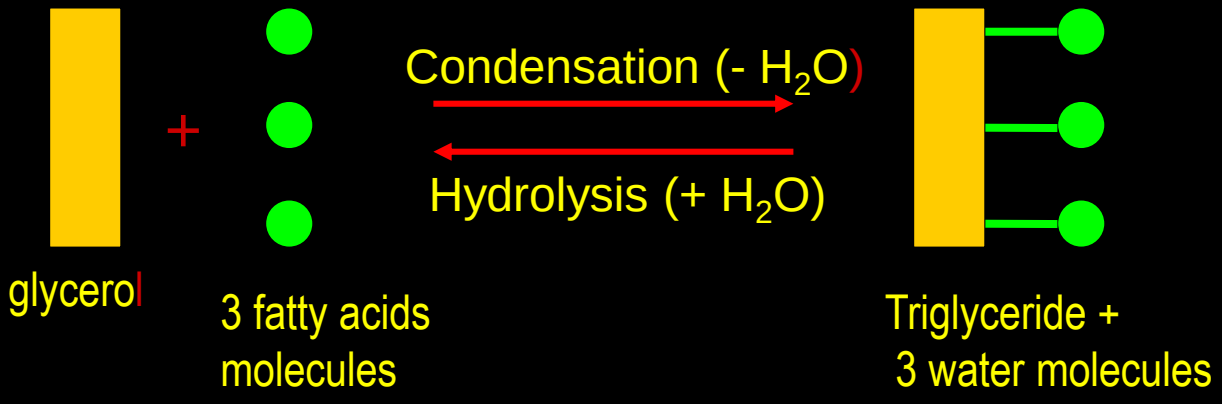
LIPIDS

- Lipids a diverse group of substance that contain carbon, hydrogen and oxygen. The proportion of oxygen is lower than that in carbohydrates. For example, the general formula of stearic acid is $C_{18}H_{36}O_{2.}$
- All lipids are insoluble in water
- Lipids dissolve readily in other lipids and in organic solvent such as ether and ethanol.
- The main types of lipids are:

a) Fats
b) Oils
c) Waxes
d) Phospholipids
e) steroids

Fats and oils

- *Fats are solid at room temperature (20°C), whereas oil are liquid*
- *Each molecule of fats or oils is made up of one glycerol combine with three fatty acids which may be the same or may be different. Three molecule of water are remove in this condensation reaction.*



- These molecules of fats and oils are known as **triglycerides.**
- Fats often contain only saturated fatty acids.
- Oils usually contain unsaturated fatty acids.
- In a **saturated fatty acids**, the carbon atoms are bonded to the maximum number of other atoms. Saturated fatty acid has only **single bond** and the hydrocarbon chain is relatively straight.
- Unsaturated fatty acids has double bond in the form of –CH=CH- in the hydrocarbon chain. Fatty acids; those with two or more double bond are called **polyunsaturated fatty acids.**

Type of fatty acids	Example	Structural formula
Saturated	Stearic acid	CH3(CH2)16COOH
Unsaturated	Oleic acid	CH3(CH2)7CH=CH(CH2)7COOH

- Fats and oils function efficiently as energy storage material. Fats and oils provide 38kJ per gram, while carbohydrates can provide only 17 kJ per gram.

Waxes

- Waxes are similar to triglycerides, but the fatty acids are bonded to long-chain alcohols rather than glycerol
- Waxes are usually hard solids at room temperature
- Waxes are used to waterproof the external surface of plants and animal. The cuticle of a leaf and the protective covering on an insect's body are made of waxes.
- Wax is also a constituent of the honeycomb of bees

Phospholipids

- Phospholipids have a similar structure to triglycerides but one of the fatty acids is replaced by a phosphate group
- The end of the phospholipids molecule containing the phosphate group is hydrophilic. The other end containing the hydrocarbon chain of the fatty acids is hydrophobic.
- The hydrophilic end is soluble in water while hydrophobic is insoluble in water.
- Phospholipids bilayer from the basis of all cell membrane.

Steroids

- A steroid molecule has a complex ring structure
- Steroid occur in plants and animals
- Examples of steroids are cholesterol, testosterone, estrogen and progesterone.

