

# MCB 150

The Molecular and Cellular Basis of Life

Lecture 3: Overview of Cell Structure;  
Begin Carbohydrates

Today's Learning Catalytics Session ID is

**31677520**



## Announcements

- Proficiency test is Tuesday 7-10 PM; register by noon Tuesday (link is in Announcements)
- Lecture 3 post-lecture assignment due 1:00 PM Tuesday; Lecture 4 pre-lecture due 1:00 PM Wednesday

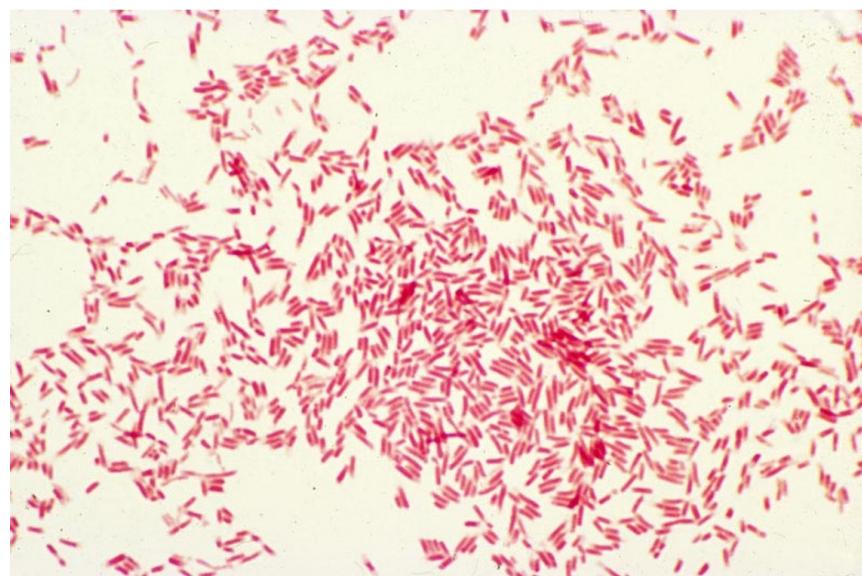


## Approaching a cell from the outside:

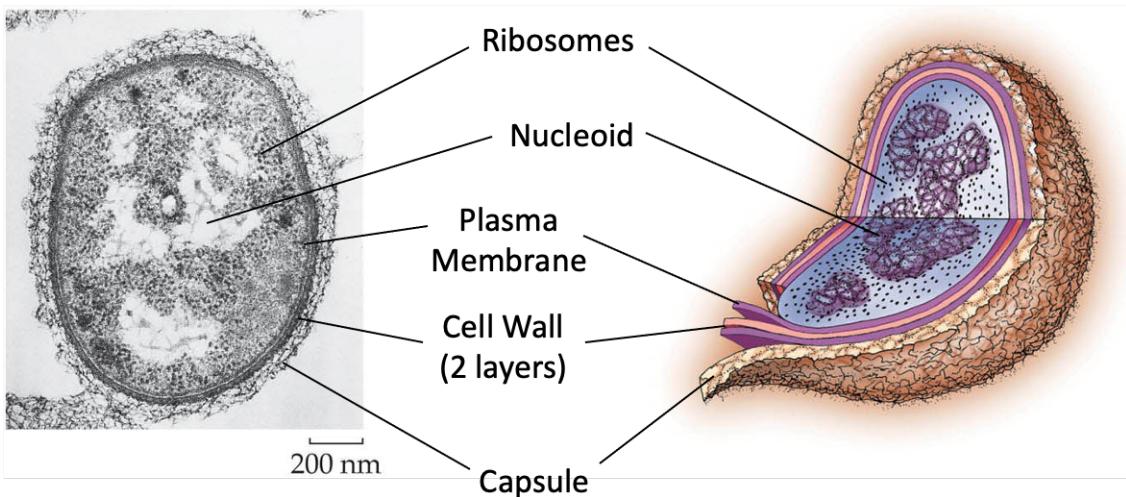
- Some cells (plants, most prokaryotes) have a relatively rigid cell wall providing shape and protection
- Every cell is surrounded by a Plasma Membrane
  - Allows cells to maintain a constant internal environment
  - Acts as a selectively permeable barrier
  - Is an interface for cells where information is received from adjacent cells and extracellular signals
  - Has molecules that are responsible for binding and adhering to adjacent cells
- Let's look closely at a prokaryotic cell...



