

Carbohydrates

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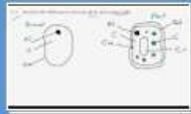
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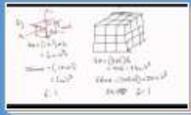
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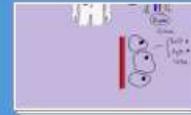
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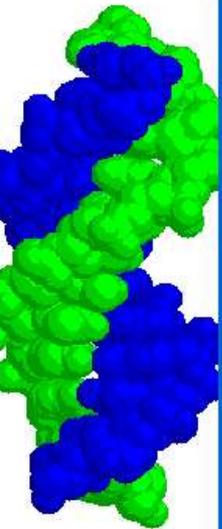
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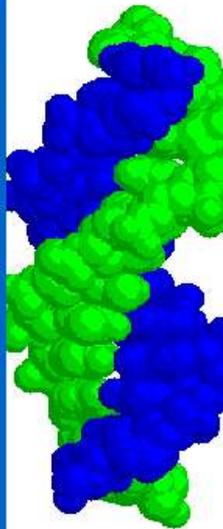
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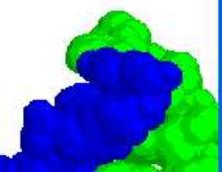
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Spacefilling model of the double helix



Spacefilling model of the double helix



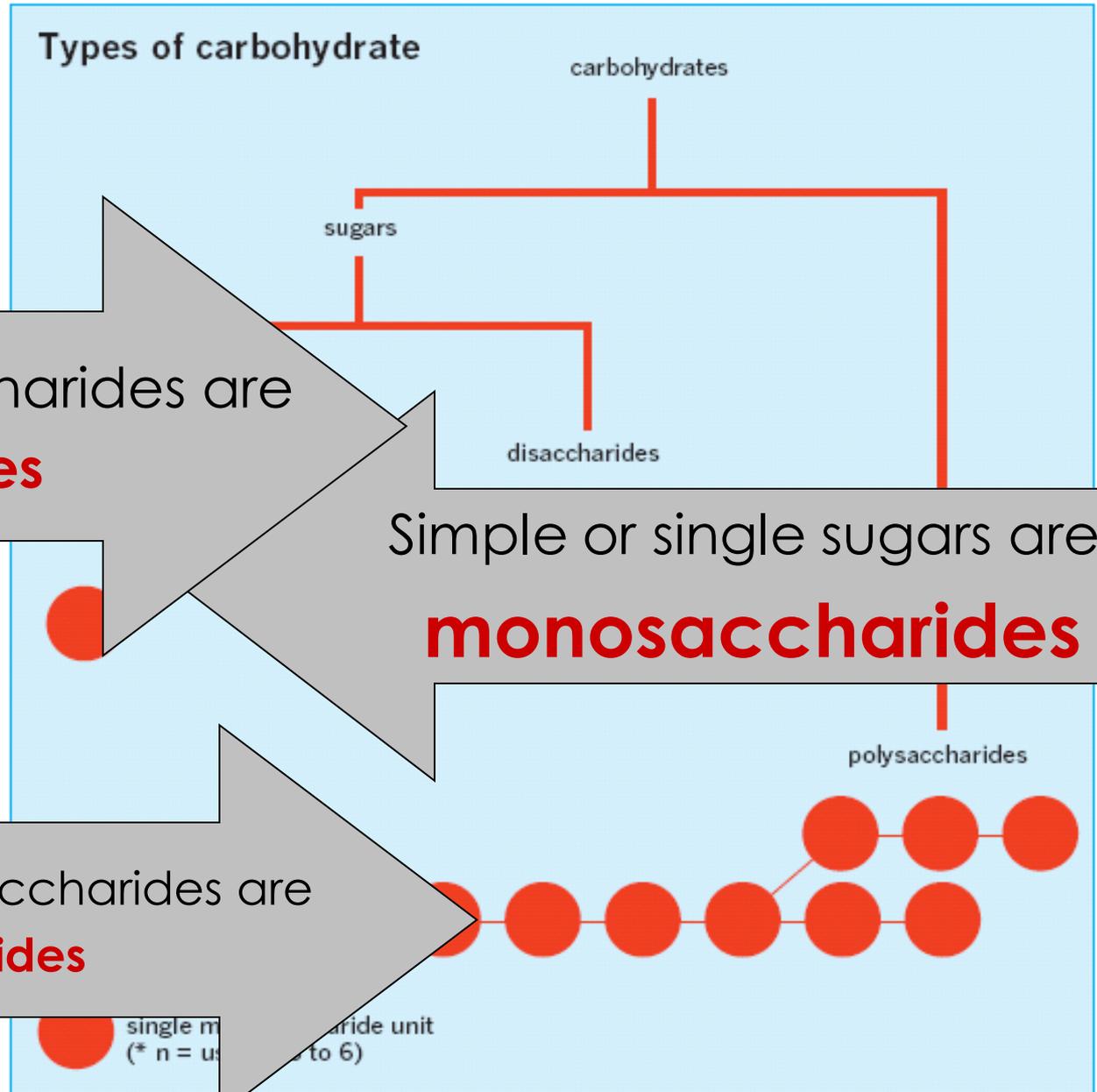
Polymer Principles

- * **Four classes of macromolecules:**
 - * **Carbohydrates**
 - * **Lipids**
 - * **Proteins**
 - * **Nucleic Acids**
- * **Polymers are made up of smaller parts called monomers.**
- * **Polymers are formed through condensation reactions.**
- * **Polymers are broken apart through a hydrolysis reaction.**

General Information about Carbohydrates

- * Are important **energy sources** for most organisms
- * Often end in “**-ose**”
- * Made of **C, H, and O**
 - * “Carbo”-contains **carbon**
 - * “Hydrate”-hydrogen and oxygen are present in the same proportions as in water (**2 H: 1 O**)

Types of carbohydrate



Two linked monosaccharides are **disaccharides**

Simple or single sugars are **monosaccharides**

Long chains of monosaccharides are **polysaccharides**

Monosaccharides -one sugar unit – are the simplest carbohydrates

- * Backbone of 3-7 carbon atoms
- * Many –OH and –H functional groups
- * Usually found in ring form in cells
- * They are characterized by **sweet taste**
- * They have several **polar** -OH groups, so they **dissolve in water**

