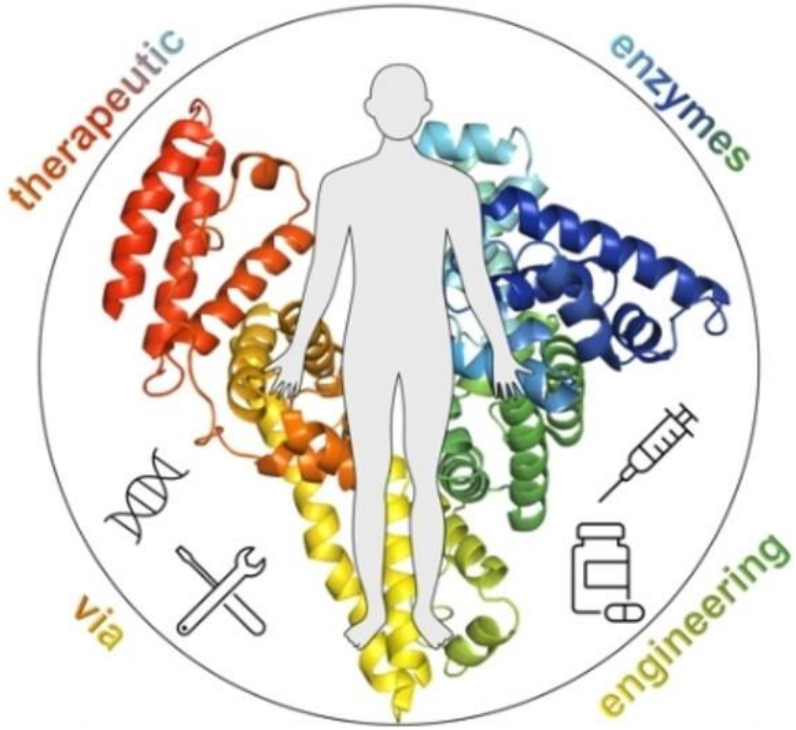
Enzymes



- Cellular chemical reactions are characterized by their speed in moderate cell conditions in terms of temperature and acidity (PH), and they stop or slow down when the cell no longer needs their products.

- These reactions occur in the cell thanks to a large number of catalysts, which are known as enzymes.

enzymes

- They are vital cofactors that accelerate the rates of chemical reactions. They have a high molecular weight protein structure, and like other proteins, the enzyme consists of the union of a large number of amino acids that form one or more polypeptide chains.

Properties of enzymes

- The amino acids in these chains are located in a specific sequence specific to each enzyme, which ultimately leads to a specific spatial structure that enables the enzyme to accelerate the occurrence of its own reaction.

- Enzymes are similar in their action to other chemical catalysts. They participate in the reaction without changing its outcome, meaning that at the end of the reaction they return to their original state before the reaction began, which enables them to participate in a new reaction. This allows small amounts of enzyme to participate in the reaction for a long period of time, but they are distinguished from other catalysts by their high efficiency.

- It is also distinguished from other cofactors by the high degree of specialization it has with respect to the reactant and the type of reaction. Each enzyme specializes in one reactant called the target substance, and the enzyme may specialize in a specific group of substances similar in structure.