## Bacterial cells under light microscopy:



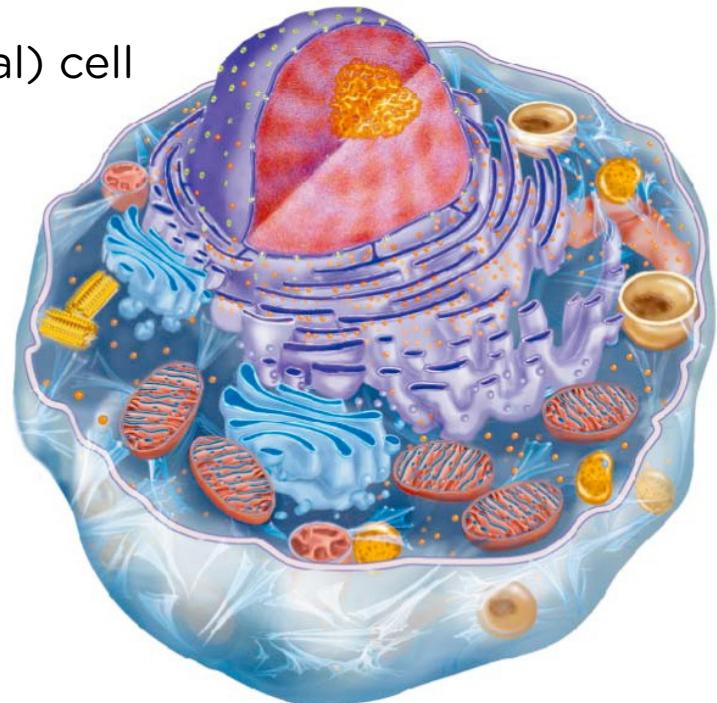
A closer look (at a different type of bacteria):



When you're bigger, you can be (need to be?) compartmentalized...

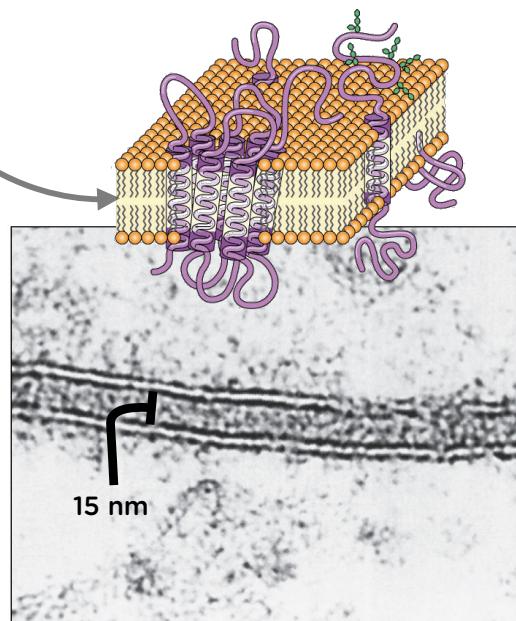
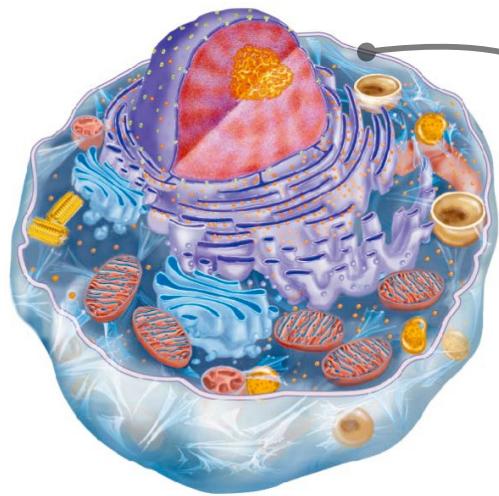


