Macromolecules of biological System :Carbohydrates

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Introduction

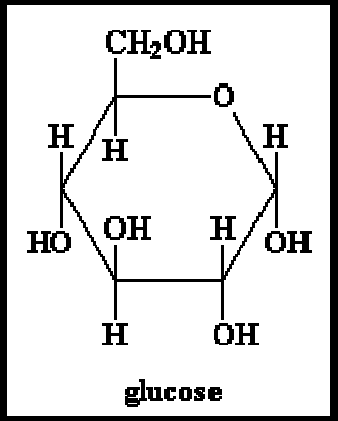
- A macromolecule is a very large molecule commonly created by polymerization of smaller subunits. In biochemistry, the term is applied to the four conventional biopolymers –
- nucleic acids,
- proteins,
- lipids and
- carbohydrates.
- The individual constituent molecules of macromolecules are called monomers (mono=single, meros=part).
- The term macromolecule was coined by Nobel laureate Hermann Staudinger in the 1920s.

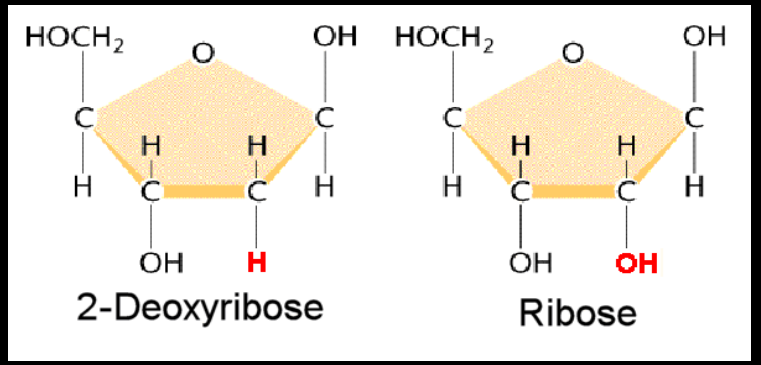
Carbohydrates

- Carbohydrates typically have CnH2nOn formula.
- There are three types of carbohydrates, monosaccharides contain one sugar, disaccharides contain two sugars, and polysaccharides contain many sugars.
- Polysaccharides play important roles in cells such as energy storage (animal glycogen) and structure support (plant cellulose).