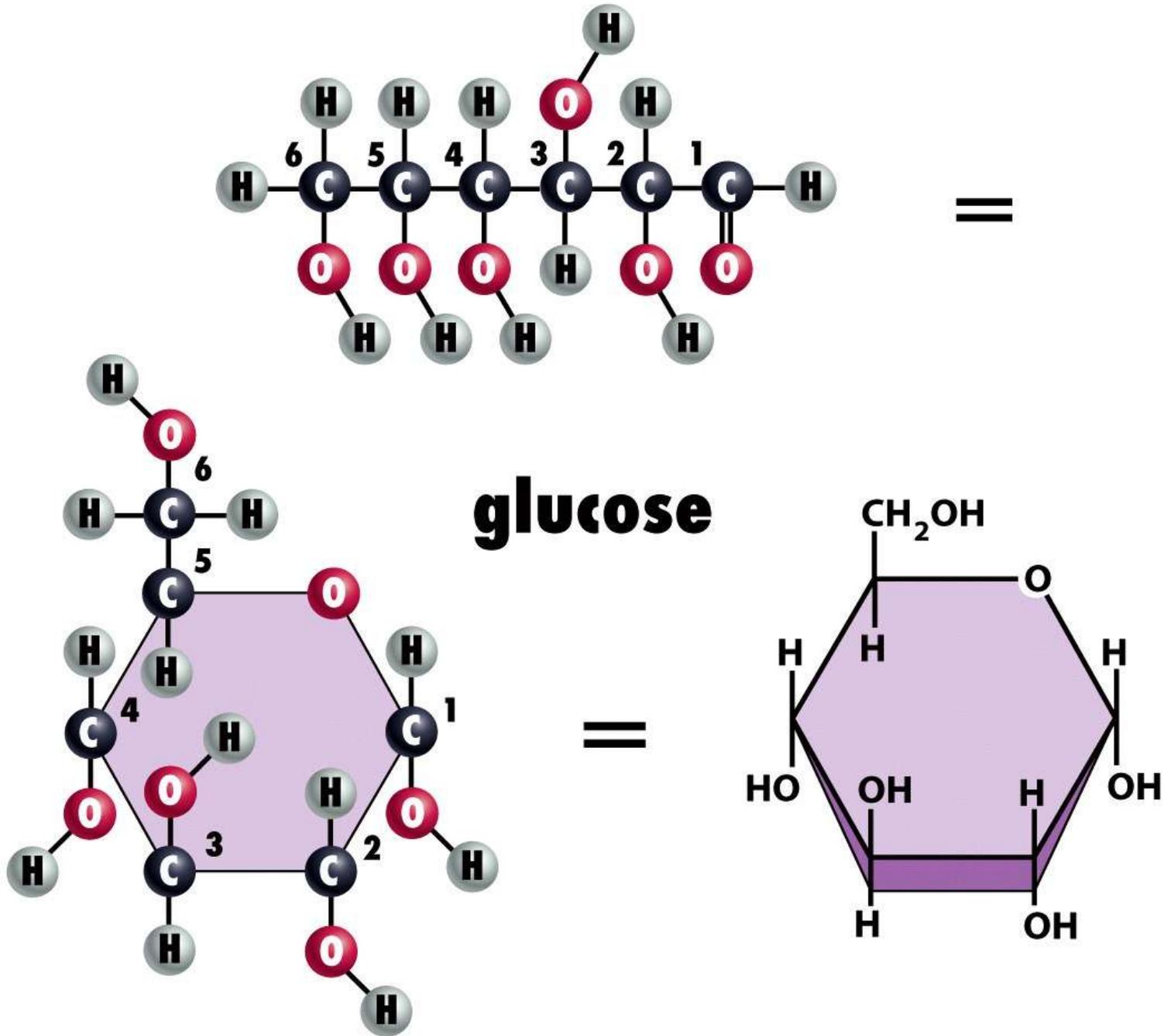
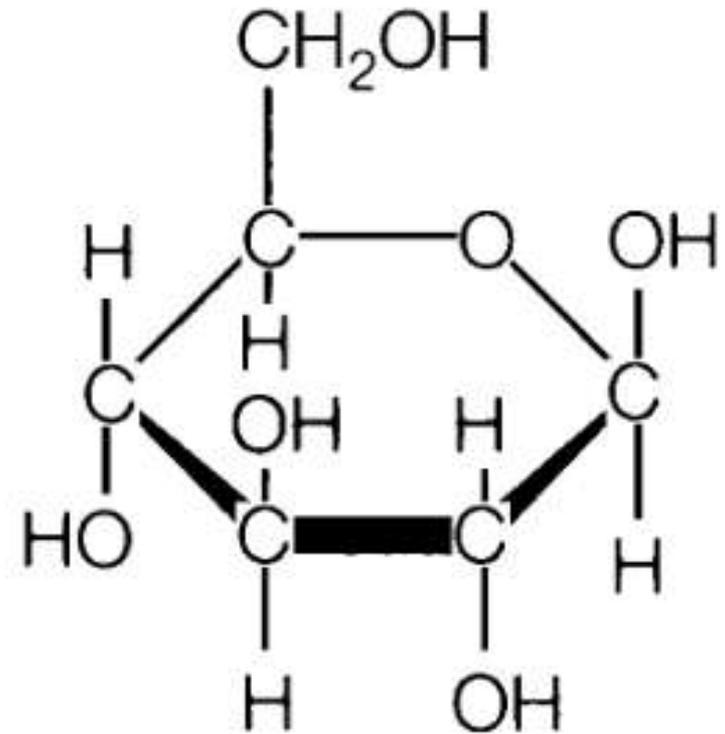
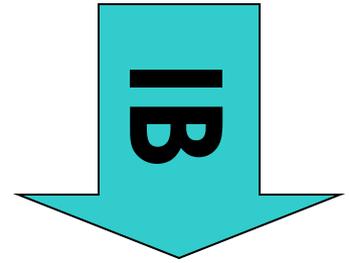


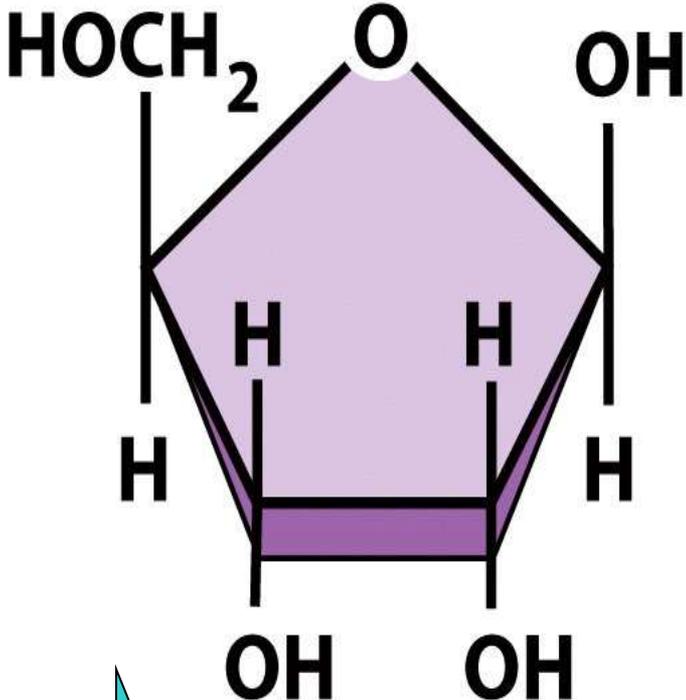
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GLUCOSE