A typical eukaryotic (animal) cell

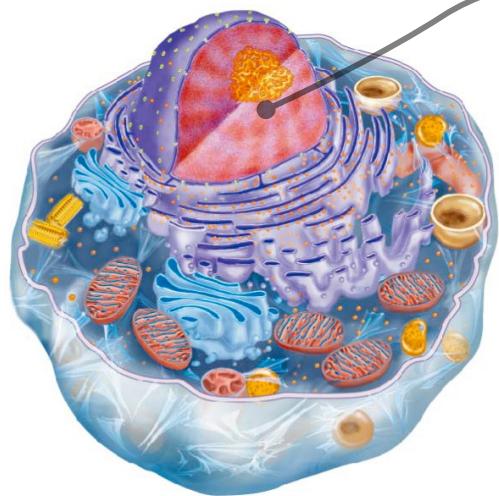


A typical eukaryotic (animal) cell

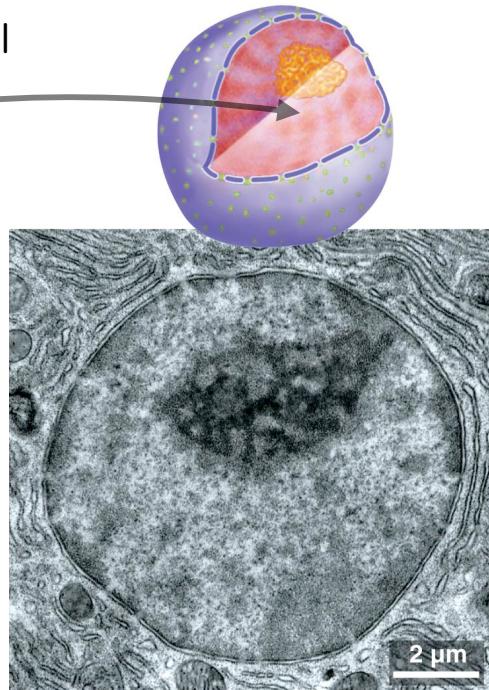
Plasma Membrane



A typical eukaryotic (animal) cell



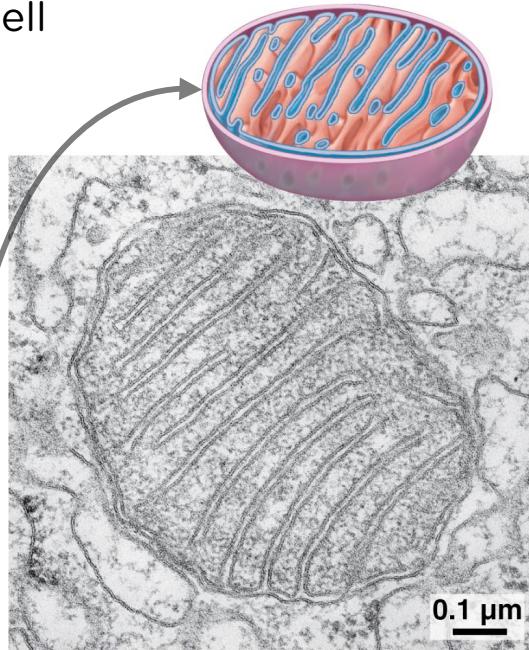
Nucleus



## A typical eukaryotic (animal) cell



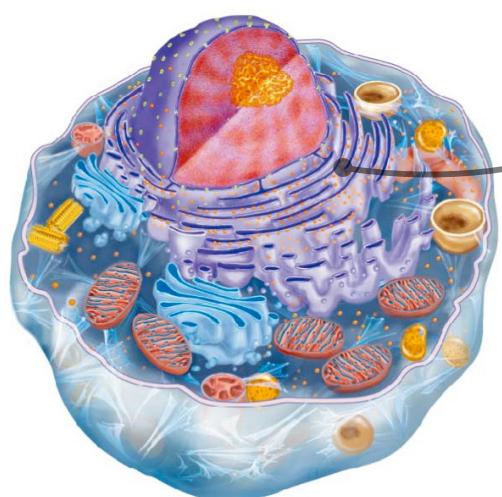
Mitochondria



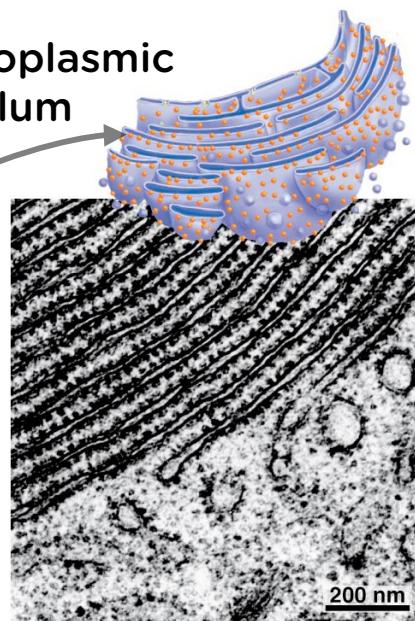
