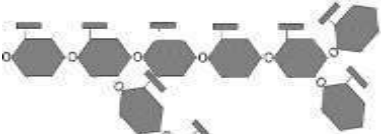
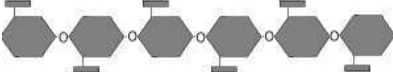
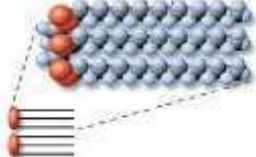
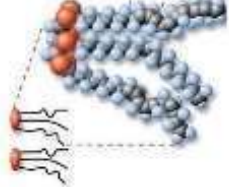
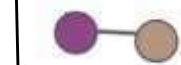
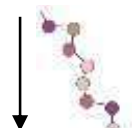


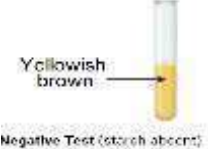
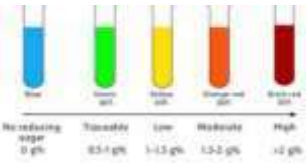
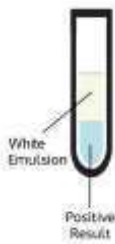
BIOLOGICAL MOLECULES

1. Carbohydrates, fats and proteins

Carbohydrates, fats and proteins are organic and they **provide energy**

	Carbohydrates	Fats	Proteins
Elements	C, H, O	C, H, O	C, H, O, N (S, P)
Formula	$C_nH_{2m}O_m$ Eg. $C_6H_{12}O_6$, $C_{12}H_{22}O_{12}$	Lesser O to H proportion $C_{57}H_{110}O_6$	
Basic unit	Glucose	3 Fatty acids + 1 glycerol	Amino acids
Types	- <u>Monosaccharides</u> (single) Glucose, fructose, galactose  - <u>Disaccharides</u> (double) Maltose, sucrose, lactose  - <u>Polysaccharides</u> (complex) Starch (storage in plant)  Glycogen (storage in animal)  Cellulose (part of cell wall) 	<u>Saturated</u> - Found in animals - Solid at room temperature. Eg. Butter  <u>Unsaturated</u> - Found in plants - Liquid at room temperature Eg. Olive oil  	<u>Amino acids</u>  <u>Peptide</u> 2 amino acids. join by a peptide bond (CO-NH)  <u>Polypeptide</u>  <u>Protein</u> 3D structure held by hydrogen bond 
Function	- To release energy through respiration for cellular activities - Form cellulose in cell wall - Converts to fats and amino acids - Synthesize DNA, lubricant & nectar	- Energy source in absence of carbohydrate - Prevent excessive heat loss, eg blubber in whales - Solvent for fat-soluble vitamins and hormones - Form cell membrane - Reduce water loss, e.g oily substance on skin surface	- Energy source in absence of fats or carbohydrates - Synthesize enzymes protoplasm, antibodies, and hormones - Growth and repair of worn-out body cells

2. Food test

	Starch/iodine test	Benedict's test	Biuret test	Ethanol emulsion test
Reagent	Iodine solution	Benedict's solution	Biuret solution	Ethanol + water
Nutrient	Starch	Reducing sugar	Protein	Fats
Procedure	Add iodine solution to food sample.	Add 2 cm ³ of food solution to 2 cm ³ of Benedict's solution. Heat for 5 mins.	Add 2 cm ³ of food solution to 2 cm ³ of Biuret solution. Shake thoroughly	Add 2 cm ³ of ethanol to 2 cm ³ of food solution and shake. Then add 2 cm ³ of water and mix thoroughly.
Observation and conclusion	Changes from yellow-brown to blue black → starch is present.  Remains yellow-brown → starch is absent 	Changes from blue to → yellow-green precipitate: little reducing sugar present → orange-red precipitate: some reducing sugar present → brick-red precipitate: alot of reducing sugar present Remains blue → reducing sugar is absent 	Changes from blue to violet → protein is present  Remains blue → protein is absent 	A white emulsion is formed → fat is present  Mixture remains clear/colourless → fat is absent 

Note: All single and double sugar are reducing sugar, except sucrose.

Solid food sample

For test for reducing sugar or protein

Chop or grind the food into small pieces to increase surface area to volume ratio Add water to dissolve reducing sugar or protein. Filter and use filtrate for food test.

