SR-5

UNIVERSITY OF HAIL

PREPARATORY YEAR PROGRAM

PBIO-121 – Preparatory Biology

Table of Contents (Syllabus)

No. of Lecture	Topic
1	Introduction to Biology
2	Bio molecules -I: Lipids and Carbohydrates
3	Bio molecules -II: Proteins
4	Bio molecules -III: Nucleic Acids (DNA & RNA)
5	Cellular Organization-I
6	Cellular Organization-II
7	Biological Membrane -I
8	Biological Membrane - II
9	Epithelial Tissues
10	Connective Tissues
11	Muscle Tissues and Nervous Tissues

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What is Life?

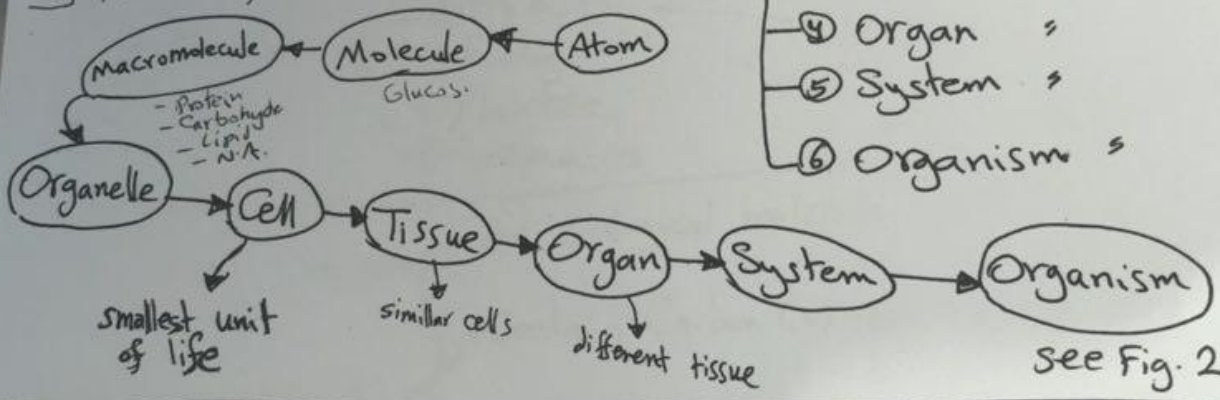
1 Life Characteristics

- A high degree of organization
- Containing materials found only in living organisms (i.e.: proteins, DNA...)
- Aquiring & used energy
- Maintaining homeostasis
- Sensing the environment
- Responding to external stimuli
- Adapting to the environment
- Altering the environment
- Able to reproduce (Reproducing)

See Fig. 1

2 Hierarchy of Organization of Life

1. Chemical Level
2. Cellular "
3. Tissue "
4. Organ "
5. System "
6. Organism "



see Fig. 2+3

3 Homeostasis

- Means "Staying the Same"
- The condition in which the body's internal environment remains relatively constant.
- Human Function Properly → Only within Narrow ranges of Temp. + chemistry

Controlled by:
- Conscious Responses
- Unconscious Responses

Ex.: Human maintain body warmth by:
- Concious response (selecting appropriate Cloths)
- Unconscious response (Constriction of Blood vessels)

Taxonomy

- Artificial classification
- Uses a system of names (to) identify organisms / show their relationships
- ⇓
- * Kingdom – Phyllum – Class – Order – Family – Genus – Specie
- Group (collate) organisms ⇐ Based on similar characteristics
- is a branch of science which classifies organisms into groups with similar characteristics

3 Domains

- Eubacteria (Prokaryotes)
- Archaebacteria (=) ← Bacteria that live in extreme conditions
- Eucharya

6 Kingdoms

1. Archaebacteria — Prokaryotes
2. Eubacteria — Prokaryotes
3. Protista — Protozoans / Algae — Eukaryotes
4. Fungi — Eukaryotes
5. Plantae — Eukaryotes
6. Animalia — Eukaryotes

See Fig. 4+5

Macromolecules

- or Biological molecule or Organic molecules/compounds
- Contain Carbon (C) Atom ⤵ with 4 Valence e⁻
- ⇓
- So that, 4 covalent bond
- From
  - Simple ⇒ ex.: Methane (CH_4)
  - Complex
    - Ring — ex.: ribose
    - Chain — ex.: starch.
- Attaching Functional groups
  - Increase the solubility in H_2O
  - Increase reactivity in water
  - to carbon structure ex.: -COOH, -OH, ⋮
- Polymer made-up from Monomers

Monomers —Dehydration→ Polymers —Hydrolysis→ Monomers

Dehydration: H_2O (remove)