0.1  $\mu\text{m}$



## A typical eukaryotic (animal) cell



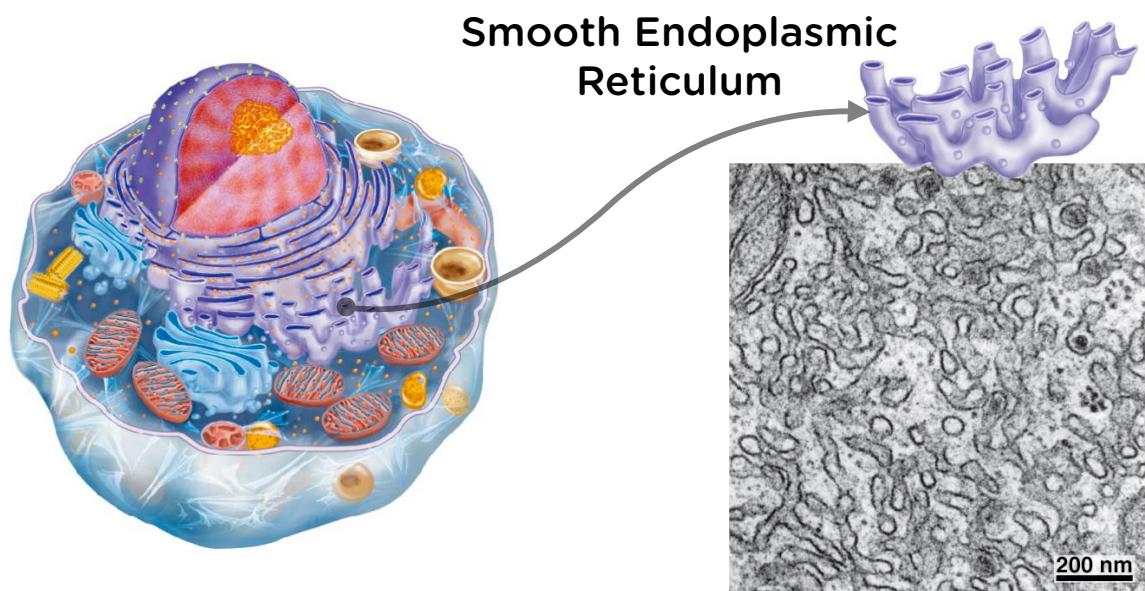
Rough Endoplasmic Reticulum



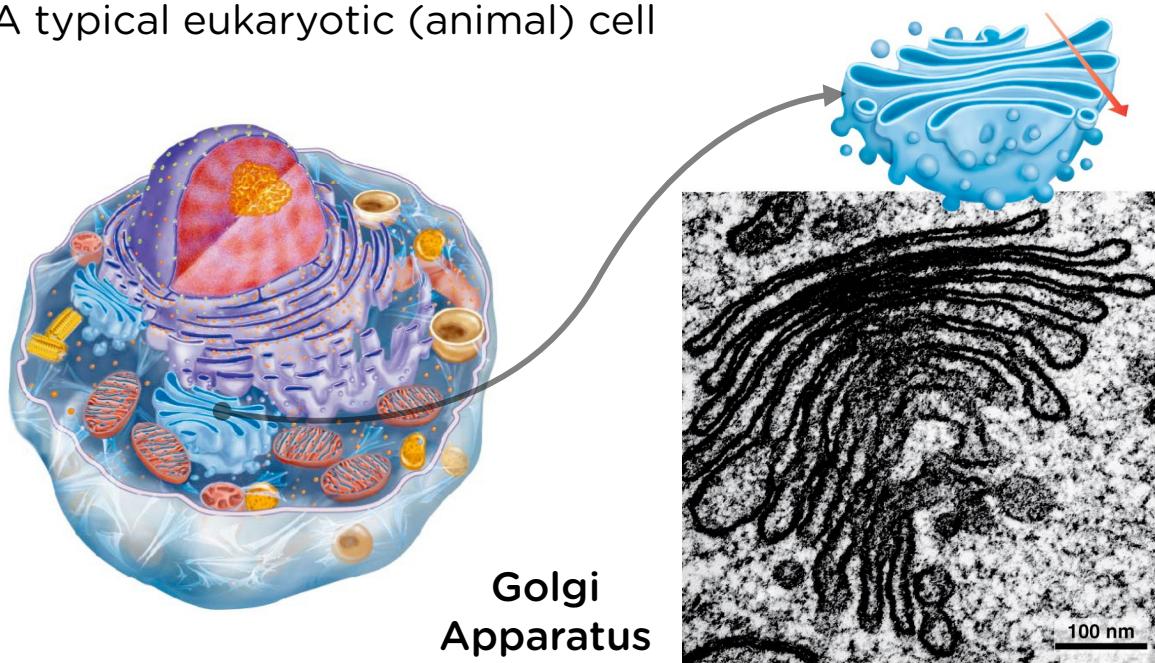
200 nm



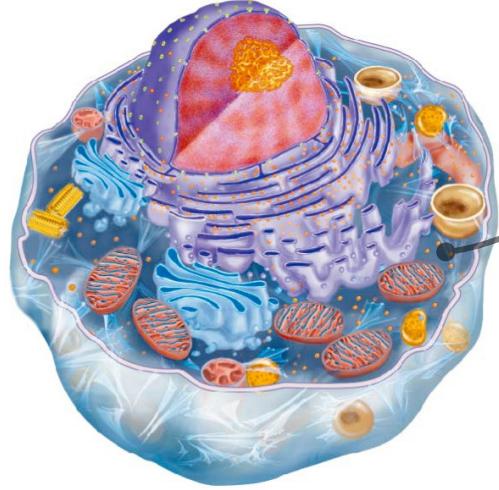
## A typical eukaryotic (animal) cell



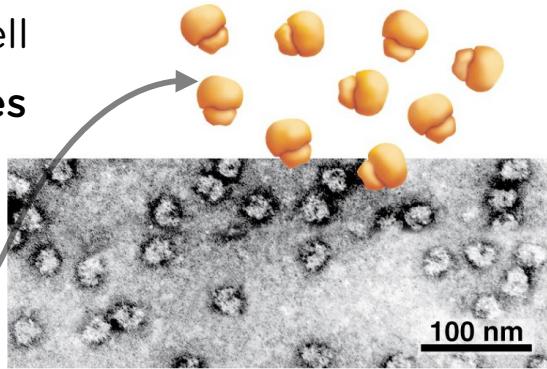
## A typical eukaryotic (animal) cell



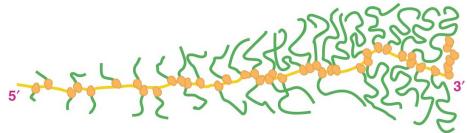