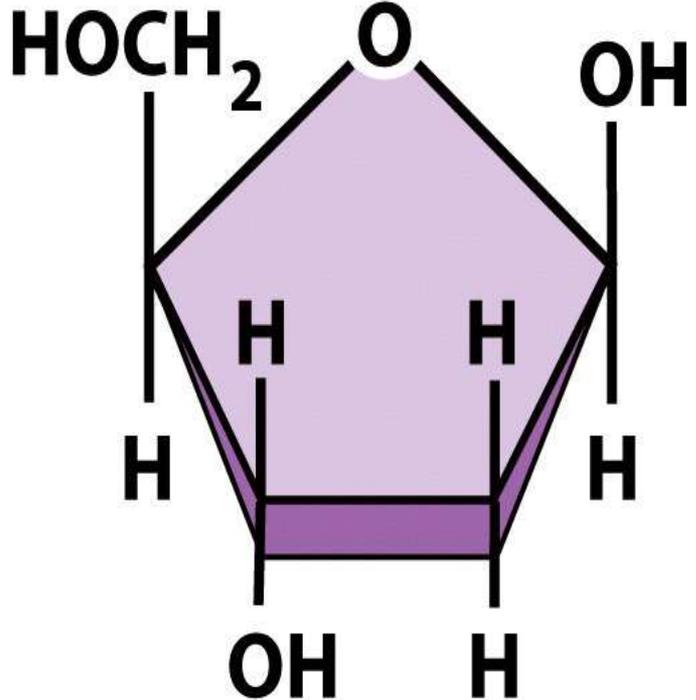
- * $(C_6H_{12}O_6)$
- * The most common monosaccharide
- * One of the products of photosynthesis.
- * In animals, glucose is synthesized in the liver and kidneys
- * Glucose is needed for ATP synthesis during cellular respiration



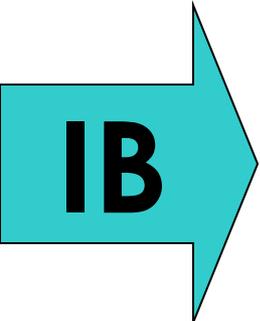
Ribose and deoxyribose are the building blocks for nucleic acids.



ribose

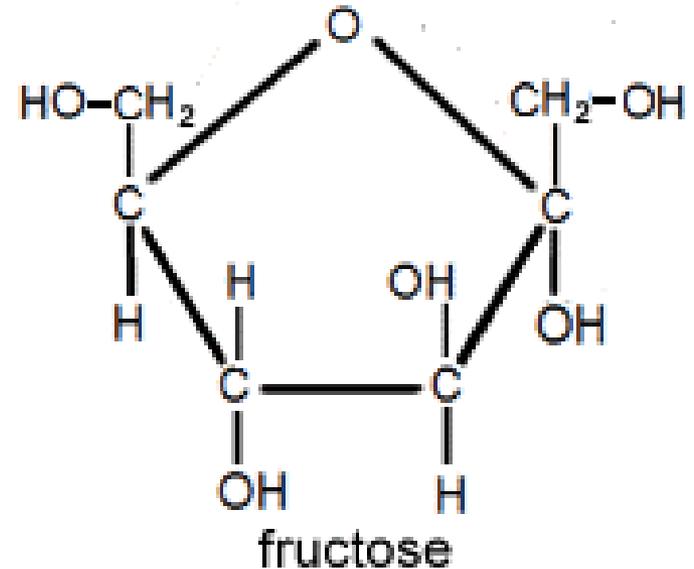


deoxyribose



FRUCTOSE

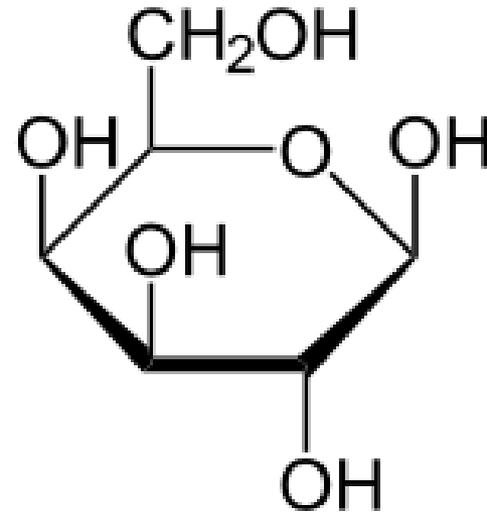
- * Found in fruits and honey.
- * It is classified as the sweetest of all the sugars.