- Key term: Active site

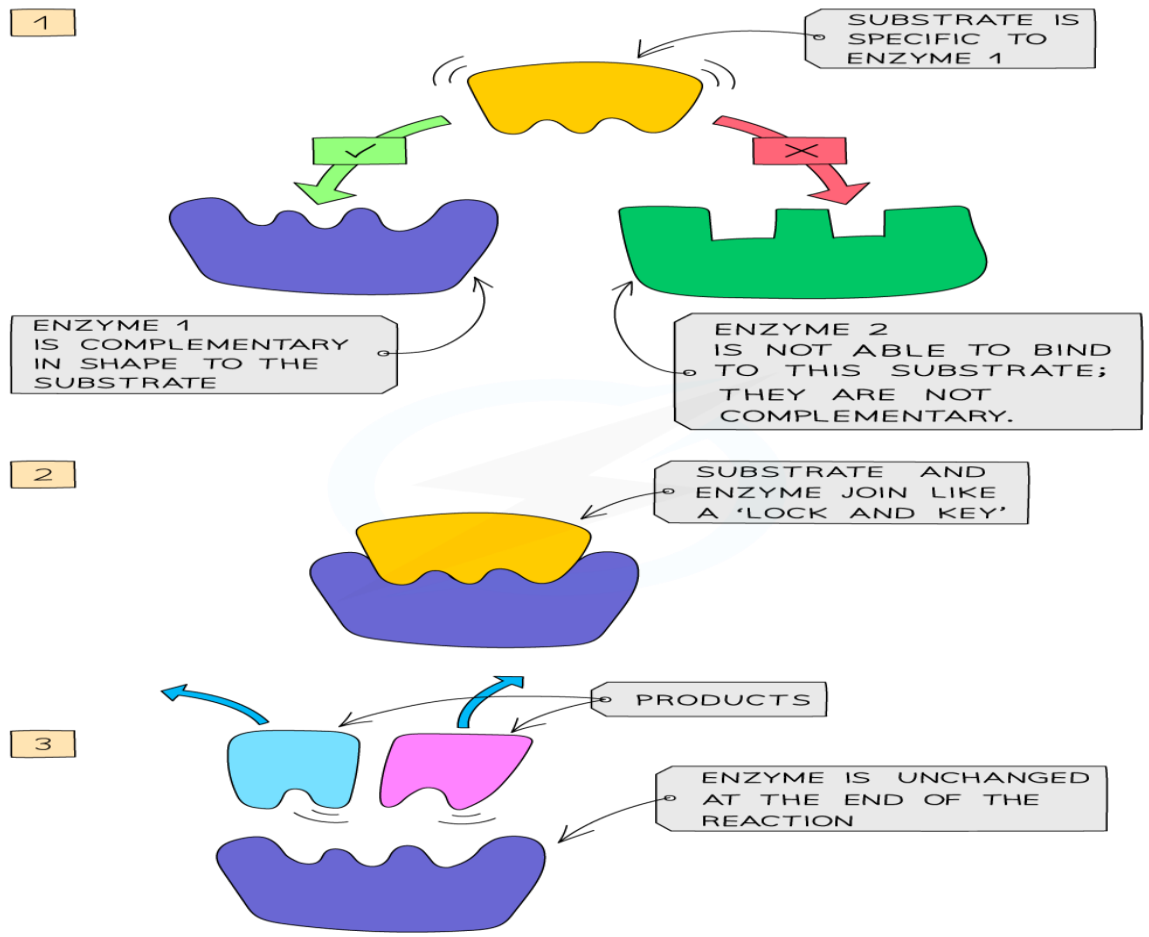
The active site is the region on the surface of an enzyme molecule to which a substrate binds to carry out a chemical reaction.

- Key term: Substrate

A substrate is a molecule, or group of molecules, that has a specific, integral shape that fits into the active site of an enzyme.

- Key term: Product

A product is the molecule or group of molecules that is released from the active site of an enzyme after an enzyme-controlled reaction.