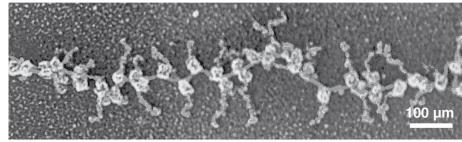
## A typical eukaryotic (animal) cell



Ribosomes



Polysomes



What composes the organelles, membranes, genomes, etc. of the cells we've examined?

4 major types of large biological polymers (macromolecules):

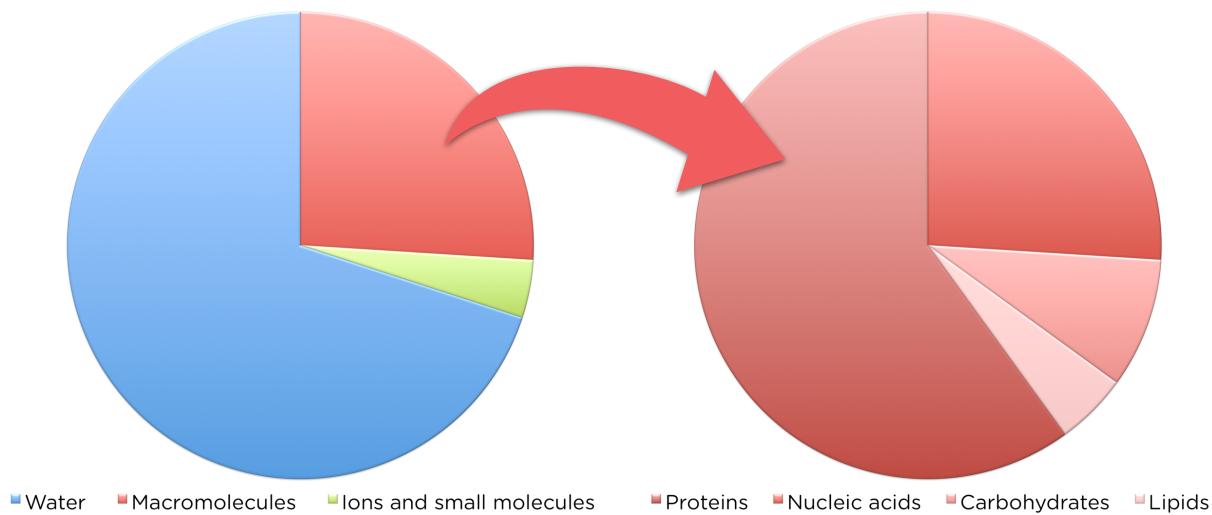
- Proteins
- Nucleic Acids
- Carbohydrates (or Polysaccharides) [sugars]
- Lipids [fats]

