POLYSACCHARIDES

BIOCHEMISTRY

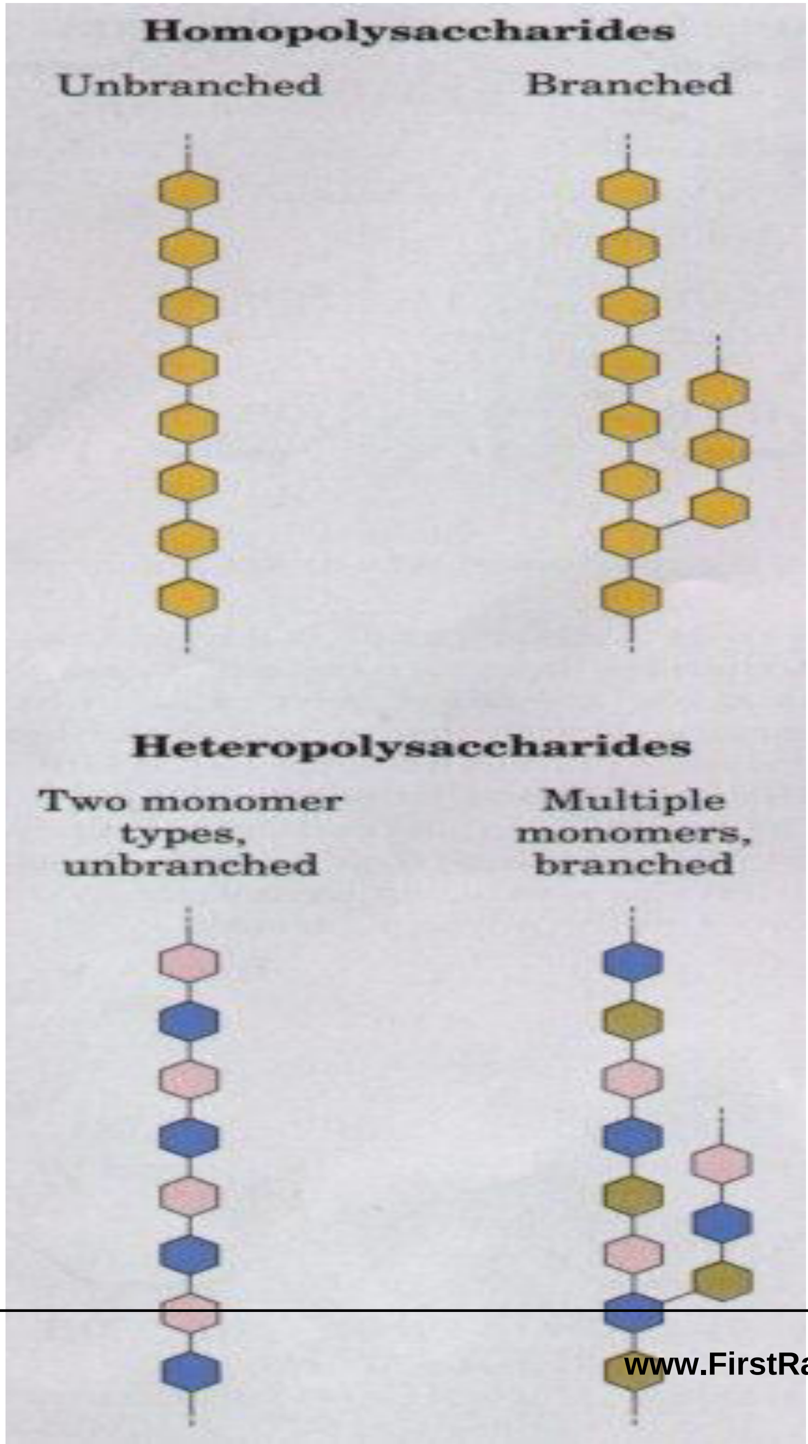
POLYSACCHARIDES

- 2 types:
  - **HOMO polysaccharides** (all 1 type of monomer)

glycogen, starch, cellulose, chitin

  - **HETERO polysaccharides** (different types of monomers)

    peptidoglycans, glycosaminoglycans


Homopolysaccharides
Unbranched
Branched
Heteropolysaccharides
Two monomer types, unbranched
Multiple monomers, branched