Monosaccharides

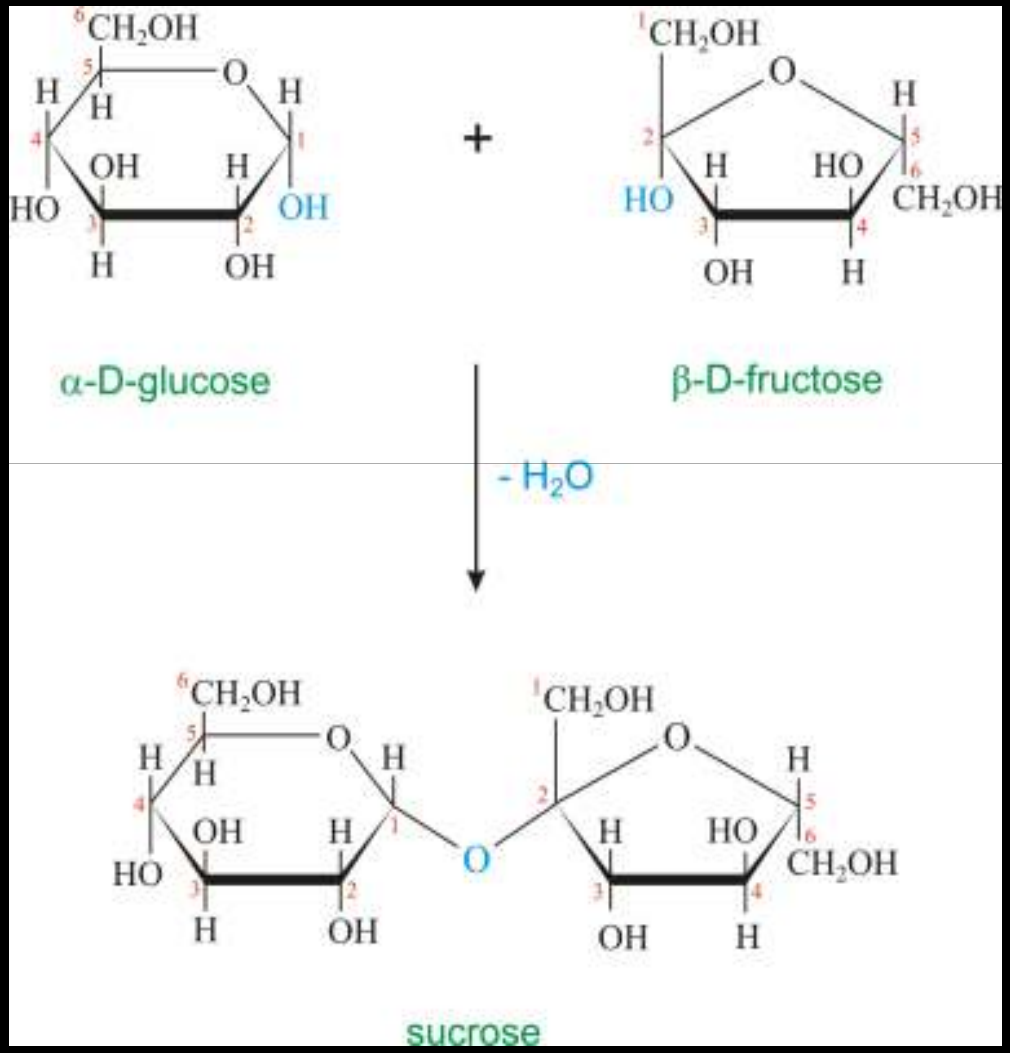
- Monosaccharides are the simplest carbohydrates in that they cannot be hydrolyzed to smaller carbohydrates.
- Monosaccharides with three carbon atoms are called trioses, those with four are called tetroses, five are called pentoses, six are hexoses, and so on.
- Example: Glucose, Dextrose, Ribose





Disaccharide

- Two joined monosaccharides are called a disaccharide and these are the simplest polysaccharides. Examples include sucrose and lactose. They are composed of two monosaccharide units bound together by a covalent bond known as a glycosidic linkage.
- Sucrose, is the most abundant disaccharide, and the main form in which carbohydrates are transported in plants. It is composed of one D-glucose molecule and one D-fructose molecule.
- Lactose, a disaccharide composed of one D-galactose molecule and one D-glucose molecule, occurs naturally in mammalian milk.

