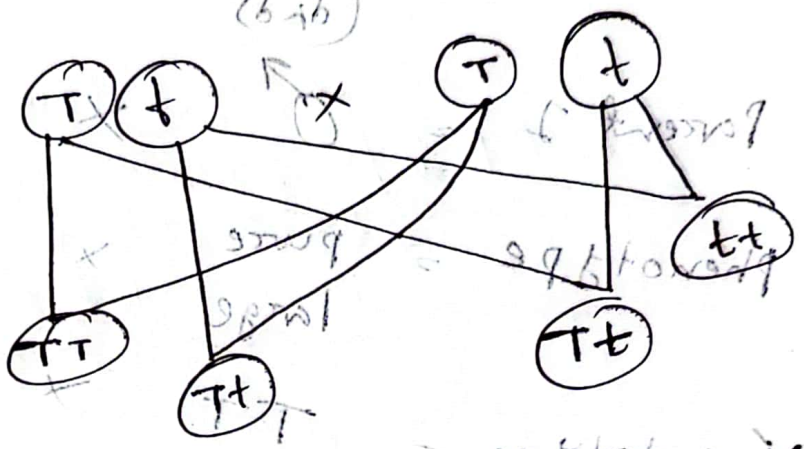


Parent 2 : ♂ × ♀

Pheno : hybrid Large | hybrid Large

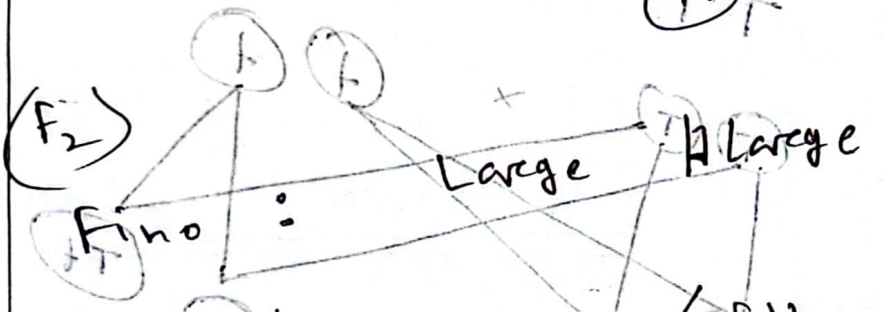
Geno : Tt × Tt

Gamit : T t | T t



changed :

Geno :



Fino :

Finotypic Ratio : (followed mandelio)