Hydrolysis: H_2O (add)

see Fig. 6
Fig. 7

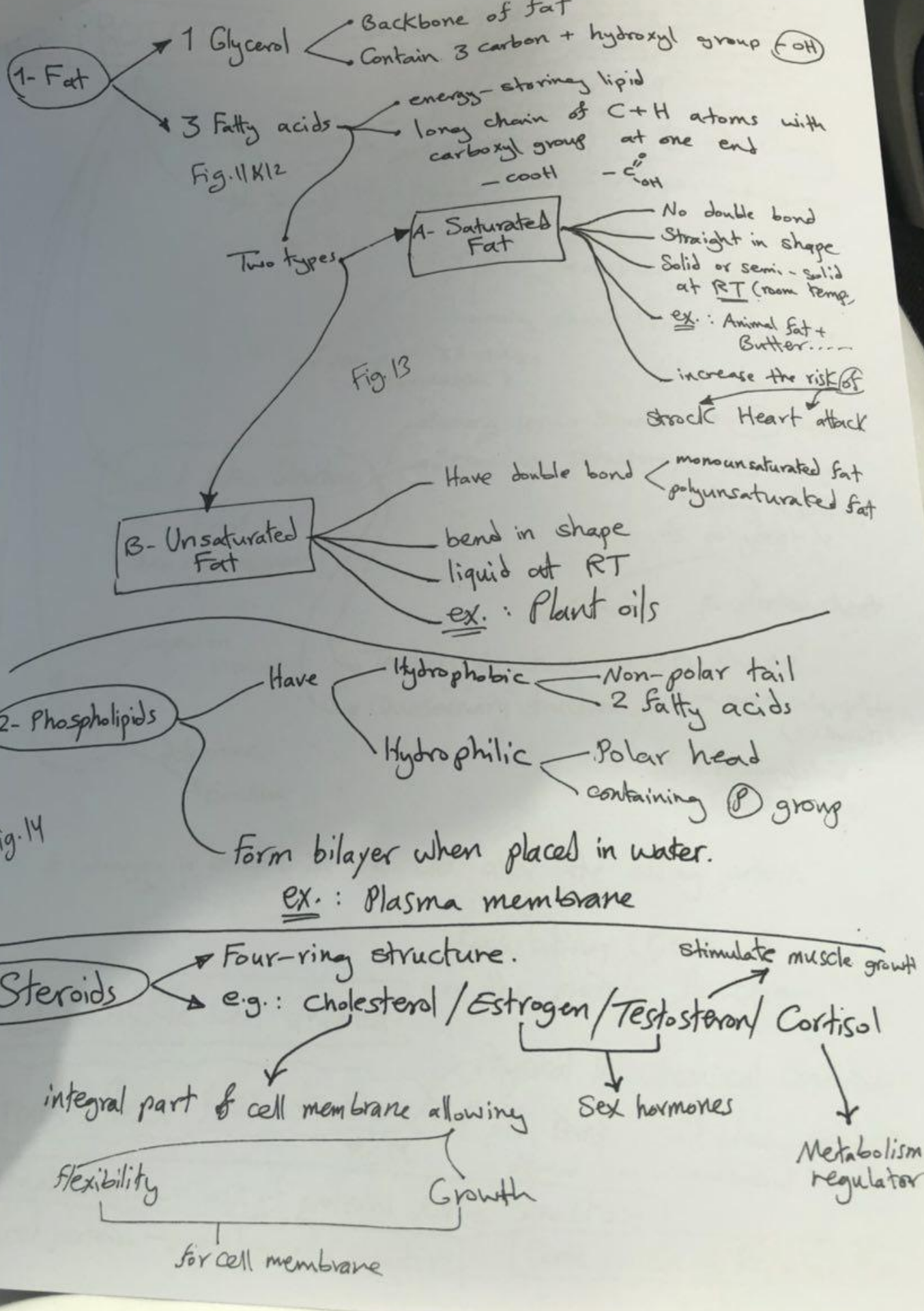
1| CARBOHYDRATES

- the most abundant organic molecules.
- Composed from C, H, & O in ration (1:2:1)
  ex.: $C_6H_{12}O_6$ - Glucose
- serve as Energy source (for human body).
- Joined by Glycosidic linkage See Fig. 8, 9 & 10
- Many are Saccharides (sugars)
  - Monosaccharides
    - single sugar molecules (simple CHO)
    - ex.: Glucose / Fructose / Ribose ..... etc)
  - Disaccharides
    - 2 monosaccharides
    - ex.
      - Sucrase (Table sugar) = Glu + Fructose
      - Lactose (Milk sugar) = Glu + Galactose
      - Maltose (Malt sugar) = Glu + Glu
  - Oligosaccharides
  - Polysaccharides
    - Storage
      - Starch — in Plants, linear
      - Glycogen — in Animal, branch — muscle, liver
    - Structural
      - cellulose — in Plant
      - Chitin — in Animals (Insect, Arthropods, spider.....)