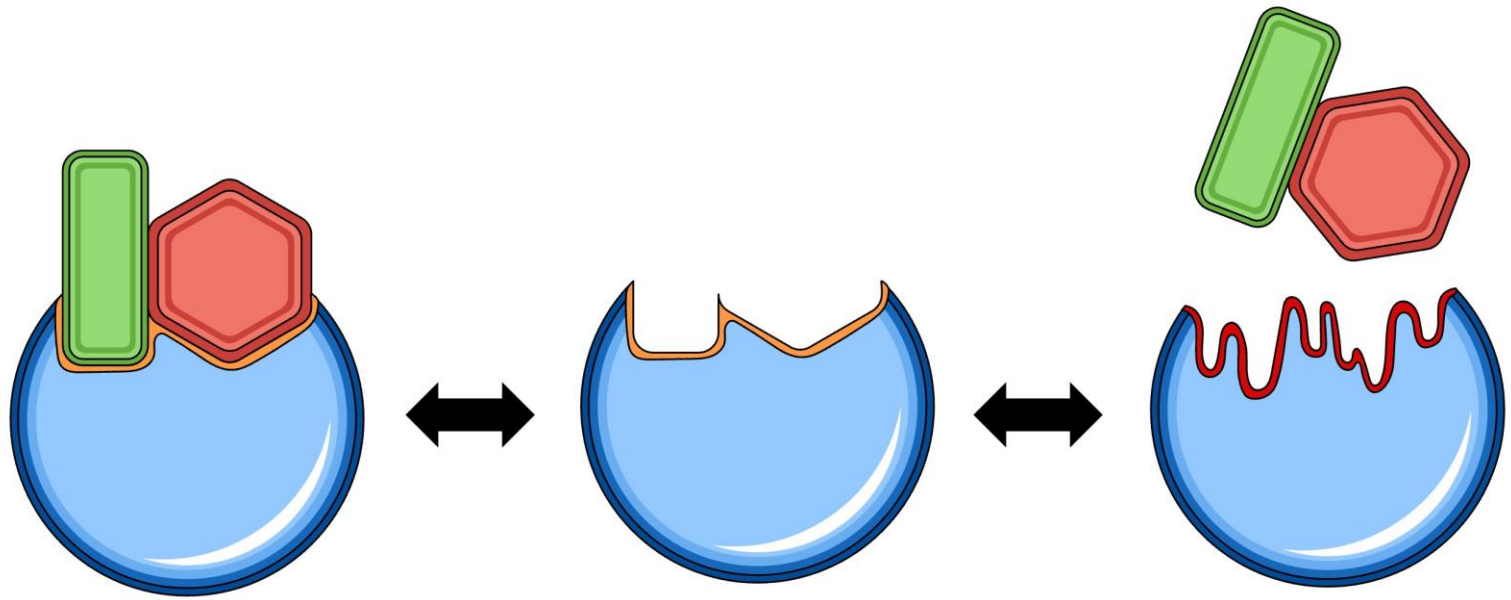


Factors affecting enzyme activity

- Although enzymes are reusable, they can be damaged. Factors affecting the effectiveness of enzymes include:
- 1- Concentration of the reactant.
- 2- Enzyme concentration.
- 3- Effect of temperature.
- 4- Acidity concentration (pH).

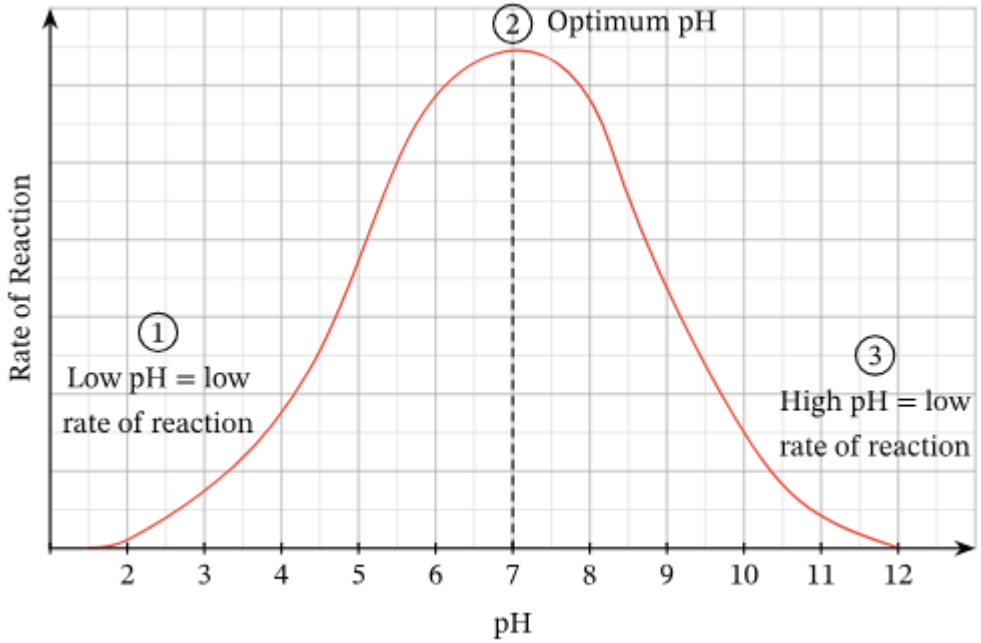
- When an enzyme is exposed to conditions such as high temperature or extremely high or low pH values, the protein structure of the enzyme changes. This means that the shape of its active site changes, and the enzyme is said to be denatured. That is, the active site is no longer integral to the shape of its substrate molecule, and it cannot perform its function of catalyzing any biological reaction.