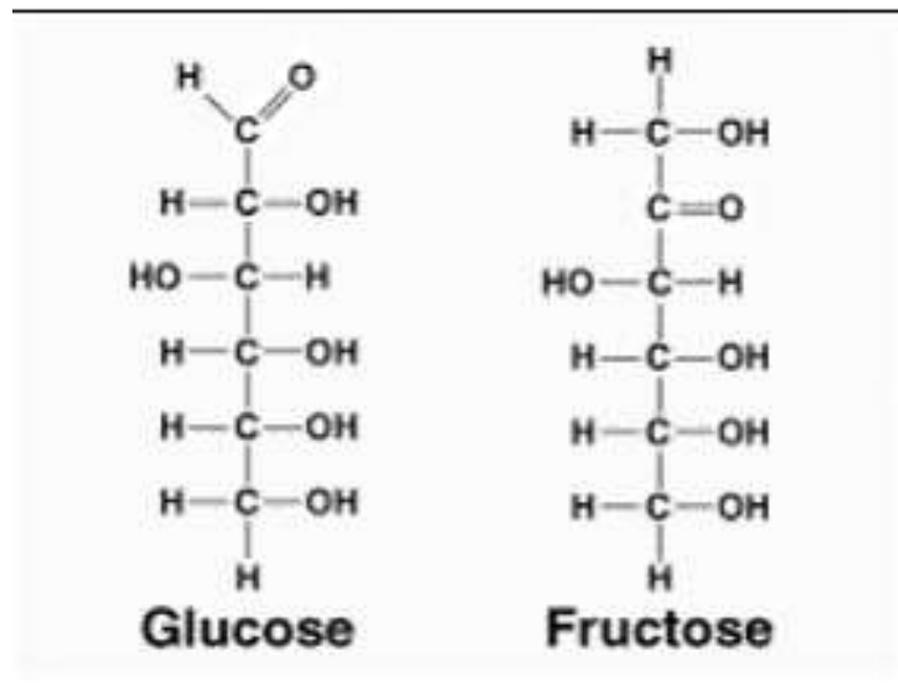
Galactose

* **Less sweet than glucose**

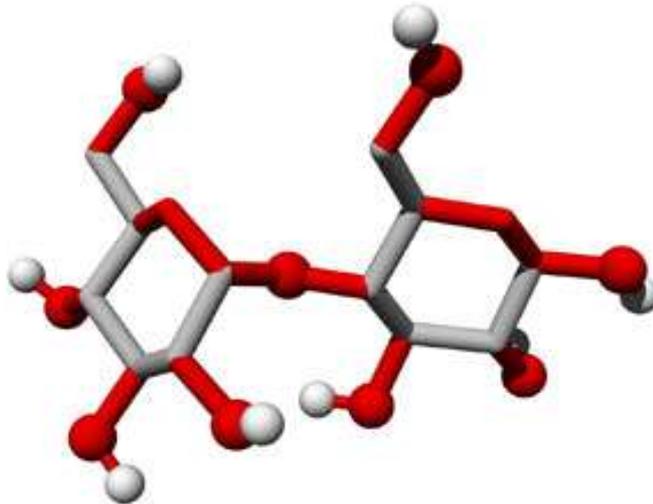
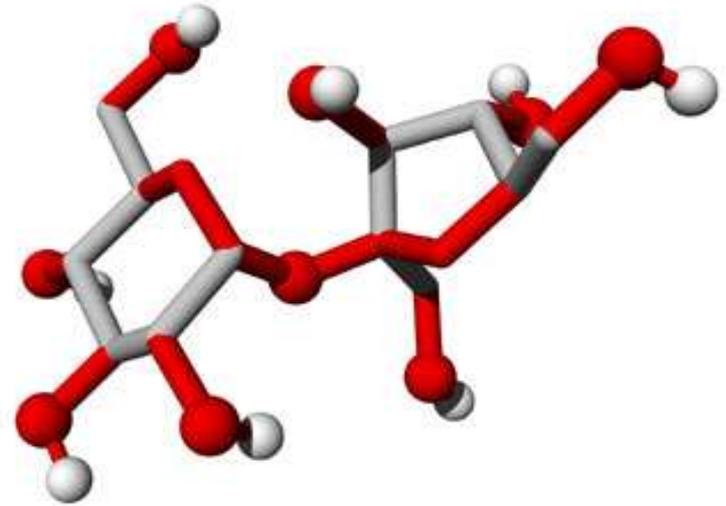
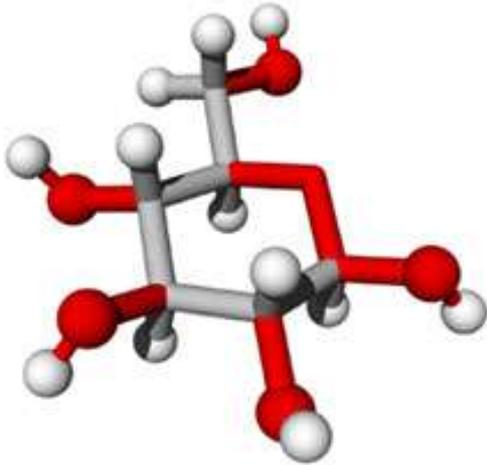
* **Milk sugar**



Glucose and fructose have the same chemical formula $C_6H_{12}O_6$ but different structural arrangement of the atoms (called **isomers**)



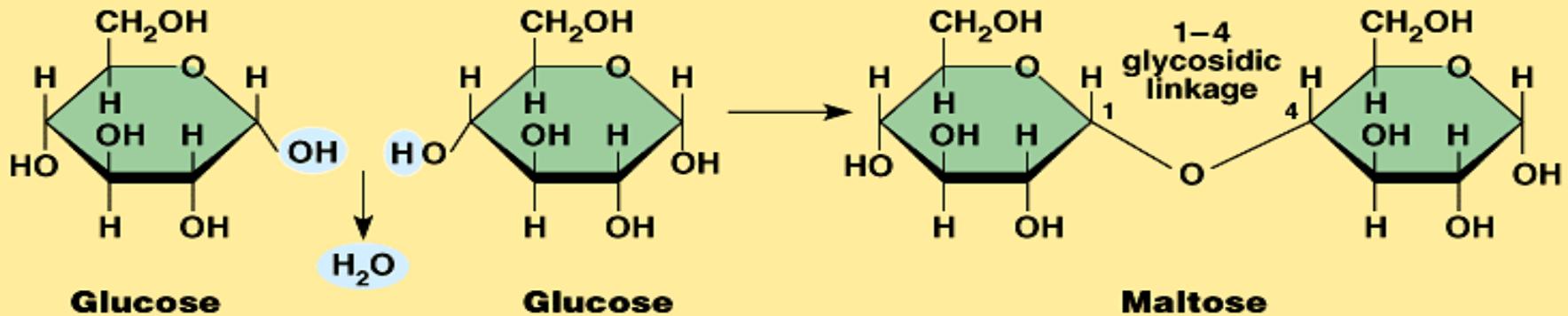
Disaccharides – two sugar units bonded together



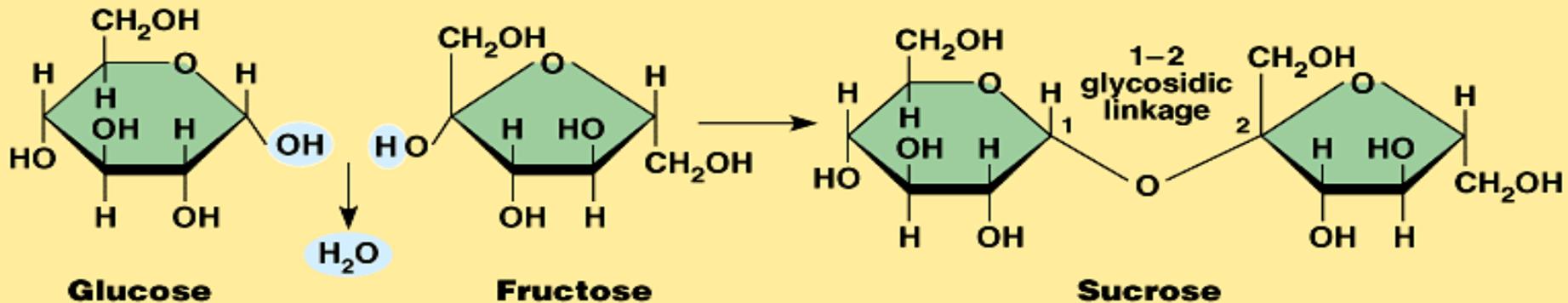
Disaccharides –two sugar unit

- * Formed through dehydration (water is removed)
- * Many –OH and –H functional groups
- * Bond can be formed between any hydroxyl group
- * They have several **polar** -OH groups, so they **dissolve in water**
- * They are not as sweet or soluble as mono-