3 : 1

Large	HL	HL
3		

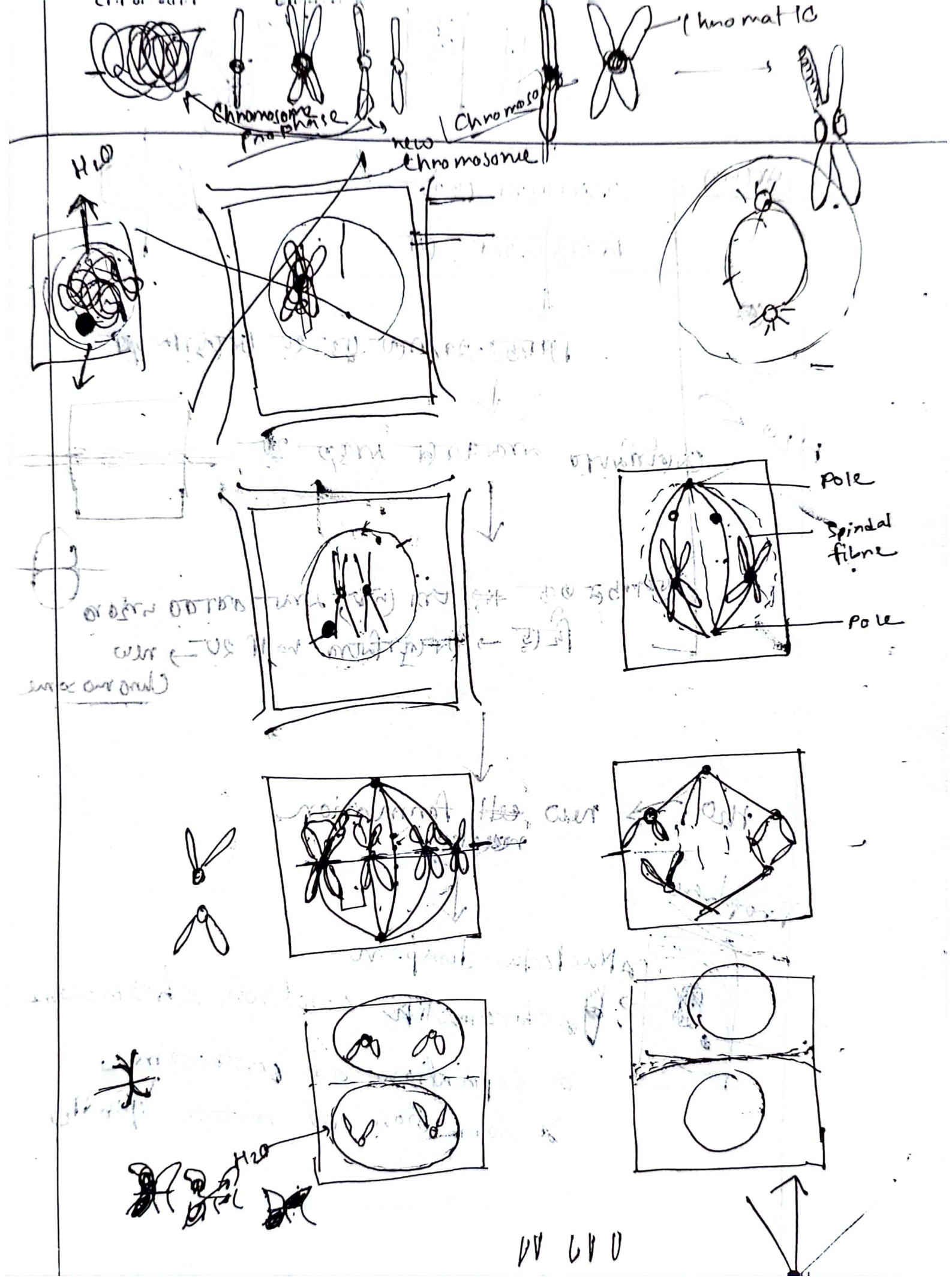
Small
1

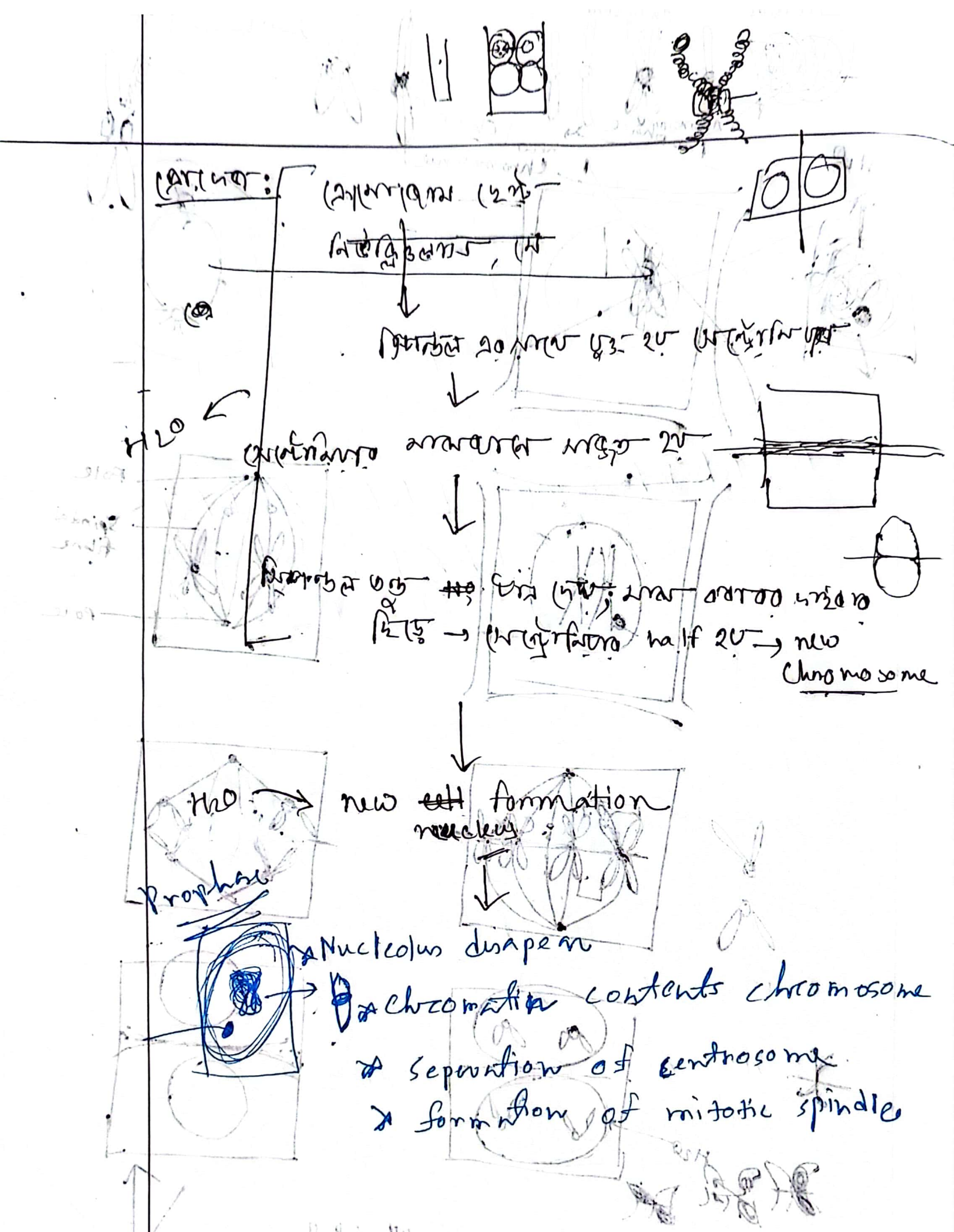
→ 75% : 25%

→ (Not followed)

→ 1 : 2 : 1

L	HL	HL	S
1	2		1


Chromosome
Prophase
Chromosome
Chromatic
H2O
new chromosome
Pole
Spindal fibre
Pole
H2O



Prophase
Nucleolus disappear
Chromatin contents chromosome
separation of centrosome
formation of mitotic spindle

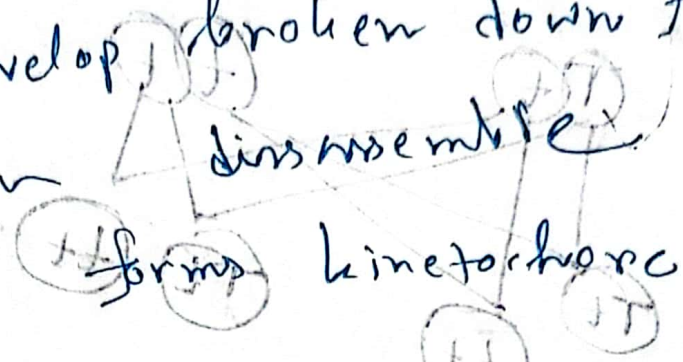
Propetaphase

→ Nuclear envelop broken down fully

→ ~~~ ~~~ dissassemble

→ chromosome forms kinetochore to centromere.

→ microtubule attach to chromosome



metaphase

→ All the chromosome aligned in a plane called metaphase plate

Anaphase

→ seperate sister cromatids at centromere