- All enzymes have an optimum temperature and pH at which the enzymes perform their function to catalyze a reaction most quickly. If these optimum conditions are exceeded, the enzymes involved in the reaction will begin to deform and the reaction rate will slow down. This change is irreversible, so when the shape of the active site changes, it will not be able to reverse the change.


Reaction
Enzyme
Denaturation

pH effect .

- pH is a representation of the concentration of hydrogen ions in a solution. A higher concentration of hydrogen ions indicates that the solution is more acidic and has a lower pH value. A lower concentration of hydrogen ions indicates that the solution is more basic or alkaline and therefore has a higher pH value.
- The graph shows how enzyme activity changes with pH. As pH increases from 2 to 7, the reaction rate increases. From pH 7 to pH 12, the reaction rate decreases. Under very acidic or alkaline conditions, the rates of enzyme-controlled reactions decrease.



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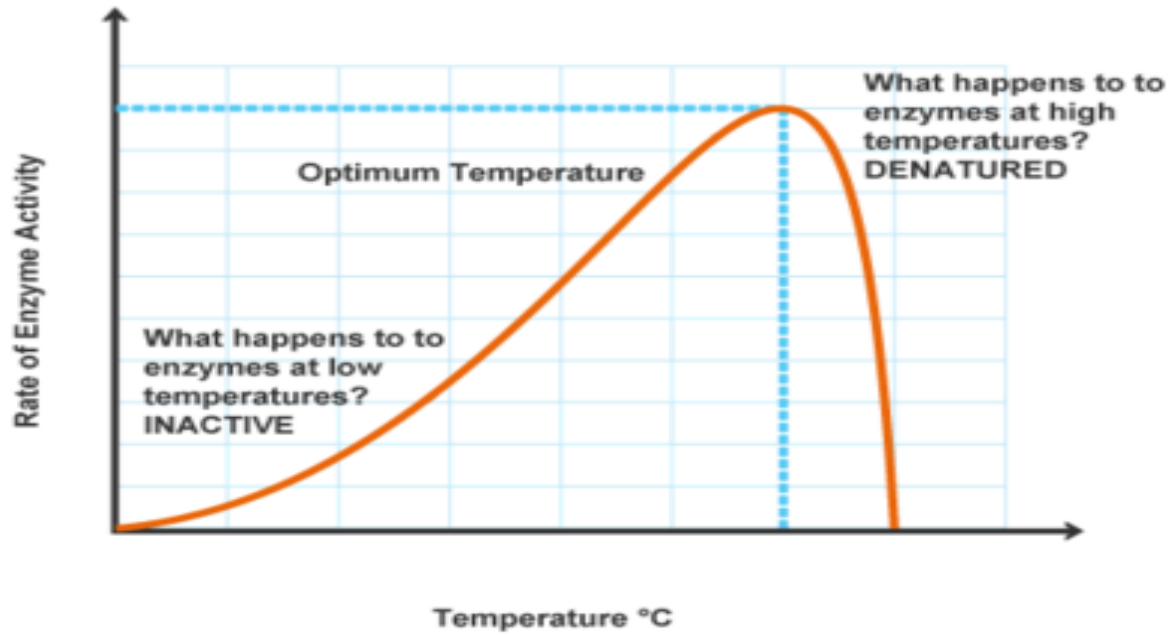
Temperature effect .

- Increasing the temperature from 50°C to 60°C, the reaction rate will also increase. From 65-90°C, the reaction rate will decrease. So, the thermal range of an enzyme, that is, the range between the temperature at which the enzyme starts to be active and the temperature at which it stops being active, is 0-90°C. This is the total temperature range within which this enzyme performs its function.