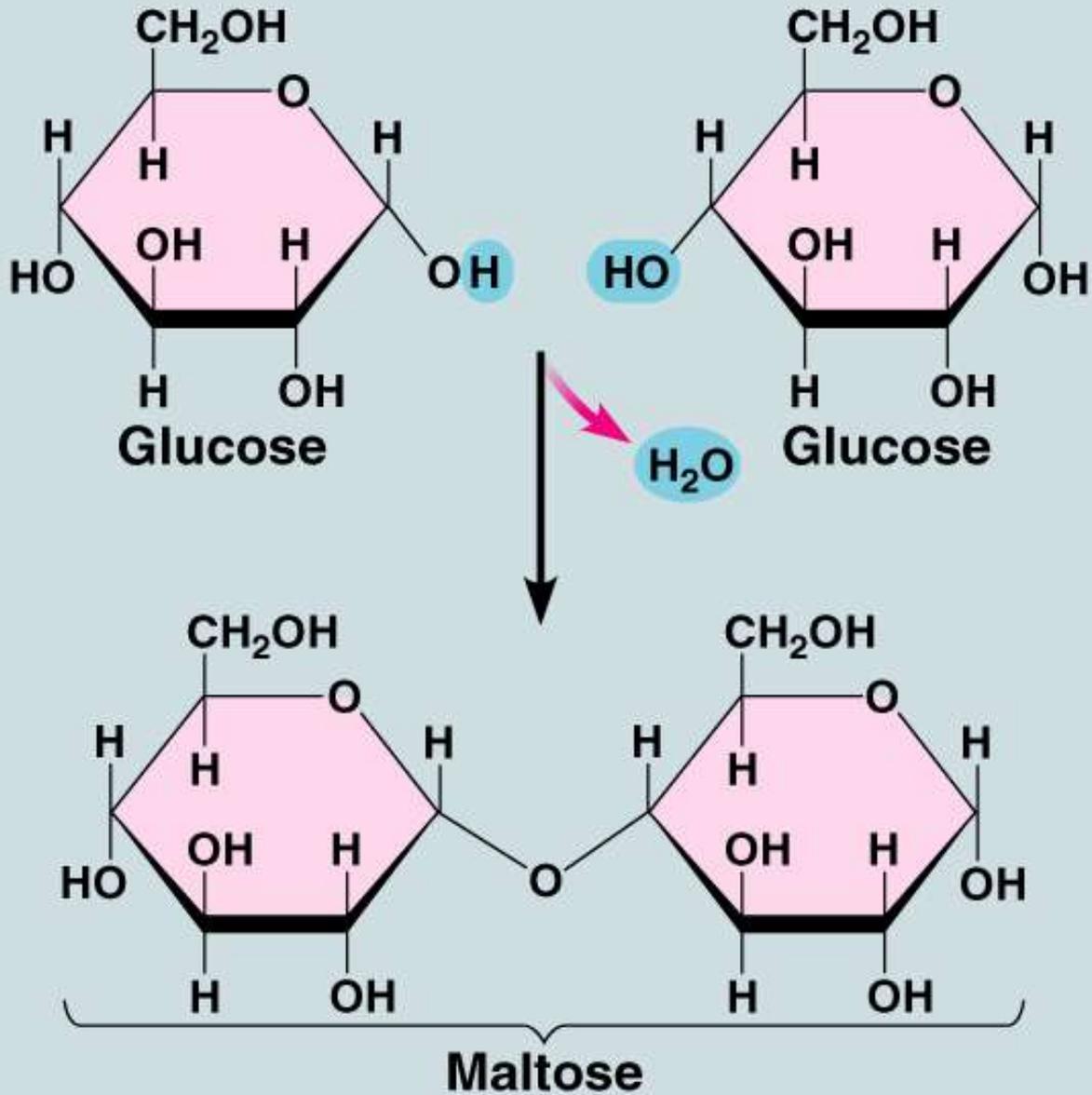
Disaccharides are formed in dehydration reactions



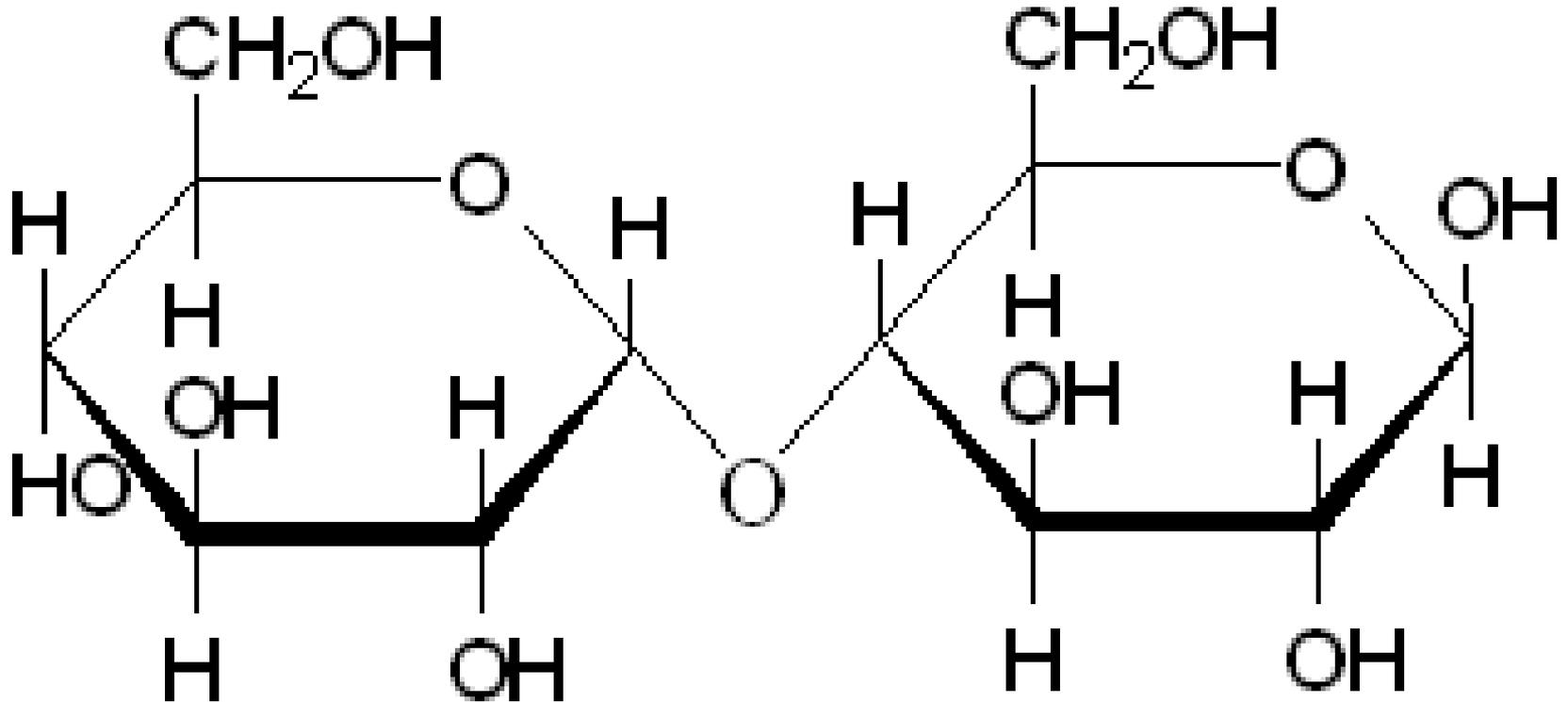
(a) Dehydration synthesis of maltose



(b) Dehydration synthesis of sucrose



Maltose (two glucose units) is present in germinating seeds.