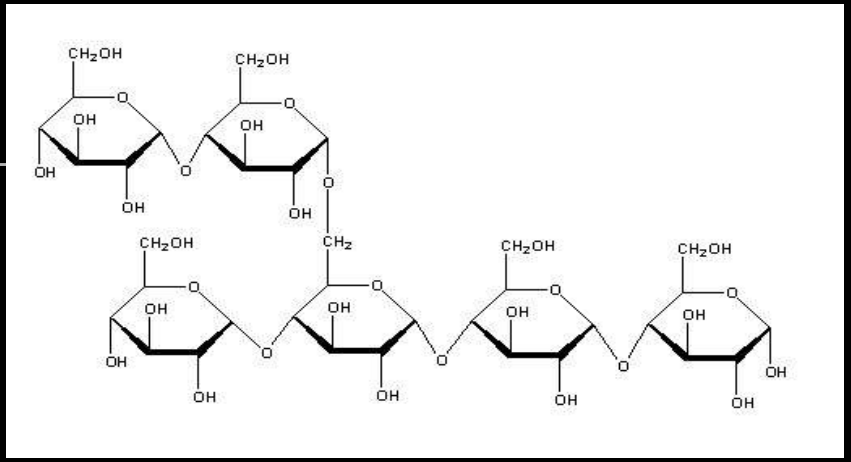

α-D-glucose
β-D-fructose
- H2O
sucrose

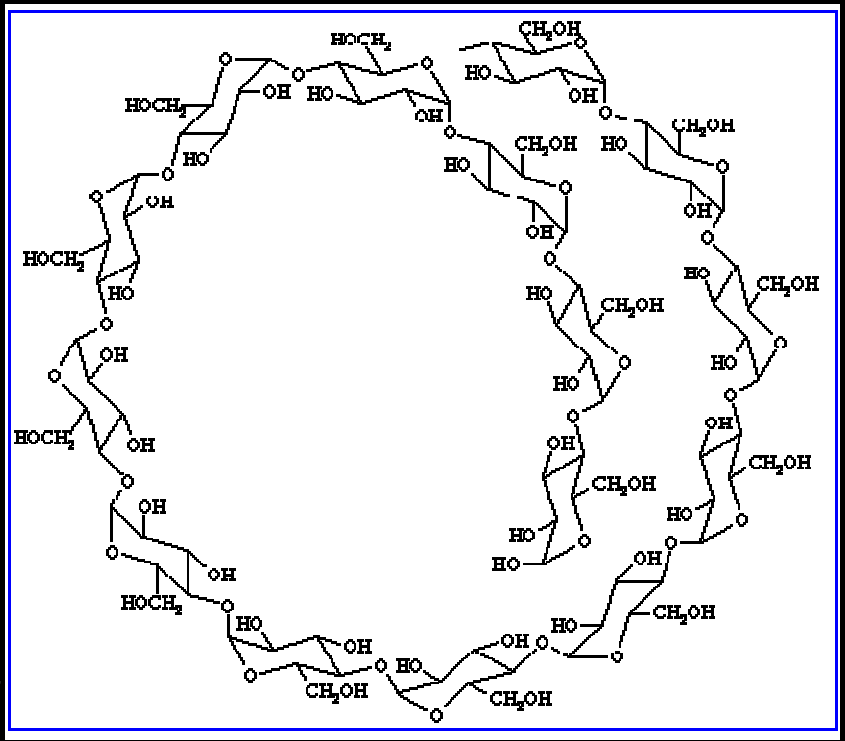
Polysaccharides

- Polysaccharides are polymeric carbohydrate molecules composed of long chains of monosaccharide units bound together by glycosidic bonds.
- They range in structure from linear to highly branched.
- Examples include storage polysaccharides such as starch and glycogen, and structural polysaccharides such as cellulose and chitin.

Starch

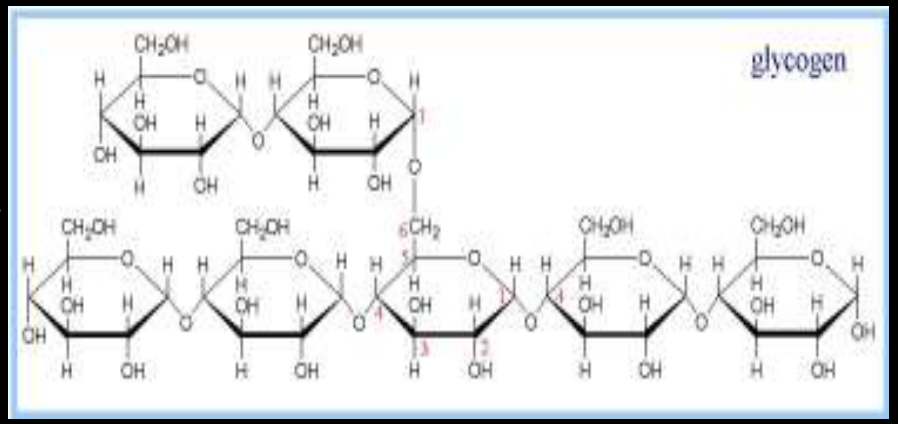
- Starch is the most common carbohydrate in the human diet. The major sources of starch intake worldwide are the cereals (rice, wheat, and maize) and the root vegetables (potatoes and cassava).
- Widely used prepared foods containing starch are bread, pancakes, cereals, noodles, pasta, porridge and tortilla.