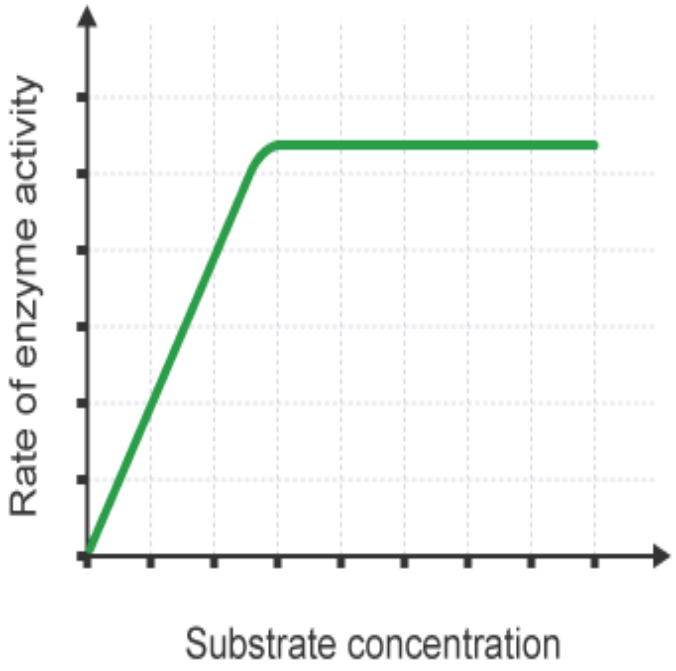

Rate of Enzyme Activity
Optimum Temperature
What happens to to enzymes at high temperatures? DENATURED
What happens to to enzymes at low temperatures? INACTIVE
Temperature °C

substrate concentration effect

- enzymes will work best if there is plenty of substrate. As the concentration

of the substrate increases, so does the rate of enzyme activity. However, the rate of enzyme activity does not increase forever. This is because a point will be reached when the enzymes become saturated and no more substrates can fit at any one time even though there is plenty of substrate available.

As the substrate concentration increases so does the rate of enzyme activity. An optimum rate is reached at the enzyme's optimum substrate concentration. A continued increase in substrate concentration results in the same activity as there are not enough enzyme molecules available to break down the excess substrate molecules.



Intestinal enzymes

Pepsin and Rennin enzymes

Pepsin

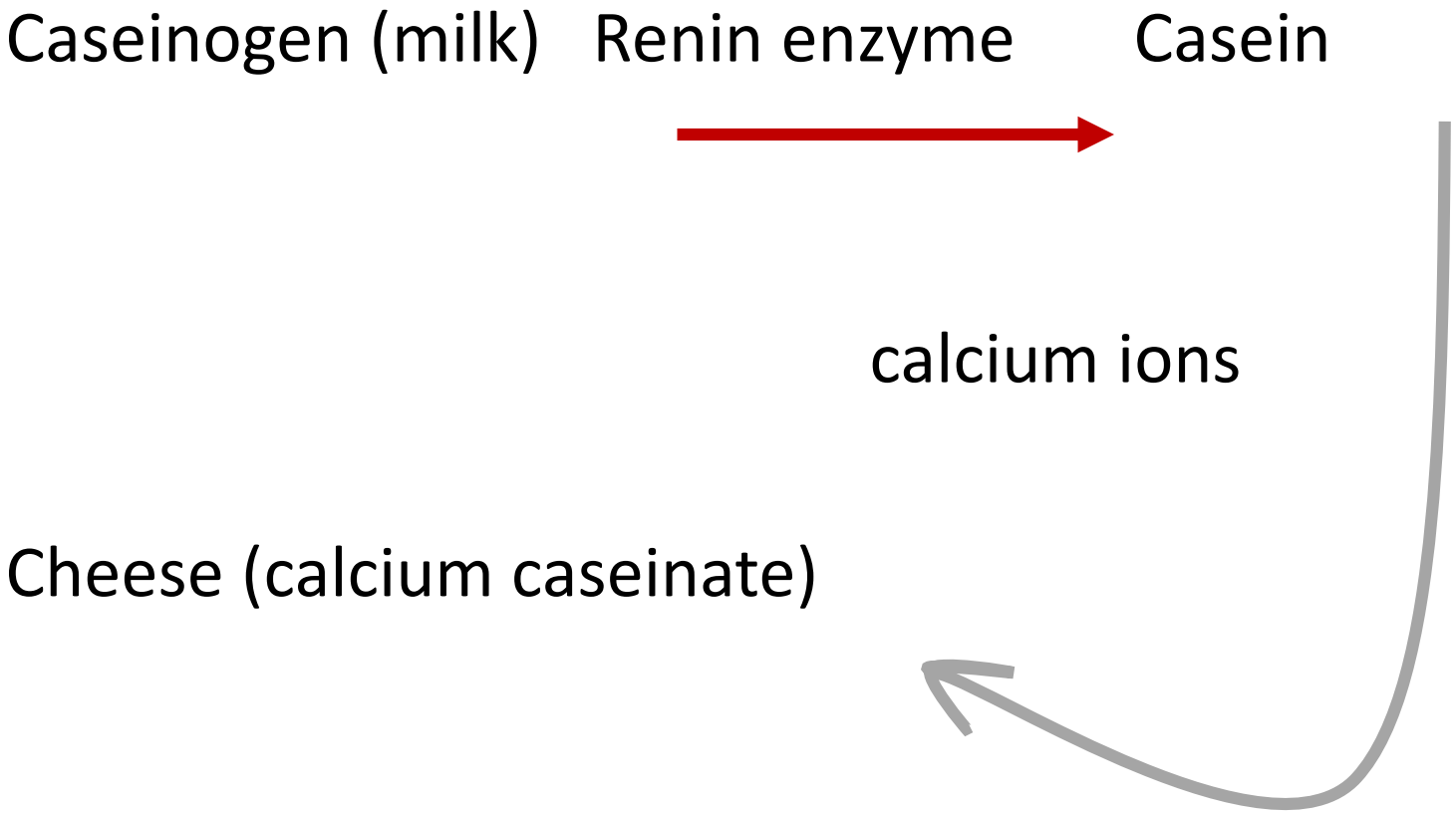
- It is one of the main enzymes responsible for digesting proteins. The process of digesting proteins occurs after the acids in the stomach break down the proteins in food until the protein molecules become exposed to the enzyme pepsin. Then pepsin breaks down the proteins into peptides and amino acids. The optimal temperature for this enzyme to work is 1.2-2 pH, which is a highly acidic medium.