Sucrose (glucose + fructose) is a transport form of sugar used by plants and harvested by humans for food.

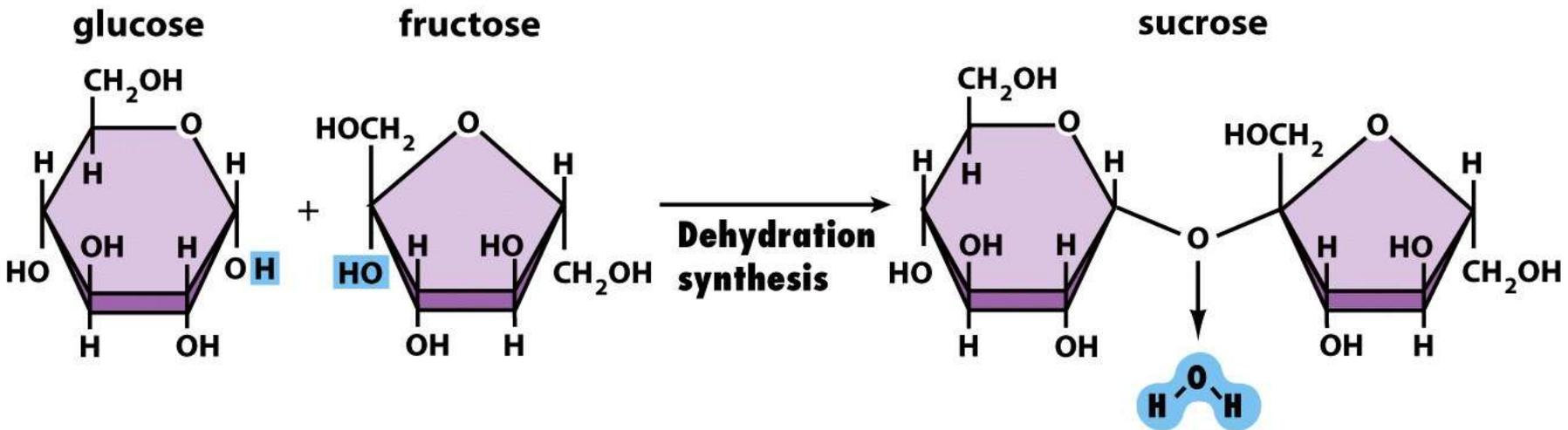
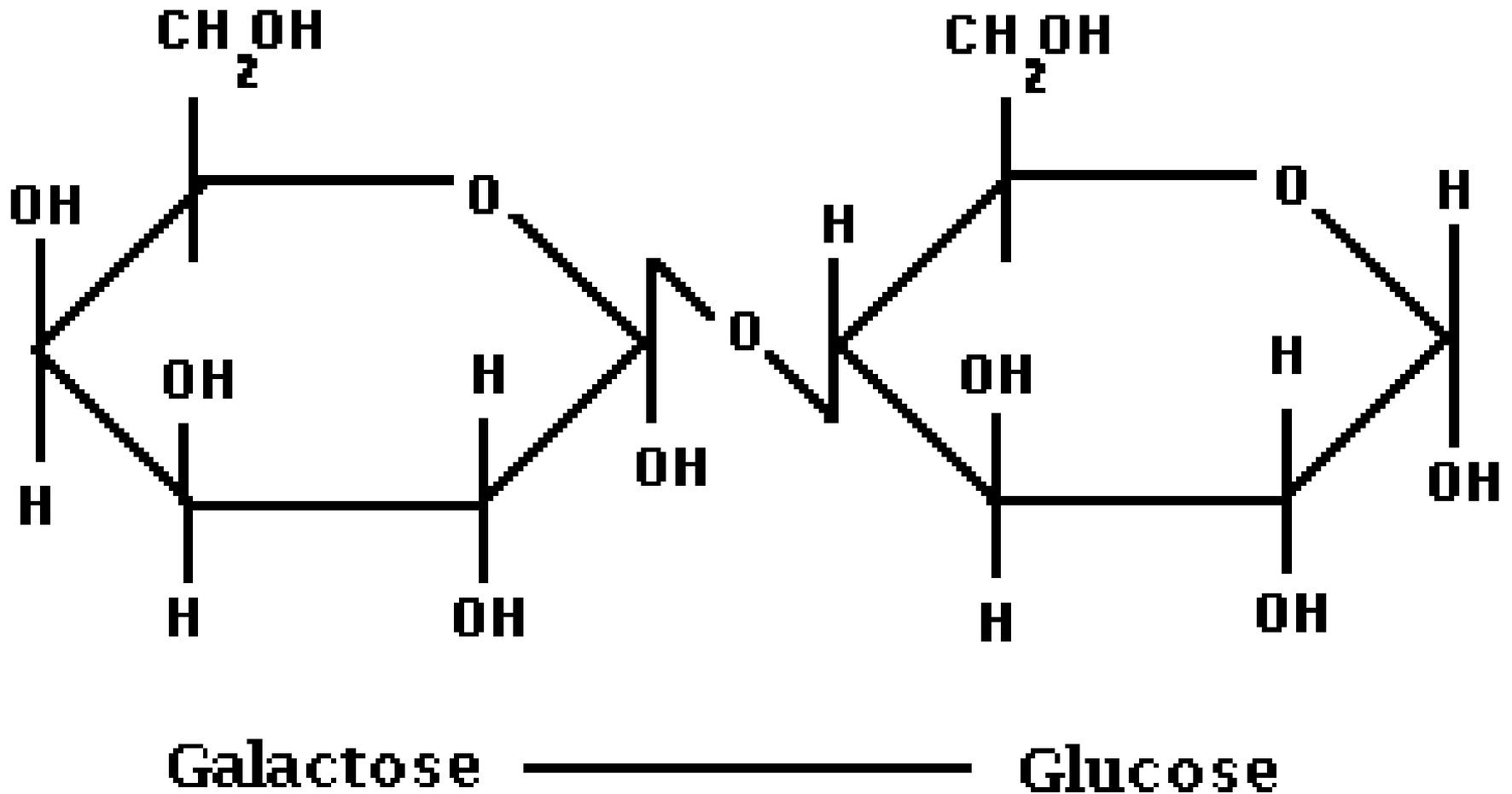