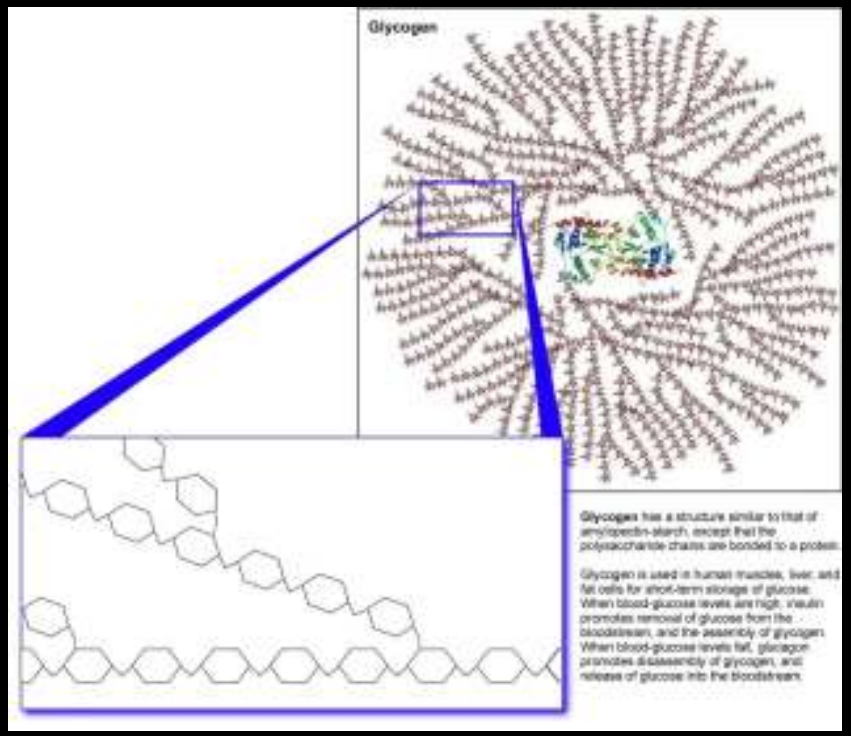




Glycogen

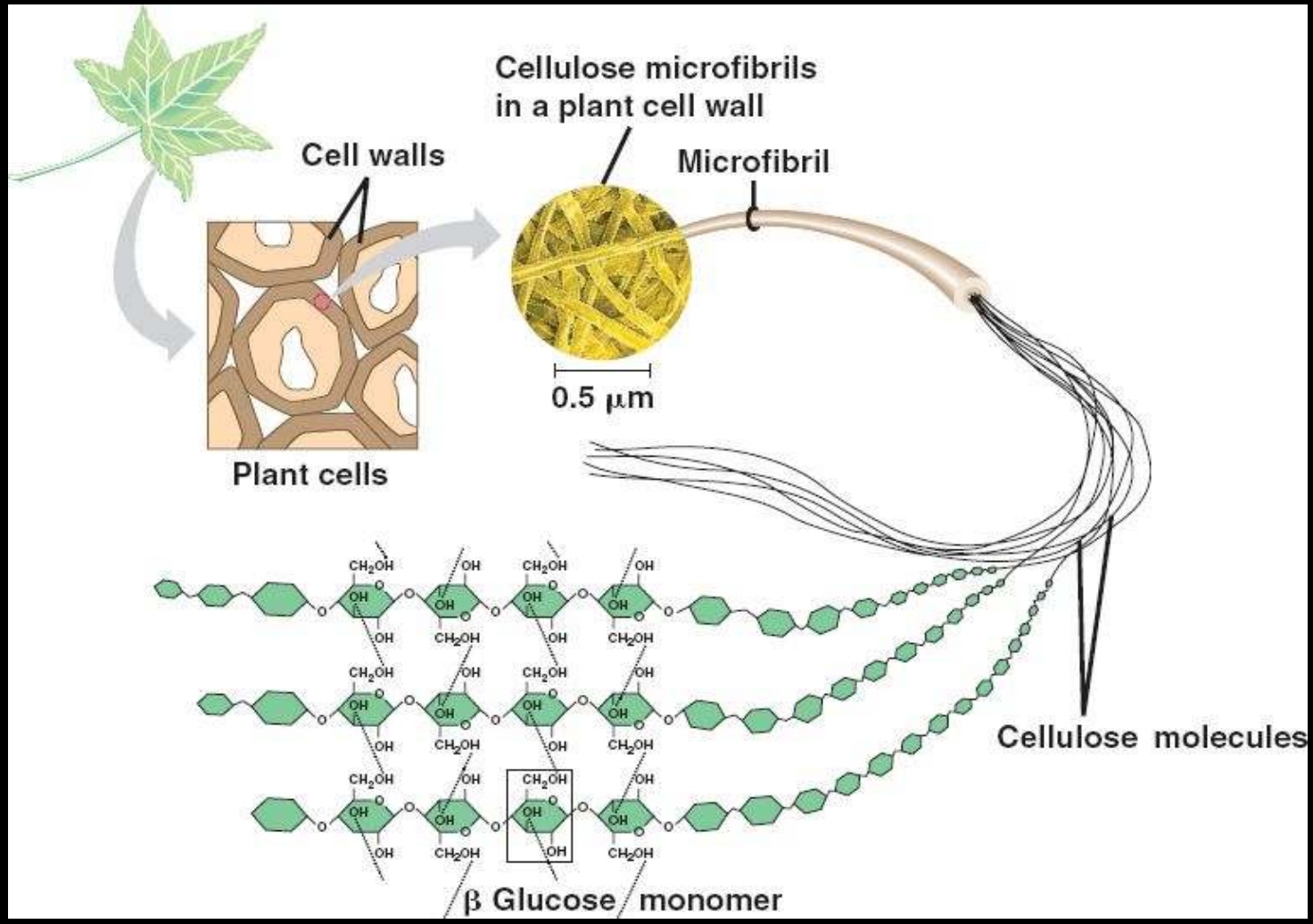
- Glycogen is a multibranched polysaccharide of glucose that serves as a form of energy storage in animals and fungi. The polysaccharide structure represents the main storage form of glucose in the body.
- In humans, glycogen is made and stored primarily in the cells of the liver and the muscles, and functions as the secondary long-term energy storage.