→ unattached microtubule push aigast each other to elongate cell.

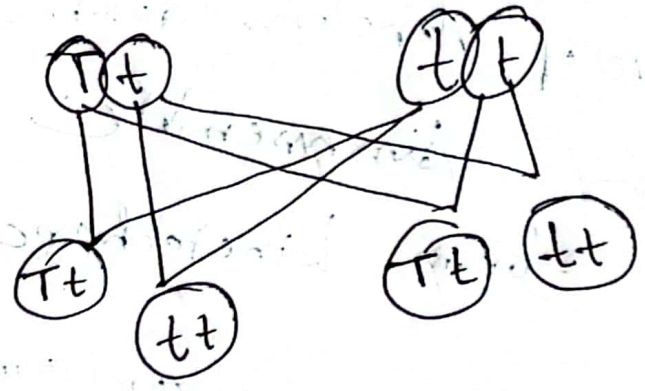
→ seperate cromatid to opposite pole

Telophase → chromosome froms chromatins again

→ neucleolus reapear.

→ new nuclear forms

→ cells continue



TATCTAATCGGCATAATACG

TTACGTAATGCTCG

Nutrition:

* Protein supplies essential amino acids, the body's building block.
* Without adequate protein, we can't build & replace muscle & repair any damage.
* Fats are much more efficient source of fuel than carbohydrate.
* Fats should supply around 30-35% of total calories.
* Carbohydrates can be manufactured by the body from fats, or proteins.
* grains, potato → complex Carbohydrate.