- **Functions:**
  - **glucose storage** (glycogen in animals & bacteria, starch in plants)
  - **structure** (cellulose, chitin, peptidoglycans, glycosaminoglycans)

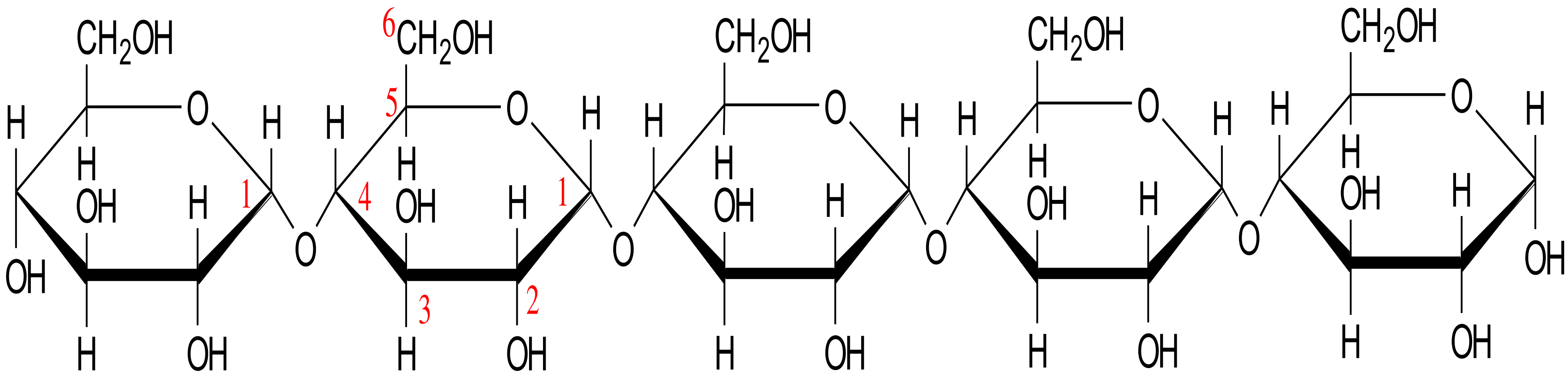
- **Information** (cell surface oligo- and polysaccharides, on proteins/glycoproteins and on lipids/glycolipids)

STARCHES

- Starches are polymers of glucose. Two types are found:
- Amylose – 15-20 %
- Amylopectin – 80-85 %
- Does not act as a reducing sugar.