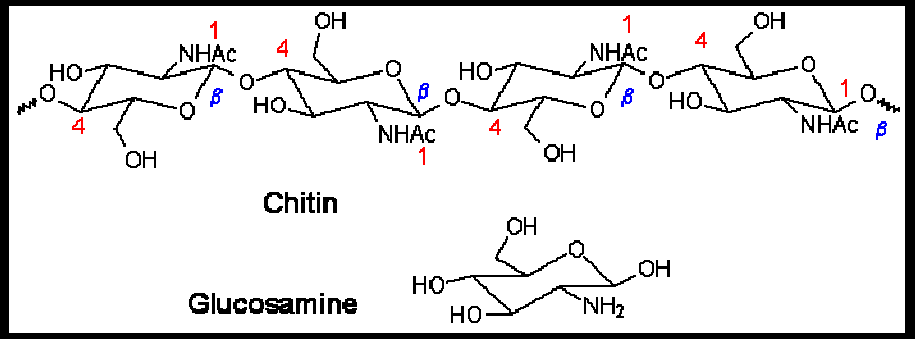
Cellulose

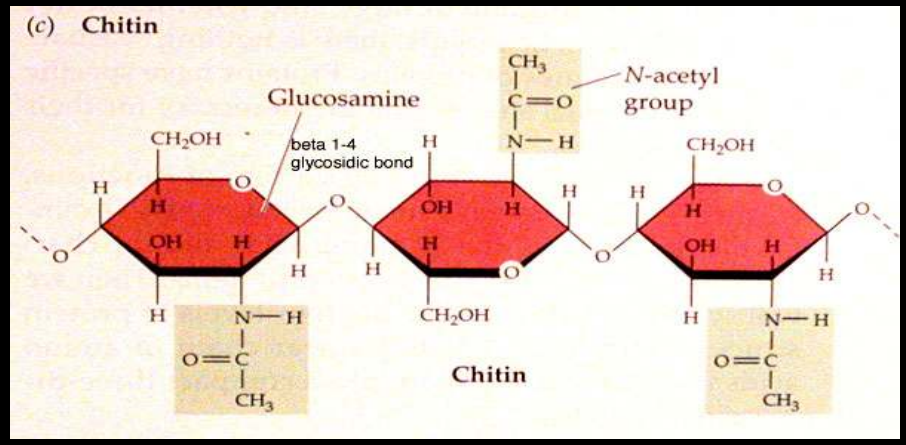
- Cellulose is an organic compound with the formula (C 6H10O5)n, a polysaccharide consisting of a linear chain of several hundred to over ten thousand β(1→4) linked D-glucose units.
- Cellulose is an important structural component of the primary cell wall of green plants, many forms of algae. Cellulose is mainly used to produce paperboard and paper.
- Conversion of cellulose from energy crops into biofuels such as cellulosic ethanol is under investigation as an alternative fuel source.