2| LIPIDS

- hydrophobic (water insoluble)
- Consisting mostly of C+H atoms.
- 3 Types
  1. Fat (Triglycerides)
     - 3 fatty acids
     - 1 glycerol
     - saturated / unsaturated
  2. Phospholipids
     - 2 fatty acids (tail)
     - 1 glycerol
     - 1 phosphate group (hea
  3. Steroids
     - Four-ring structure
     - ex.: Cholesterol, sex hormone

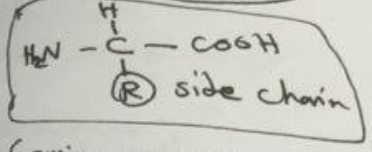
See Fig. 11, 12, 13, 14 & 15


1- Fat
1 Glycerol
Backbone of fat
Contain 3 carbon + hydroxyl group (-OH)
3 Fatty acids
energy-storing lipid
long chain of C+H atoms with carboxyl group at one end
-COOH
Fig. 11 & 12
Two types
A- Saturated Fat
No double bond
Straight in shape
Solid or semi-solid at RT (room temp.)
ex.: Animal fat + Butter....
increase the risk of
Stroke
Heart attack
Fig. 13
B- Unsaturated Fat
Have double bond
monounsaturated fat
polyunsaturated fat
bend in shape
liquid at RT
ex.: Plant oils
2- Phospholipids
Have
Hydrophobic
Non-polar tail
2 fatty acids
Hydrophilic
Polar head
containing (P) group
Form bilayer when placed in water.
ex.: Plasma membrane
Fig. 14
3 Steroids
Four-ring structure.
e.g.: Cholesterol / Estrogen / Testosteron / Cortisol
Stimulate muscle growth
integral part of cell membrane allowing
flexibility
Growth
for cell membrane
Sex hormones
Metabolism regulator
Fig. 15

5 PROTEINS

Consist of 20 amino acids (side chain)
- H-atom
- Carboxyl group
- α-Carbon
- Amino group

Fig. 16



Functions
- serve as transport
- = messenger molecule
- act as enzyme

Joined by Peptide bonds --(amino group + carboxyl group)

Fig. 17

- Dipeptide
- Polypeptide
  - are linear sequences of a.a.
  - Normally cannot funtion as protein
  - must develop in 3D-shape (conformation)

Levels of Protein Structure

Fig. 18

- Primary level or Structure → a.a. (amino acids) sequences
- Secondary structure → 2D-shape
  - Twisting & folding of polypeptide
    - α-helix
    - β-pleated sheet
- Tertiary structure → 3D-shape
- Quaternary structure → 2 or more polypeptide (subunits)
  - ex.: Hemoglobin (4 subunits)

Amino acids sequences depend on Shape determine Function

* Changing in an even one a.a. can alter the folding pattern
⇓
Devastating effects on the protein function

ex.: Sickle Cell anemia

Factors affect Protein structure

Fig. 19

- Physical & chemical conditions
  - [pH, temp., salt conc., solubility, other environmental conditions.

Denaturation = loss of protein's native structure.

- Denatured protein → Biologically inactive
- Some protein ⇒ Renaturation

*Enzymes
- Serve as Catalyst (molecule accelerate reaction without consuming)
- Bring the reactant (substrate) together ⇒ reaction more quickly
- without altered (consuming reactant → may be altered)
- Rely on shape ⇐ to function properly.
- Have active site ⇐ shaped to bind to the specific one substrate

Fig. 20

4 Nucleic Acids
- Store an organism's genetic information.
- Two types

RNA
- Ribonucleic acid
- A single-stranded molecules
- Act as a messenger molecule (inside nucleus: outside =)
- Serves to regulate cellular metabolism = = produce proteins
- Govern developmental timing.