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Lactose (galactose and glucose) is present in milk



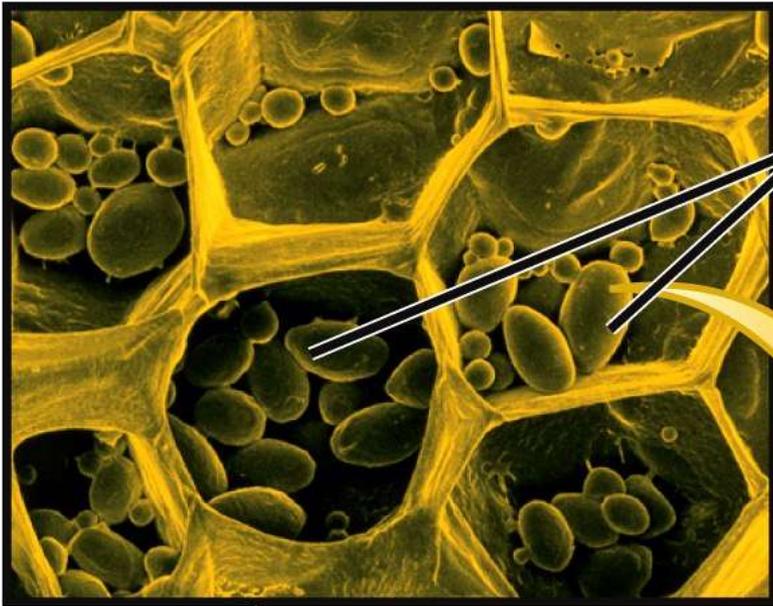
Complex carbohydrates: the polysaccharides

- * A polysaccharide is a straight or branched chain of hundreds or thousands of sugar monomers.**

Storage polysaccharides

- * Starch (polymer of glucose)
 - * Found in PLANTS
 - * Formed in roots and seeds as a form of glucose storage

- * Glycogen (polymer of glucose)
 - * Found in ANIMALS
 - * Formed in the liver as a form of glucose storage



starch globules

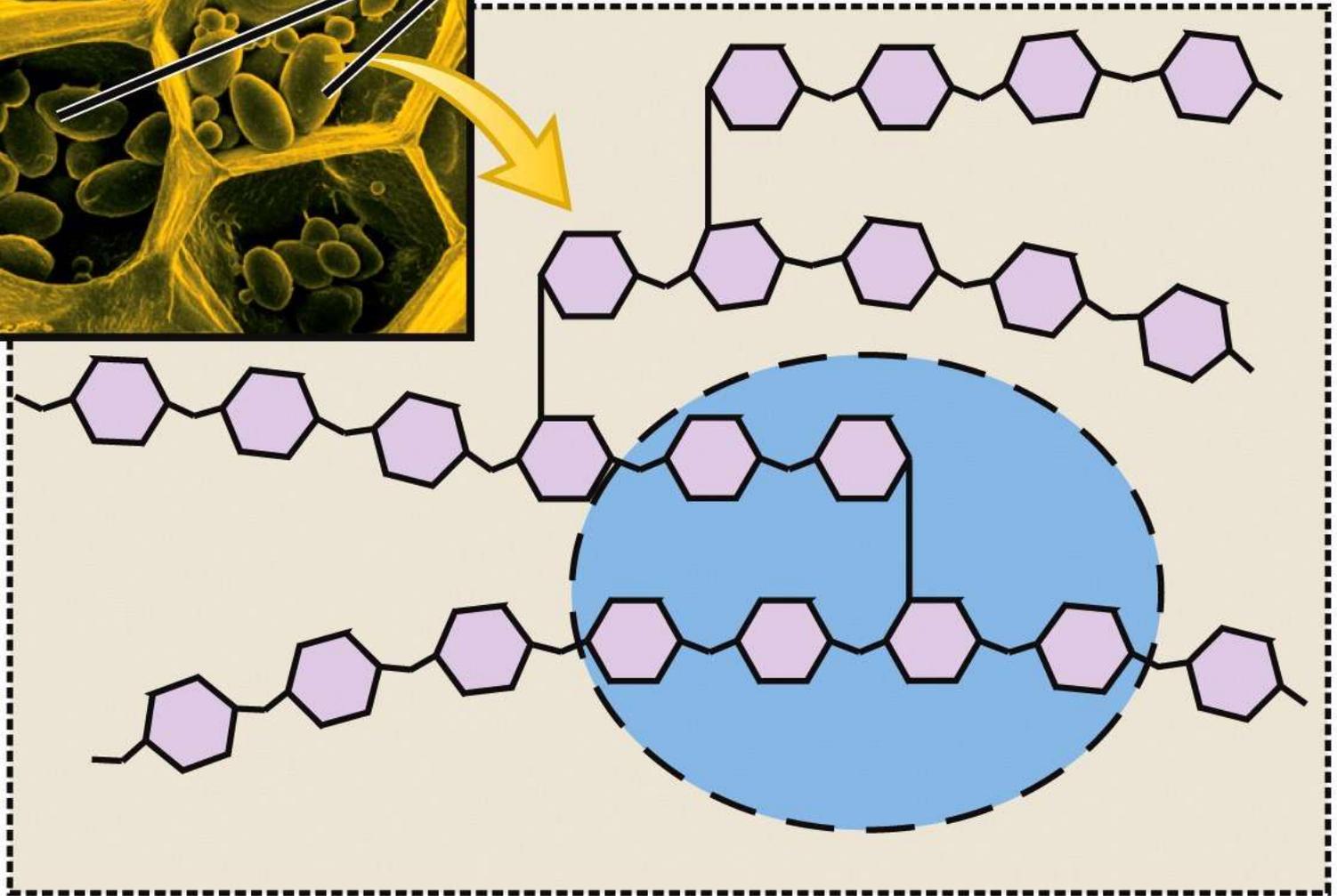


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Structural polysaccharides

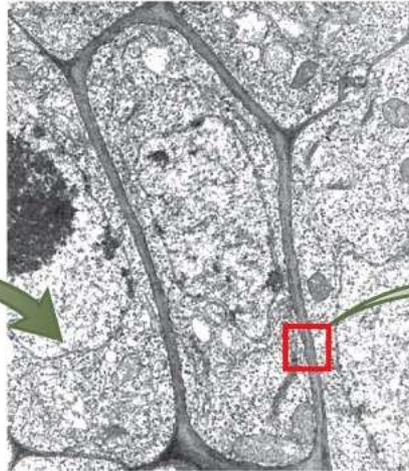
- * Cellulose (polymer of glucose)
 - * Found in the cell walls of plants
 - * Indigestible for most animals due to orientation of bonds between glucoses
- * Chitin (polymer of modified glucose units)
 - * Found in the outer coverings of insects, crabs, and spiders
 - * Found in the cell walls of many fungi