Rennin

- It is a protein-degrading enzyme related to the pepsin enzyme, produced in the stomachs of some mammals and used in cheese making.
- **Rennet**: It is a synthetic form of the enzyme renin, and its English name is Rennet. It contains the enzyme renin and is used in cheese making.

- Rennin enzyme works to convert milk protein (caseinogen) into soluble casein, which combines with calcium in milk to form calcium caseinate, which precipitates in the form of a clotted mass known as cheese.

Cheese Formation Equation



Effect of renin enzyme on milk

- 1-Take two test tubes and put 5 ml of milk in each one.
- 2-Add 1 ml of potassium oxalate to each tube.
- 3-Place the two tubes in a water bath at 37-40 degrees for 5 minutes.
- 4-Add 10 drops of Renin enzyme solution to each tube and observe the results.

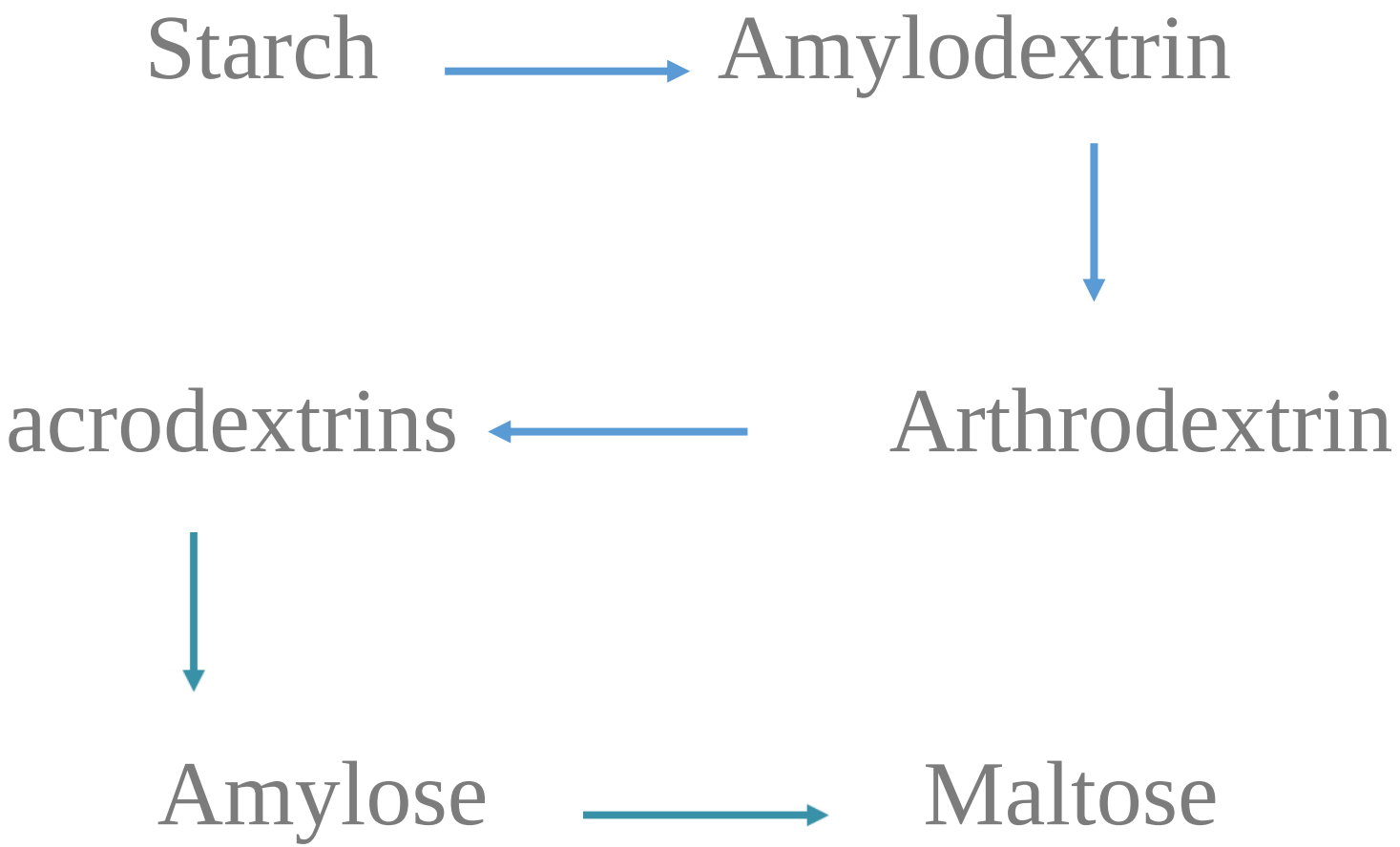
- 6-After waiting for 5 minutes, add 1.5 ml of calcium chloride solution to one of the tubes. Record the results and compare the two tubes.

Amylase

- It is an enzyme secreted by the body through the pancreas and salivary glands in the mouth, which in turn works to digest carbohydrates, by converting starches, glycogen and sugars into small digestible sugar molecules (glucose), as glucose is transported through the bloodstream to the rest of the body to provide it with energy, and this happens when eating foods rich in carbohydrates, as the salivary glands secrete