P.T.O

* Fibre, usually plant material, helps our guts to work properly.
  - → not digested.
  - → fruits, vegetables.
  - → key reason to encourage to eat 'five a day'.

* 13 vitamins.

* Vitamin C is essential for producing & maintaining connective tissue which holds the body together.

* diseases (shortage of vitamins)
  - → Scurvy → (Vitamin C)
  - → rickets → (Vitamin D)
  - → spina bifida → (Vitamin B9 / folic Acid)
    to new born babies

* BMI (Body Mass Index)

→ calculation of weight & height

→ unit → kg/m²

→ BMI ≥ 25.0 is overweight

→ BMI → (18.5 - 24.9) healthy range

→ BMI applies to most (18 - 65) years.

→ BMI isn't used for

- muscle builders
- long distance athletes
- pregnent woman
- elderly or young children

* NCD → Non-communicable diseases

* To avoid unhealthy weight gain total fat should not exceed 30% of total energy intake

→ saturated fat should be less than 10% of total energy intake.

→ trans-fat less than 1% of total energy intake.

→ free sugars less than 10% of total energy.

→ A further reduction to less than 5% of total energy.

→ salt less than 5 g per day

→ sodium less than 2g per day.

* Who agreed to reduce the global population intake of salt by 30% by 2025.

→ also halt the rise in diabetes & obesity in adults and adolescents as well as childhood overweight by 2025.

healthy diet:

→ fruits, vegetables, legumes (lentils, beans), nuts & grains (maize, millet, oats, wheat, brown rice)

→ 400 g (5 portions) of fruits & vegetables per day.

→ less than 10% of total energy from free sugars ≡ 50 g (12 level tea-spoons) for a person of healthy body weight consuming 2000 calories per day.

→ additional health benefits less than 5-1. of total energy.

* Tram- fatty acids are created during (hydrogenation), which is aimed at stabilizing polyunsaturated oils to prevent them from becoming rancid and to keep them solid at room temperature.

→ Unsaturated fats
  ↳ fish, avocado, nuts, sunflower, soybean, canola & olive oils

→ saturated fats
  ↳ fatty meat, butter, coconut oil, cream, cheese, ghee, lard.

→ trans fat :

→ fried food, frozen pizza, pies, cookies, biscuits, wafers & cooking oils.

Healthy diet → baby :

→ first 6 month → exclusively breastfed.

→ 2 years of age → continuously breastfed.

→ milk should be complemented with a variety of adequate, safe & nutrient-dense foods.

Fat (healthy diet)

→ steaming or ~~[illegible]~~ boiling instead of frying when cooking.

→ replacing butter, lard & ghee with oil rich in polyunsaturated fats soybean, canola, corn, sunflower oils.

→ eating reduced fat - dairy foods & lean meats.

→ limiting the consumption of baked & fried foods.

Salt / Sodium / Potassium

→ High sodium intake & insufficient potassium intake causes high blood pressure & heart diseases.

→ Reducing salt level less than 5 g per day could prevent 1-7 million death each year.

Sugar

→ less than 10% of total energy intake

P.T.O

tear contains

Cortisol → main human stress hormone

Catecholamines → group of hormones

- → Adrenaline
- → norepinephrine
- → Vasopressin.

Vitamin-B:

→ helps in feel more engergetic after a stressful episodes.

→ Banana, green vegetables, nuts, seeds, meat, fish, dairy products.

Vitamin C:

→ The adrenal glands contain the largest store of vitamin-C.

→ production of stress hormone.

→ oranges, tomatos, green vegetables, broccoli

P.T.O

Magnesium:

→ help to relase muscles & reduce anxiety.

→ (nuts, peanuts, green vegetables, grains, oats, brown rice, beans.)

Caffeine:

→ coffee, tea, drinks, chocolates (negative effects)

→ herbal tea, green tea (full of antioxidants) [good effect]

→ (Thanks)

W = 75 kg

H = 1.702 m

$$BMI = \frac{75}{(1.702)^2} = \frac{75}{2.896} \approx 25.89$$

(Over weight)

→ DNA polymerase: The enzyme that adds the primers by adding nucleotides to it using the desired DNA template.

→ Nucleotide: Single base A, T, G or C are the building block of DNA structure.