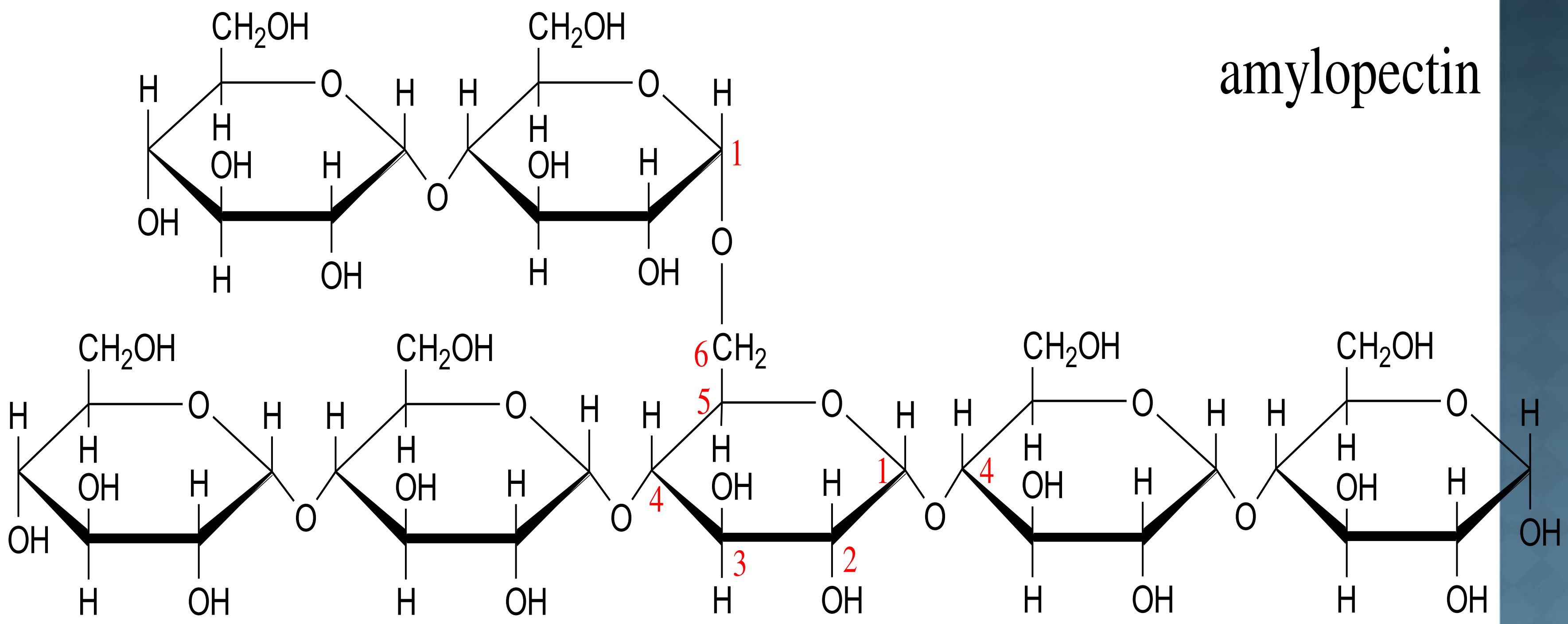
- **Amylose** consists of linear, unbranched chains of several hundred glucose residues (units).

- The glucose residues are linked by a glycosidic bond between their #1 and #4 carbon atoms.
- **(α1---4 linkages)**



amylose

- **Amylopectin** differs from amylose in being highly branched.
- At approximately every thirtieth residue along the chain, a short side chain is attached by a glycosidic bond to the #6 carbon atom .
- **(α1---4)(1---6 linkages).**



amylopectin
CH_2OH
O
H
OH
1
2
3
4
5
6
CH_2

- The total number of glucose residues in a molecule of amylopectin is several thousand.
- Starches are insoluble in water and thus can serve as storage depots of glucose. Plants convert excess glucose into starch for storage.

- Rice, wheat, and corn (maize) are major sources of starch in the human diet.
- Before starches can enter (or leave) cells, they must be digested. The hydrolysis of starch is done by amylases.

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- With the aid of an **amylase** (such as pancreatic amylase), water molecules enter at the 1 -> 4 linkages, breaking the chain and eventually producing a mixture of **glucose** and **maltose**

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DEXTRANS

- They are formed in the lab.
- They have different molecular sizes
- Their solutions are very viscous
- α-D glucose polymers
- Used as **plasma expanders** in hypovolemic shock
- In nature form an adhesive coat around certain bacteria.

GLYCOGEN

- Animals store excess glucose by polymerizing it to form **glycogen**.

- structure of glycogen is similar to that of amylopectin, although the branches in glycogen tend to be shorter and more frequent.