wood is mostly cellulose



(a)

plant cell with cell wall



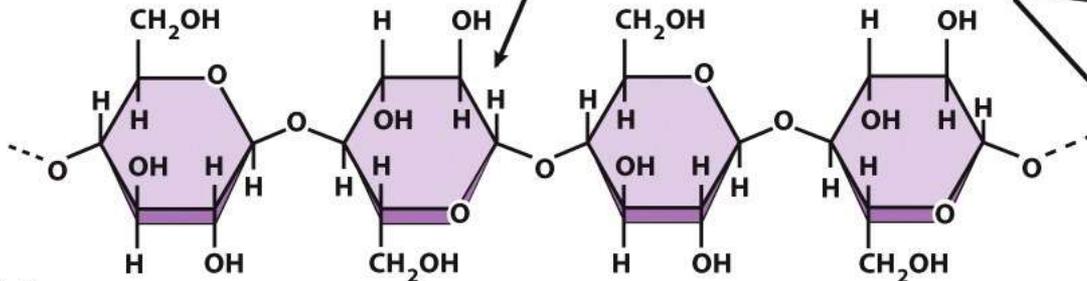
(b)

close-up of cell wall

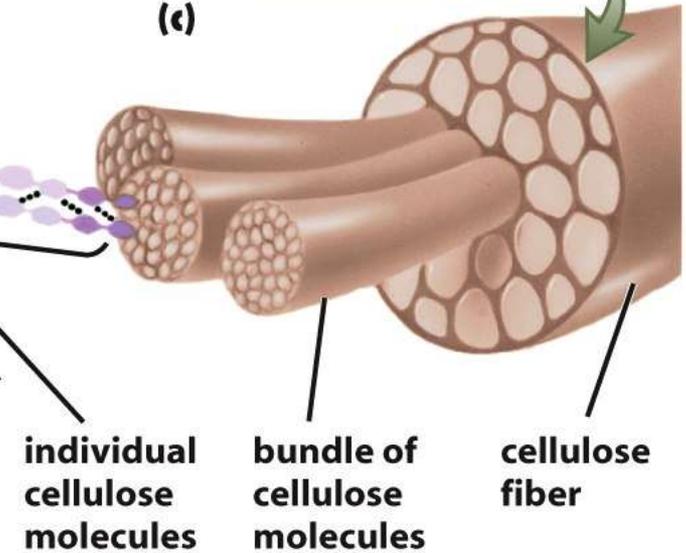


(c)

hydrogen bonds
cross-linking
cellulose molecules



(d)



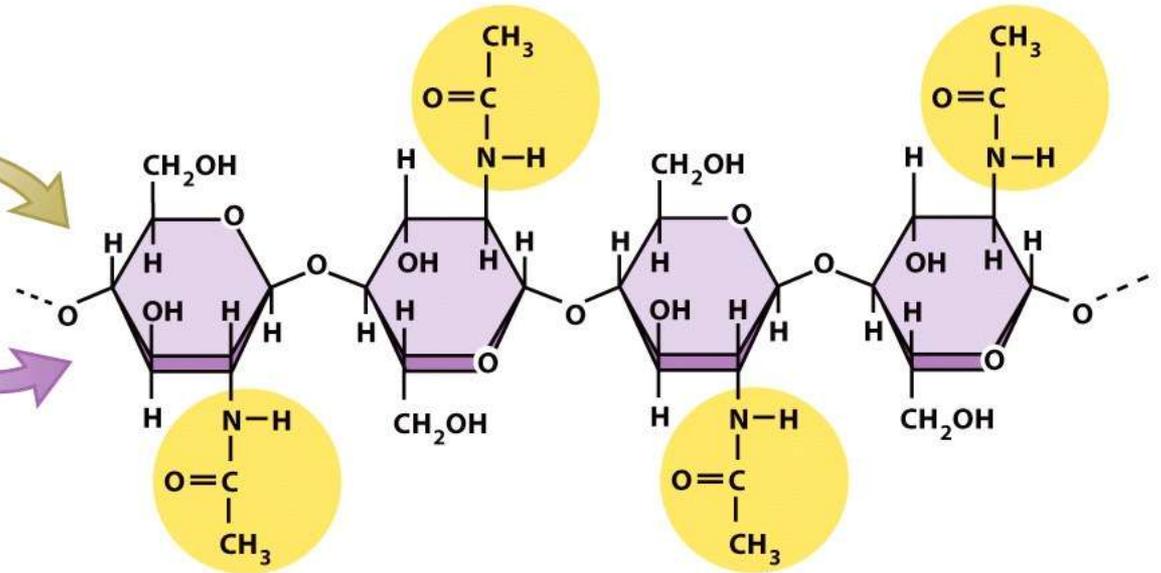
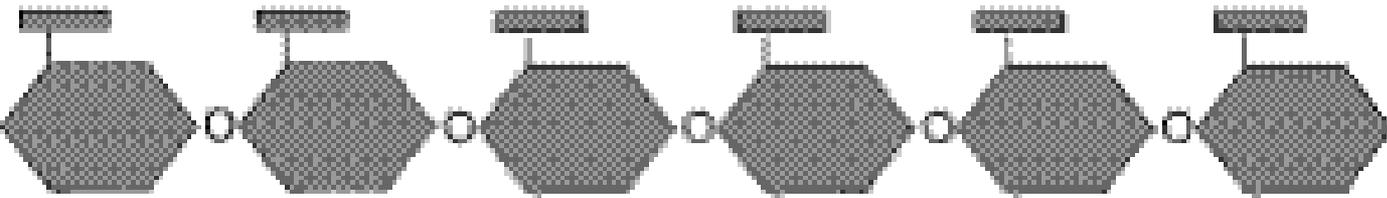
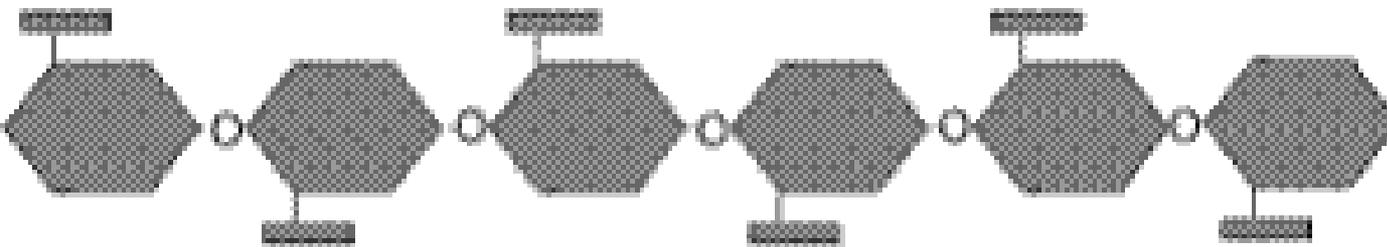


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Starch



Cellulose



Glycogen