For test for fat

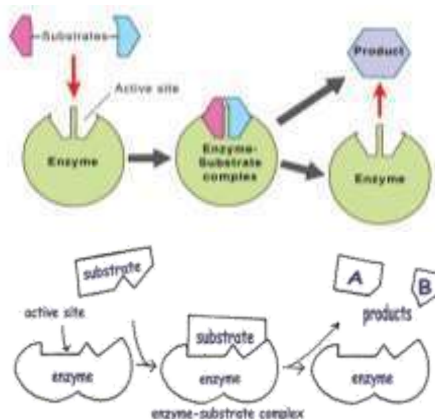
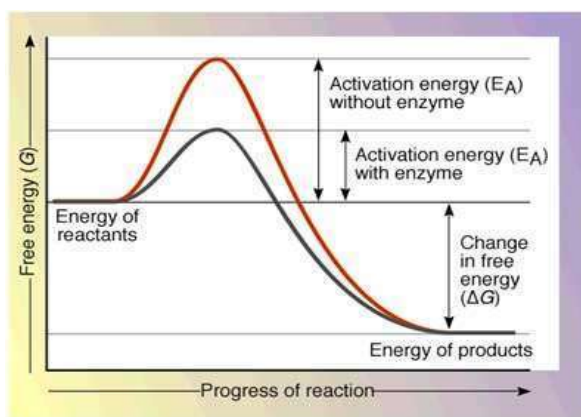
Add alcohol in dry test tube, filter and add water

3. Enzymes

- **Definition:** Biological catalyst made of proteins that speed up the rate of chemical reaction but remains chemically unchanged at the end of reaction.

- Lock and key hypothesis

- Enzyme is the lock and substrate is the key
- Shape of the substrate is **complementary** to the shape of **active site** on the enzyme
- Substrate binds to the active site on the enzyme, forming **enzyme-substrate complex**
- This **lowers the activation energy** for reaction, allowing chemical reaction to proceed
- Substrate becomes **products** and **leave** the active site
- Enzyme **remains chemically unchanged** and can **catalysed the next substrate/reuse** again.



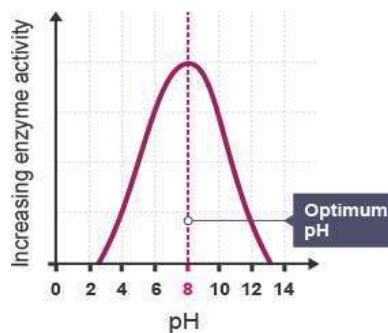
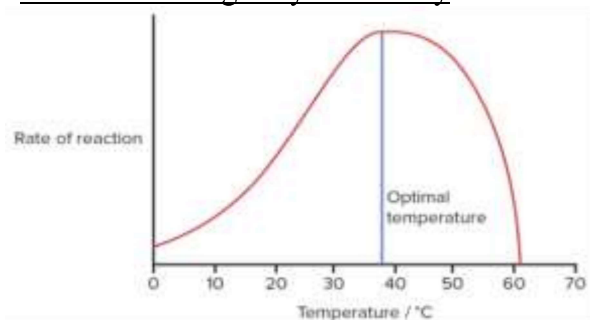
- Properties of enzyme

- **Speed up** chemical reaction by **lower activation energy**
- Required only in **small amounts** as it remains **chemically unchanged/can be reused**
- **Highly specific** due to the 3D shape on the **active site** that is **complementary only to its substrate**
- Eg. **Build up** (photosynthesis), **break down** (digestion) or **reversible reactions**
($\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3$)

Why biological better than conventional washing powder?

Biological (contains enzymes)	Conventional (contain detergent)
Can break down tough stain into smaller products that can escape through clothes fibres or dissolve in water. eg. Fat in curry stain.	Depends on ability of detergent to dissolve stain, may not be effective if the stained area is large.
Can be reused, small amount required for large load	Cannot be reused, need a large amount for large load
Lower temperature. required. Save energy.	Higher temperature. required for detergent to dissolve stain effectively.

- Factors affecting enzyme activity



Temperature

Describe	Explain
At low temperature, low reaction rate.	- Enzymes are inactive - Substrates do not have enough activation energy for reaction. - Enzymes and substrate also collide less frequently due to low kinetic energy
As temperature increases, reaction rate increases. Reaction rate 2x for every 10°C rise until/near its optimum temp. (highest rate)	- Enzyme and substrate have more kinetic energy & collide more frequently. - Specific substrates binds to the active site of the enzymes, form enzyme-substrate complex. - Reaction proceeds quickly and products are formed. - Product leaves active site as its shape it is no longer complementary to the shape of the active site - Enzymes remain chemically unchanged at the end of reaction and can be reused again.
Beyond optimum temperature, reaction rate decreases steeply till it reaches zero.	- High temperature causes enzymes to be denatured as it loses its 3D structure. Irreversible reaction. - Substrates are no longer bind to the active site of enzyme, hence no enzyme-substrate complex is formed. Rate of reaction decreases.

pH

Describe	Explain
At/near optimum pH, reaction rate is highest.	- High frequency of collision between enzyme and substrates - More enzyme-substrate complex formed
Slight changes from optimum pH., reaction rate decrease steeply	- Changes in pH value break the bonds in active site in enzyme. - Shape of substrate is no longer complementary to the shape of the active site, no enzyme-substrate complex forms, causing reaction rate decrease.
At extreme pH, reaction rate becomes zero.	- Extreme pH cause enzymes to be denatured as it loses its 3D structure. - Substrate no longer binds to active site of enzyme. Irreversible reaction.