Cellulose microfibrils
in a plant cell wall
Cell walls
Microfibril
0.5 μm
Plant cells
Cellulose molecules
β Glucose monomer

Chitin

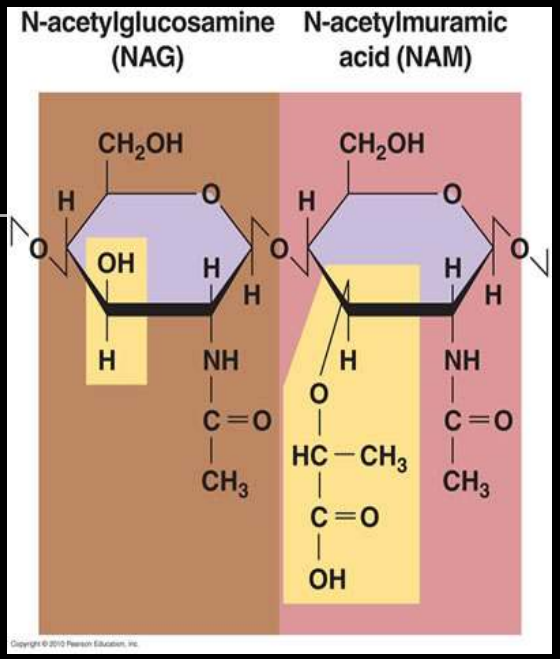
- Chitin (C8H13O5N)n is a long-chain polymer of a N-acetylglucosamine, a derivative of glucose, and is found in many places throughout the natural world.
- It is the main component of the cell walls of fungi, the exoskeletons of arthropods such as crustaceans (e.g., crabs, lobsters and shrimps) and insects, the radulas of mollusks.

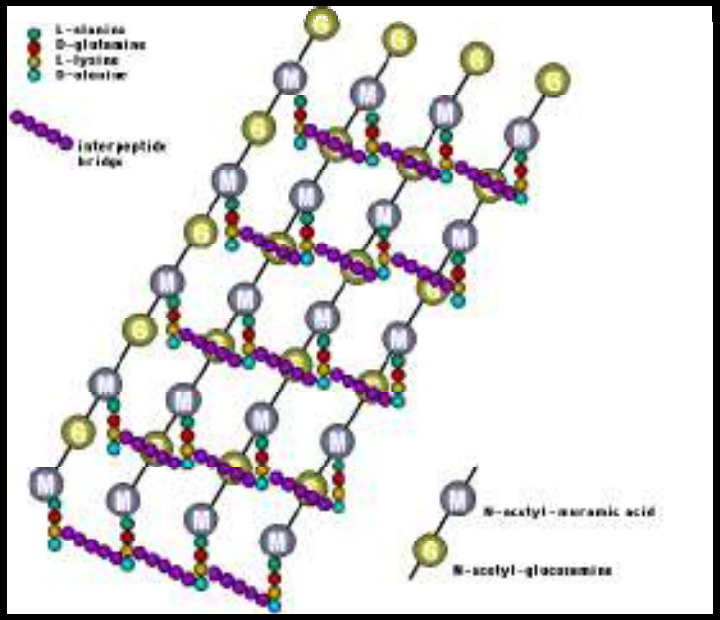




Peptidoglycan

- Peptidoglycan, also known as murein, is a polymer consisting of sugars and amino acids that forms a mesh-like layer outside the plasma membrane of bacteria (but not Archaea), forming the cell wall.
- The sugar component consists of alternating residues of β-(1,4) linked N-acetylglucosamine and N-acetylmuramic acid. Attached to the N-acetylmuramic acid is a peptide chain of three to five amino acids.



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