→ Buffer system: contain potassium and magnesium that are essential for the DNA denaturation & polymerization steps. It also contains other factors important for enzyme activity, stability.

Biotechnology

PCR (Polymerase Chain Reaction)

→ DNA Templete: double stranded DNA fragment, is to be amplified.

→ Primers: short, chemically synthesised, single-stranded pieces of DNA that are complementary to the DNA fragment.

→ DNA polymerase: The enzyme that elongates the primers by adding necleotides to it, using the desired DNA fragment.

→ Nucleotides: Single bases A, T, C, G are the building blocks of DNA synthesis.

→ Buffer system: contain potassium and magnesium that are essential for the DNA denaturation & renaturation steps. It also contains other factors important for enzyme activity, stability.

Annealing:

→ when the temperature is lowered to enable the DNA primers to attach to the template DNA. (54°C - 60°C)

Extending:

→ when the temperature is raised and the new strand of DNA is made by Taq polymerase enzyme.

annealing important in PCR?

→ → the primers interact with the template.

→ In low temp a partial match between primers & the template will be stable enough & amplification from more primer.

Steps in PCR

* **Denaturation:**

→ This steps involves heating the reaction mixture to a high temp (95°C). This denatures the Double-stranded DNA template into single-strands by breaking the weak H-bonds between two DNA strands.

* **Elongation / Extension:**

→ The DNA polymerase sequentially adds nucleotides to the primers & extends it in the 5' to 3' direction.

Gel electrophoresis:

This technique helps to seperate DNA, RNA or proteins based on their size.

Working of Agarose Gel Electrophoresis

→ The DNA to be seperated is added to the wells of an agarose gel matrix.

→ The negetively charged DNA moves to the positive electrode.

→ Largers fragments move slowers, while smallers fragments fit through the gel pores easily & move faster.

Recombinant DNA technology

W

20.12.23

Biology

Ecosystem (slide numbers)

4, 5, 6, 9, 10, 11, 12, ##, 18, 20, 21, 26, 27, 28, 29

Biotechnology

* PCR
* Gel electrophoresis
* rDNA
* Tools of biotechnology
* Bioreactor
* Down stream processing
* Application
  - → Agriculture
  - → Medecine
* GMO
* Transgenic Animal
* Bio-piracy

Ecosystem Dynamics

1. Give the equations for chemosynthesis & photosynthesis. Which one of these two do you think vital for ecosystems on earth?

→ 18, 19, 20.

2. Our environment is comprises of land, river, ocean, & many. In ecosystem how we can differentiate.

→ 4, 5, 6

3. Impact of environmental disturbance how directly and indirectly effect our health. → 8, 27, 28, 29

4. Do you think pandemic spread out from the ecosystem? ecosystem dynamics.

→ 24, 25, 26.

5. Equilibrium, resistance, resilience,

→ 8, 24, 25, 26

6. Sketch the flow diagram to show the resistance & resilience of a land based ecosystem after deforestation.

→ 26,

8. Grazing food web and detrital food web what it is?

→ 17, 18, 19, 20, 21, 22, 23, 15

7. H_2S used as a chemical energy of chemoautotropes how the energy to the rest of the ecosystem is done.

→ 18, 20

10. What should be the change in energy flow for a typical ecosystem where there are 3 level of consumers

⇒ 12, 9, 10, 11

11. Mention the basic differences between food web & food chain.

⇒ ##, 13, 14, 15,

12. Mention the name of substances we give up in the environment which can be harmful for us?

⇒ 27, 28, 29

13. Name natural external factors?

⇒ 25

14. ⇒ 26

15 ⇒ 9, 10, 11, 12

Ecosystem

1. 18, 19, 20
2. 4, 5, 6
3. 8, 27, 28, 29
4. 24, 25, 26
5. 8, 24, 25, 26
6. 26
8. 15, 17, 18, (19 - 23)
9. 18, 20
10. 9, 10, 11, 12
11. 13, 14, 15
12. 27, 28, 29
13. 25
14. 26
15. 9, 10, 11, 12
16. 27, 28, 29
17. 4, 5, 6, 7, 8
18.

Immunity

1. 49, 50, 51, 52

2. 49, 50, 51, 52

3. 26, 27,

4. 24, 17,

5. 6, 7, 8, 9, 10, 14,

6. 8

7. 49, 50, 51, 52

8. 25,

9. 40 - 48

16. 27, 28, 29.