Fig. 21

DNA
- Deoxyribonucleic acid + double strand molecules
- Exists in the nucleus.
- Functions
  - To build proteins
  - To regulate physiological processes
  - To maintain homeostasis

Structure of DNA

Composed of Nucleotids
- Nitrogenous Base
  - A = adenine
  - C = cytosine
  - G = guanine
  - T = thymine (in DNA)
  - U = uracil (in RNA)
- Sugar
  - Ribose (in RNA)
  - Deoxyribose (in DNA)
- Phosphate group

linked by

Bond = Phosphodiester bond

Complementary Base Pairing

A = T
G ≡ C

Purine — Pyrimidines

Fig. 24+23

Semiconservative Replication

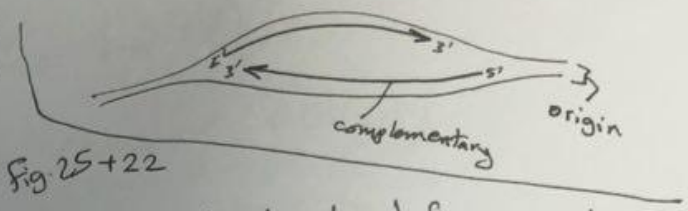
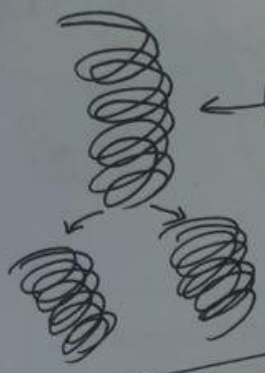


Fig. 25+22



Parent molecule

Daughter molecules

- one original strand from parent
- one complementary strand

DNA Synthesis / Replication

Fig. 26

- Bidirectional replication
- Begin at [Origin of replication]
- Proceeds in [5' → 3' direction]
- leading strand → synthesized continuously
- lagging strand → synthesized discontinuously
  - forms short (okazaki fragment)

Enzymes

involved in DNA replication

- Helicase ← seperate DNA double helix
- Topoisomerase ← Solve the problem of winding & unwinding of DNA
- Primase ← synthesize a (primer) = short RNA segment
- Polymerase ← add free nucleotides to (3' end)
- Ligase ← joins the okazaki fragment on lagging strand
- SSB (single strand binding protein)
  - ⇑ prevent the helix from reforming

Pakaging DNA in eukaryotes

Fig. 27+28

Histone Proteins + associated DNA = (Nucleosome)

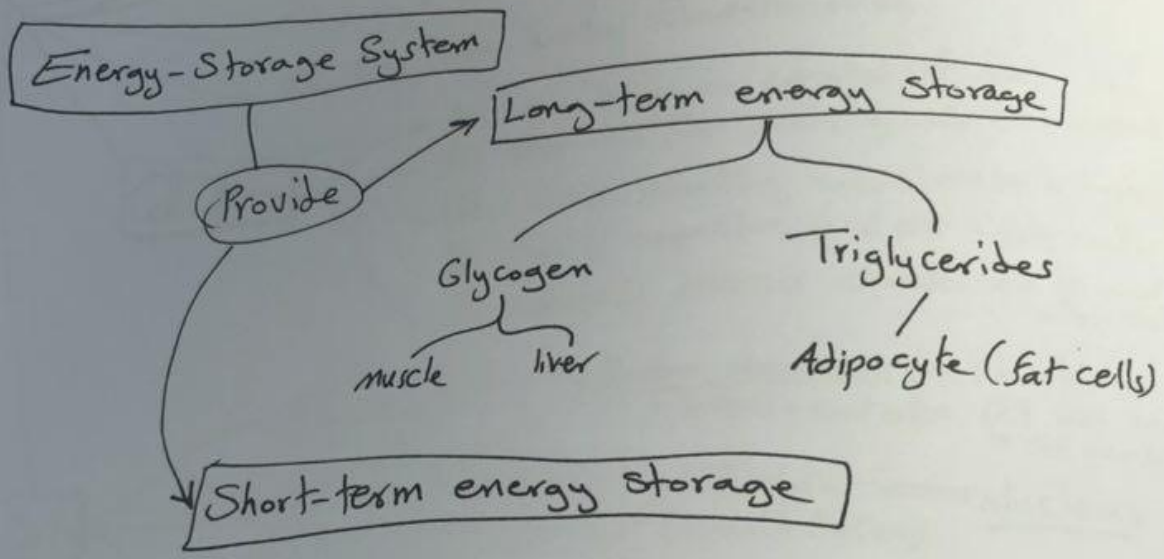
⇓ 1st level of Chromatin package

uncoil chromosomes inside nucleus

Chromatin = DNA + protein complex

Energy → requires by Life.
→ power cellular activity
→ Available in ~~eg~~ spurts
→ Not available as a continuous stream

Fig. 29



uses a high energy system
- reversible
- instantly available

The most common is

ATP — Adenosine triphosphate.
- Powers all cellular activity i.e. forming proteins. contracting muscles.

$$ATP + H_2O \longrightarrow ADP + P_i + Energy$$