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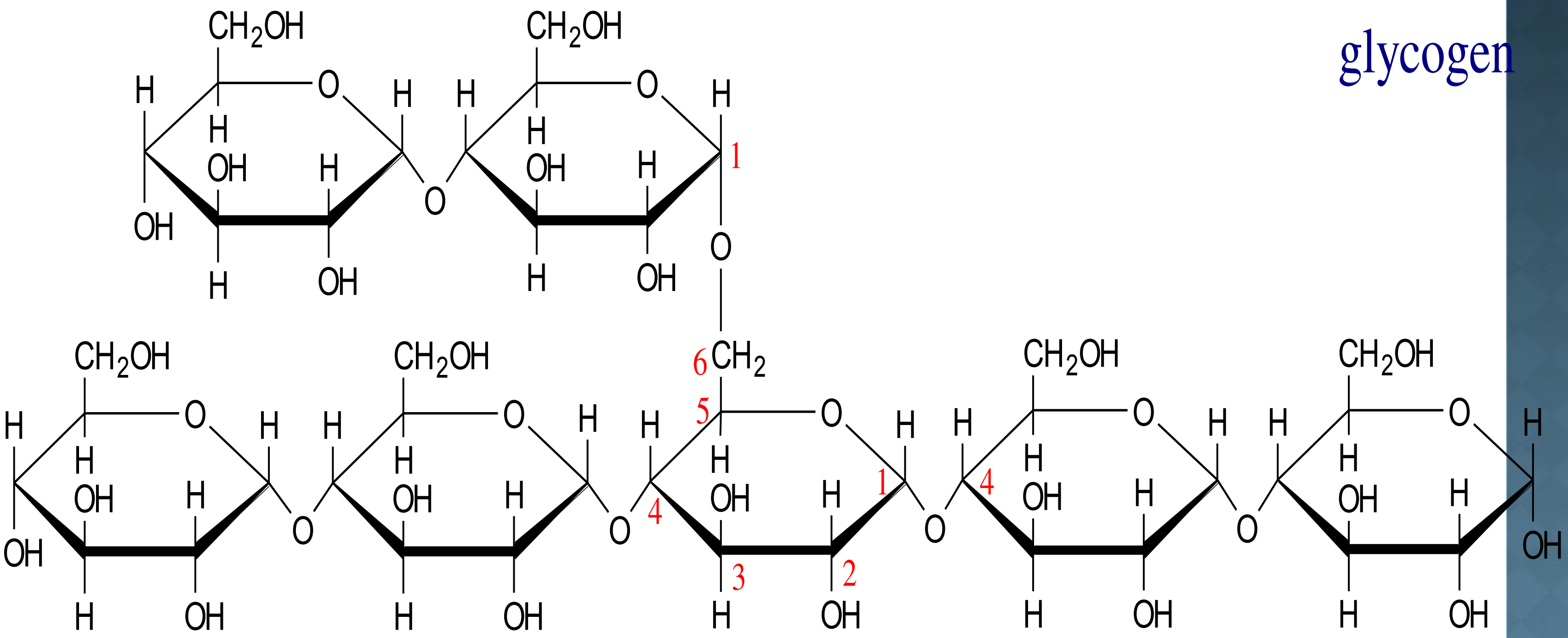
glycogen



- Glycogen is broken down into glucose when energy is needed (a process called glycogenolysis.
- The highly branched structure permits rapid glucose release from glycogen stores, e.g., in muscle during exercise.

- The **liver and skeletal muscle** are major depots of glycogen.

CELLULOSE

Cellulose is the single most abundant organic molecule in the biosphere.

- It is the major structural material of which plants are made.
- Wood is largely cellulose while cotton and paper are almost pure cellulose.

- cellulose differs profoundly from starch in its properties:

1. Made up of repeating units called cellobiose (ß 1—4 linkage).

2. This produces a long, straight, rigid molecule.

3. There are no side chains in cellulose as there are in starch. The absence of side chains allows these linear molecules to lie close together.

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4. Because of the many -OH groups, as well as the oxygen atom in the ring, there are many opportunities for hydrogen bonds to form between adjacent chains.

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- The result is a series of stiff, elongated fibrils — the perfect material for building the cell walls of plants.

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