## Approximate chemical composition of a bacterial cell:

	% Total cell weight	Types of molecules
Water	70	1
Inorganic ions	1	20
Monosaccharides and precursors	1	250
Amino acids and precursors	0.4	100
Nucleotides and precursors	0.4	100
Fatty acids and precursors	1	50
Other small molecules	0.2	300
Macromolecules (proteins, nucleic acids, polysaccharides, and lipids)	26	3000

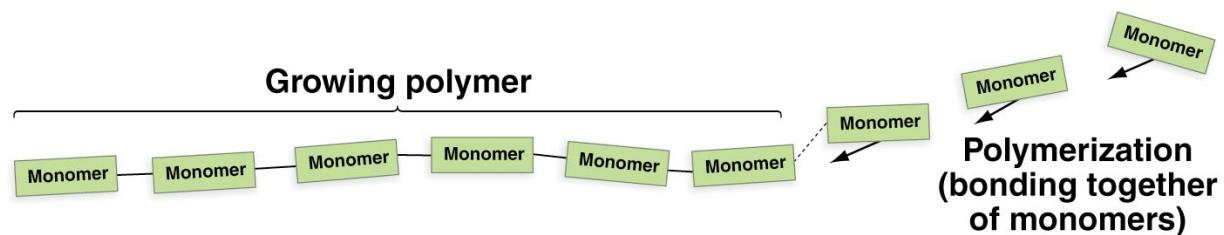


## Approximate chemical composition of a bacterial cell:



Macromolecules (Polymers) are made up of Monomers:

- Proteins are composed of Amino Acids
- Nucleic Acids are composed of Nucleotides
- Polysaccharides are composed of Monosaccharides
- (Membrane) Lipids are composed of Fatty Acids (and usually Glycerol)

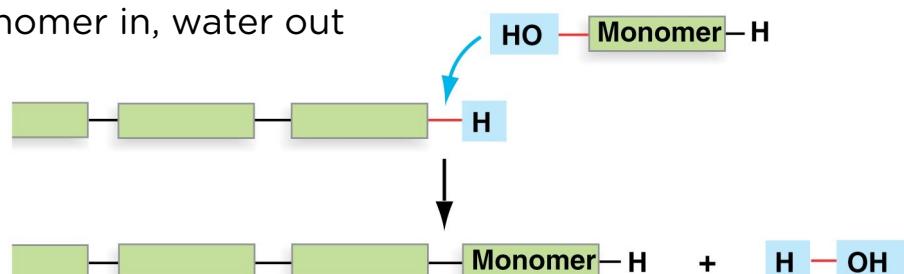


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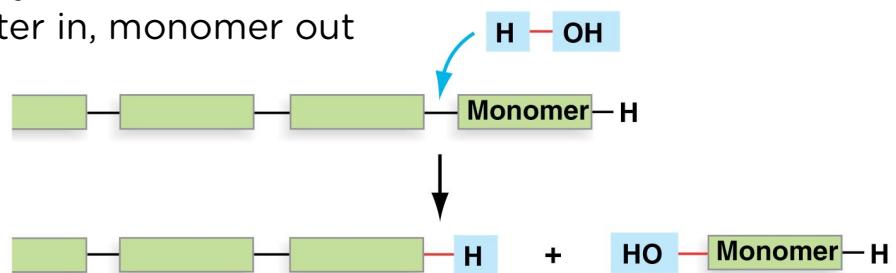
Condensation (or Dehydration Synthesis):

- Monomer in, water out



Hydrolysis:

- Water in, monomer out



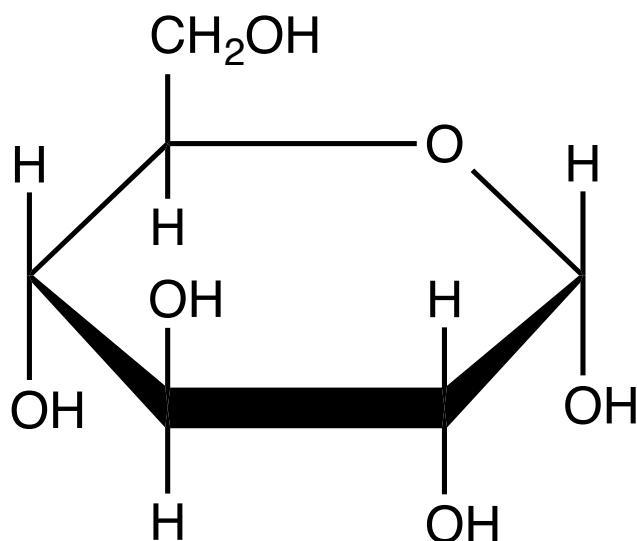
## Our first macromolecule: Polysaccharides (Carbohydrates)