Steroid	Function
cholesterol	Strengthens the cell membrane at high body temperature
testosterone	Male reproductive hormone
estrogen and progesterone.	female reproductive hormone

- Saturated and and saturated fats
- Animal fats such as lard, butter and cream are example of saturated fats
- Vegetable oil such as olive oil and sunflower oil are example of unsaturated fats.

Saturated fats	Unsaturated fats
Similarities	
1. Both are triglycerides 2. They yield 38 kJ per gram 3. Their molecules congregate into globule because of their hydrophobic properties	
Differences	
Saturated fats	**Unsaturated fats**
Higher melting point	Lower melting point
Most are solid at room temperature	Most are liquid at room temperature
More likely to cause disease of the heart and arteries	Less likely to cause disease of the heart and arteries
More stable at room temperature and less readily become rancid	Unstable at room temperature and less readily become rancid

ENZYMES

- Enzymes are protein molecules act as biological catalysts. They speed up the rate of metabolic reactions and do not chemically changed at the end of the reaction
- The substance whose reactivity is increased by an enzymes is knowing as a substrate

THE GENERAL CHARACTERISTICS OF ENZYMES

- Enzymes speed up the rates of biochemical reactions in cells.
- Only a small amount of enzymes is needed to catalyze a lot of substrate.
- Enzymes are very specific – each class of enzymes will catalyze only one particular reaction.
- Enzymes are not used up or destroyed in the reactions that they catalyze, but can be reused again.
- Enzymes catalyze reversible reactions
- Many enzymes are only able to work with in presence of a coenzymes (or cofactor).
- Enzymes are effected by changes in temperature and pH

NAMING OF ENZYMES

- An emzyme is named by taking its substrate name and adding the suffix ‘-ase’
- Example, protease catalyses the hydrolysis of protein.
- The ‘-ase’ rule does not apply to enzymes discover before the ‘-ase’ idea was introduced. For example, pepsin, rennin, ptyalin and tripsin.
- The modern classification of enzymes was decided by the International Union of Biochemistry (IUB) in 1961

INTRACELLULAR AND EXTRACELLULAR ENZYMES

- Intracellular emzyme that catalyses reaction within a cell and formed by the free ribosome in the cytoplasm.
- Extracellular emzyme that leaves the cell and catalyses reaction outside the cell and synthesised by ribosome attached to the rough endoplasmic recticulum.

MECHANISM OF ENZYMES ACTION

- Each enzyme molecule has a region with very precise shape called active site.
- The substrate molecule fit into the active site of the enzymes like a key into a lock, forming an enzyme-substrate complex, a temporary structure.
- Reaction take place at active site to form a product.
- The product have a different shape from the substrate and therefore repelled from a active site.

- **THERE ARE 4 FACTORS AFFECT THE ACTIVITY OF ENZYMES**

1. **pH**
2. **Temperature**
3. **Concentration of enzyme**
4. **Concentration of substrate**

The effect of pH on enzyme activity

- **Each enzyme has a optimum pH at which its rate of reaction is the fastest. i.e. pepsin at pH 2,(acidic) amylase pH 7 (neutral) and trypsin at pH 8-9 (alkaline)**

The effect of temperature on enzyme activity

- The rate of reaction will increase up to maximum, known as optimum temperature.
- After the optimum temperature around 37ºC-40ºC, the rate of reaction falls quickly because of the bonds maintaining the structure of the enzyme start to break and the active site loses its shape.
- At 60ºC, enzyme activity will stop altogether because the enzyme is denatured

THE EFFECT OF SUBSTRATE CONCENTRATION ON ENZYME ACTIVITY

1. *Increase the substrate concentration will increase the chance of enzyme-substrate collision, and the rate of reaction will increase.*
2. *Addition of substrate will not increase the rate of reaction anymore because the constant enzyme concentration becomes the limiting factor.*