17. 4, 5, 6, 7, 8

18. 

Food & Nutrition

1. 11, 13, 14, 15, 16, 19, 20, 22,

2. 9, 10, 11, 12

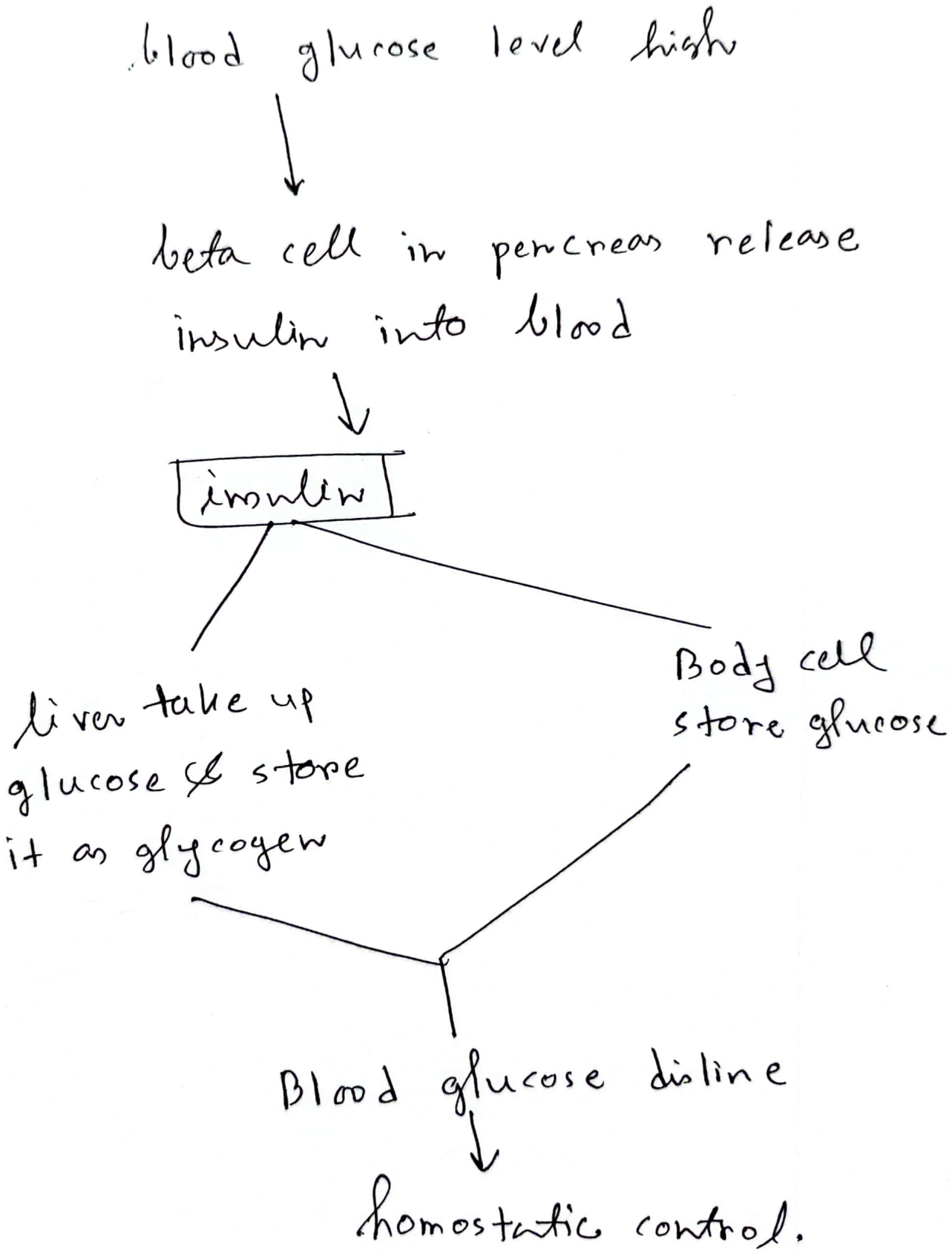
3. 22, 23, 24, 25, 26, 27

4. 18,

5. 9 - 22

6. 39, 40, 41, 42, 43, 44

7. 10, 11, 12, 14, 19 - 25


blood glucose level high
beta cell in pancreas release insulin into blood
insulin
liver take up glucose & store it as glycogen
Body cell store glucose
Blood glucose dicline
homostatic control.