Polysaccharides are made from condensation reactions bringing together monosaccharides

- Uses: energy sources, structural roles like insect exoskeletons & cell walls, or cell identification & recognition
- “Carbohydrate” can refer either to the complex sugars (polysaccharides) or the simple sugars (monosaccharides)
- General formula of a carbohydrate:
  - $C_n(H_2O)_n$  with a backbone of H-C-OH

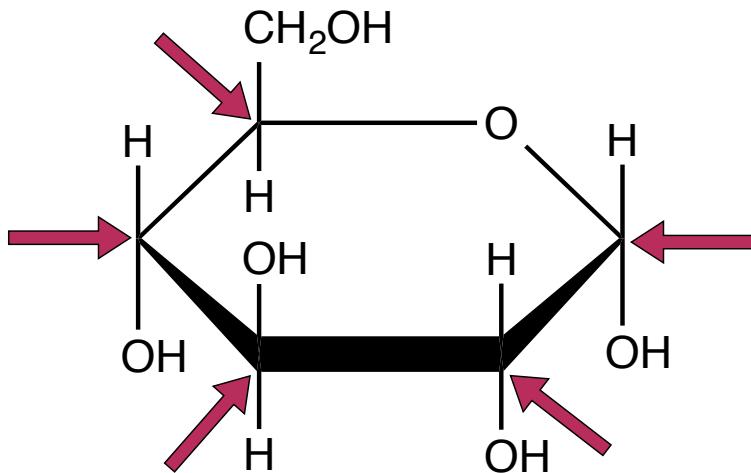


Standard ring structure of a monosaccharide (glucose):



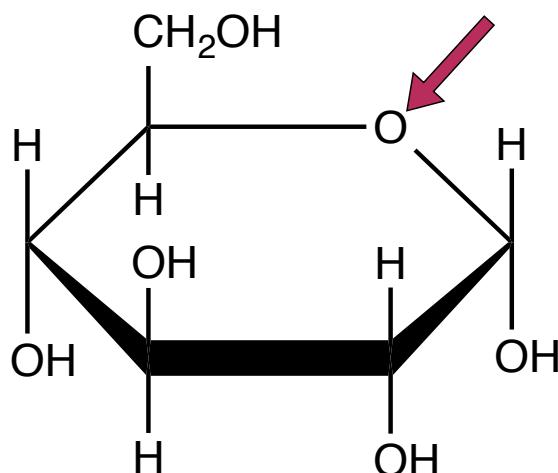
Standard conventions for atoms in ring structures:

- *Within the ring itself*, if you're not explicitly told otherwise, the atom is a **Carbon (C)**



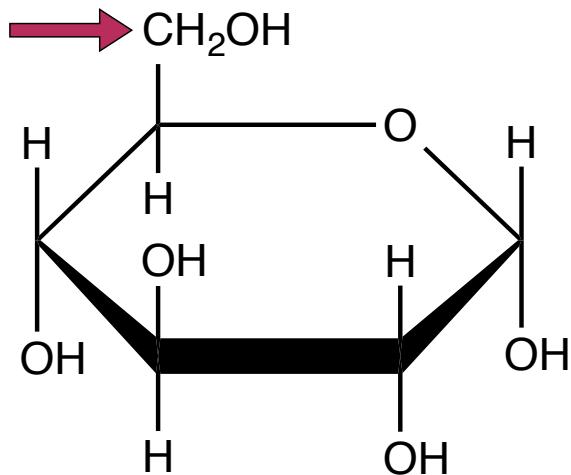
Standard conventions for atoms in ring structures:

- *Within the ring itself*, if an atom is **not** a Carbon, it needs to be specified



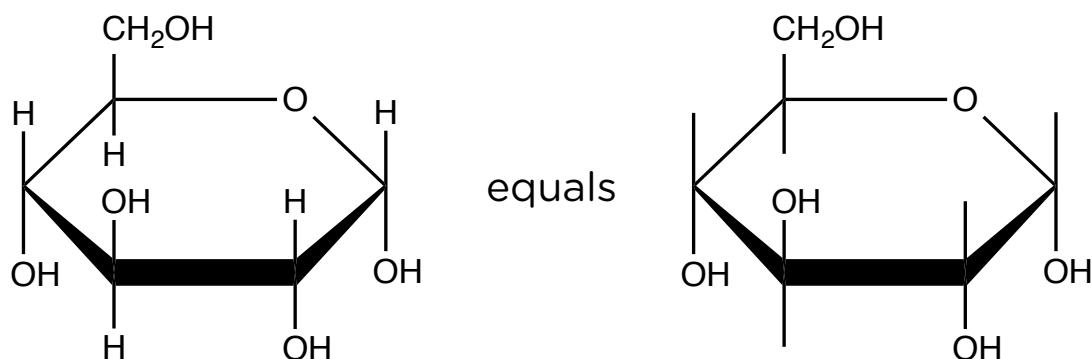
Standard conventions for atoms in ring structures:

- *Above or below the ring*, Carbons need to be specified

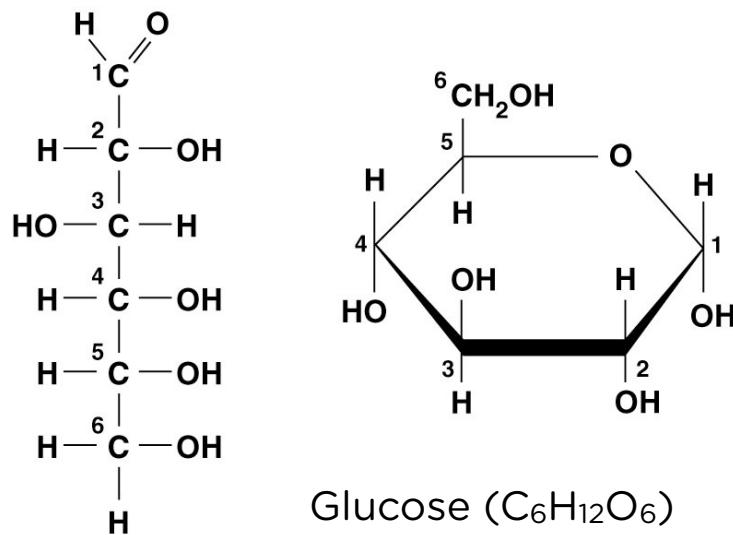


Standard conventions for atoms in ring structures:

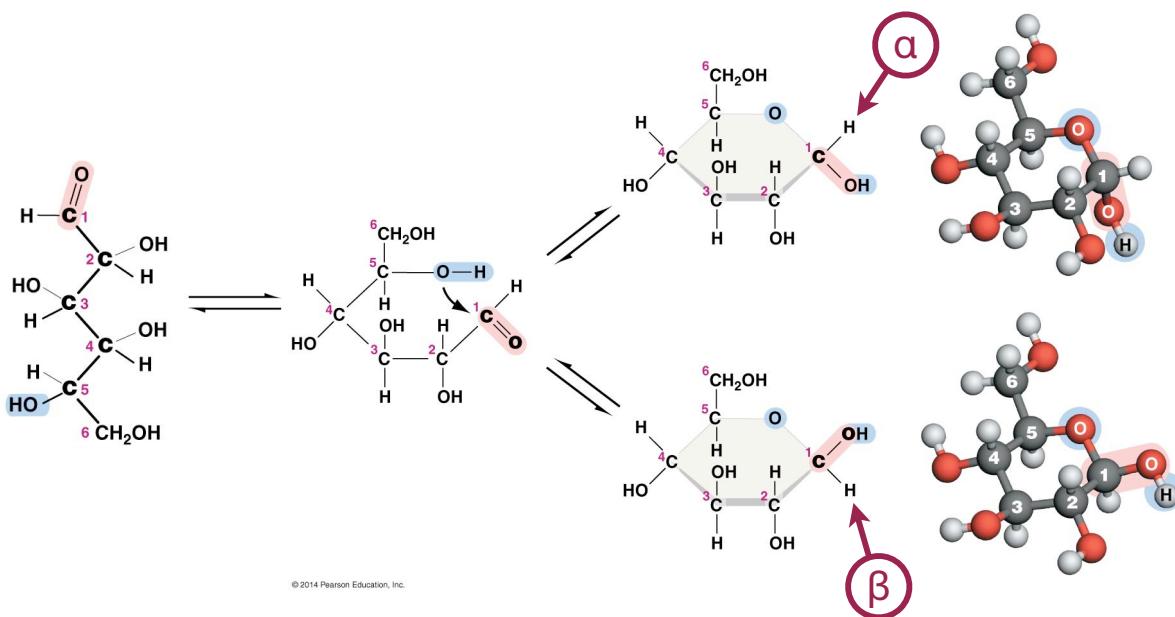
- *Above or below the ring*, any atom that is not specifically identified is assumed to be a **Hydrogen (H)**



Monosaccharides are typically found with 3, 5, or 6 carbons



### Circularization of Glucose: $\alpha$ -glucose vs. $\beta$ -glucose



Some monosaccharides have identical formulas but different structures (called isomers):