THE EFFECT OF ENZYM CONCENTRATION ON ENZYME ACTIVITY

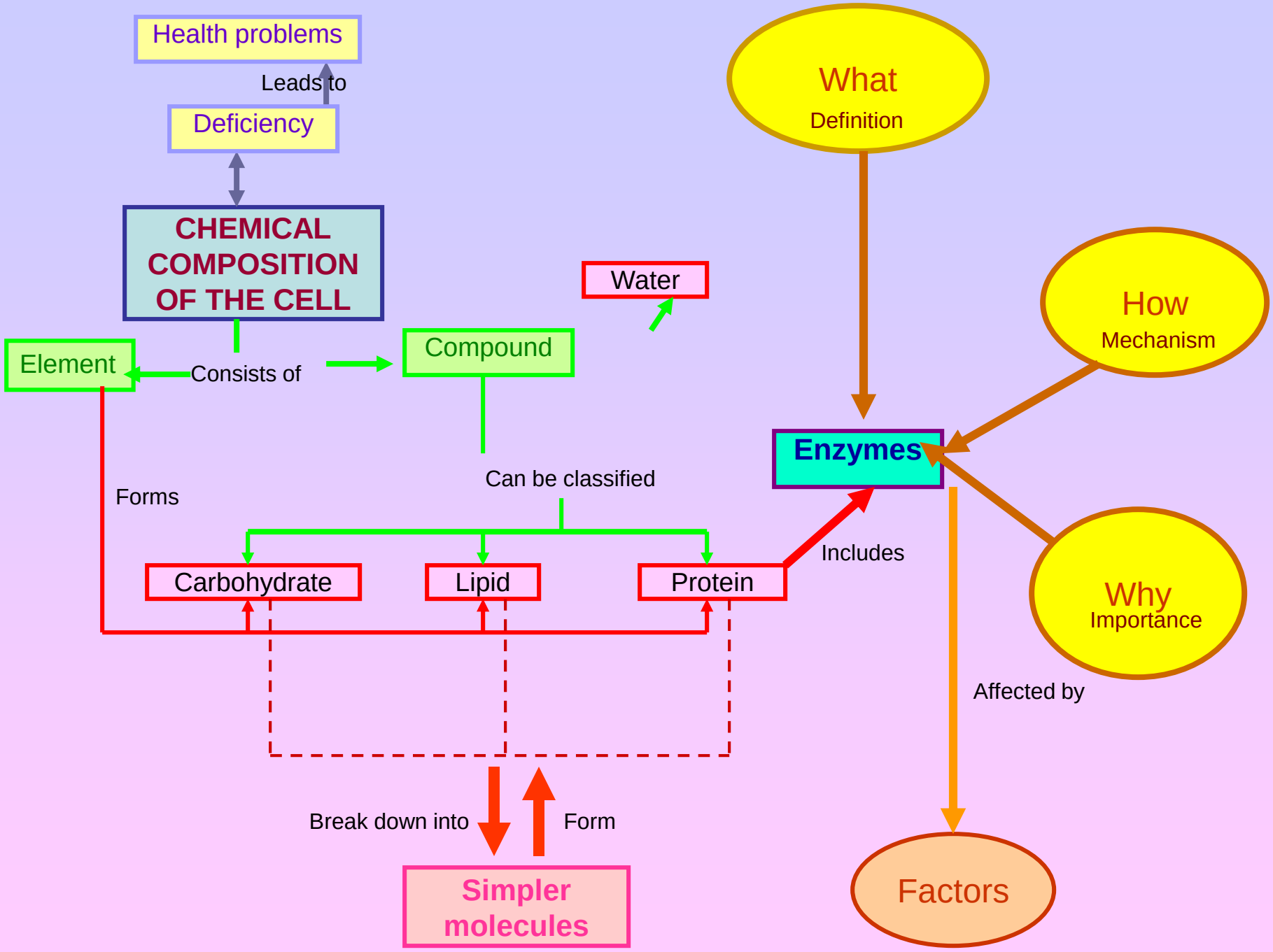
1. *When the concentration of enzyme increase, there are more chance enzyme-substrate collision. The rate of reaction increase linearly as long as no other factors are limiting.*

THE USES OF ENZYMES

1. *Enzyme can extracted from any living organism, and used either at home or in industry*
2. *Enzymes that are commonly used in daily life are:*

a. *Papain-found in papaya used to tenderise meat*

b. *Protease-used to tenderise meat and remove hair from the skin etc.*


Health problems
Leads to
Deficiency
CHEMICAL COMPOSITION OF THE CELL
Water
Element
Consists of
Compound
What
Definition
How
Mechanism
Enzymes
Forms
Can be classified
Includes
Carbohydrate
Lipid
Protein
Why
Importance
Affected by
Break down into
Form
Simpler molecules
Factors