the enzyme amylase, which in turn breaks down carbohydrate molecules into smaller parts until they reach the intestines, at which point the process of digesting carbohydrates is completed through the enzyme amylase secreted by the pancreas, and the enzyme amylase is also found in bacteria, yeasts and plants

Amylase enzyme activity test

- Starch is hydrolyzed by salivary amylase enzyme into high dextrins which give a blue-bronze or brown colour with iodine followed by erythrodextrins which give a red or orange-red color with iodine followed by acrodextrins which give no color with iodine then the final stage which is maltose.


Starch
Amylodextrin
Arthrodextrin
acrodextrins
Amylose
Maltose

Temperature effect .

1- Take four test tubes and put 5 ml of milk in each one.
2- Take four other tubes and put 0.5 ml of renin enzyme in each one.
3- Put a tube of enzyme and a tube of milk in an ice bath (0 degrees Celsius)
4- Put a tube of enzyme and a tube of milk at room temperature.

- 5- Put a tube of enzyme and a tube of milk in (37-40 degrees Celsius).
- 6- Put a tube of enzyme and a tube of milk in (80 degrees Celsius)
- 7- Wait for 15 minutes.
- 8- Mix both tubes and observe the curdling.. and record the time.
- 9- Draw a graph that shows the relationship between temperature and enzyme activity.

Tube No.	benedict test	Iodin test	Time/ min
1			0
2			15
3			30
4			45
5			60
6			75
7			90
8			105
9			120
10			