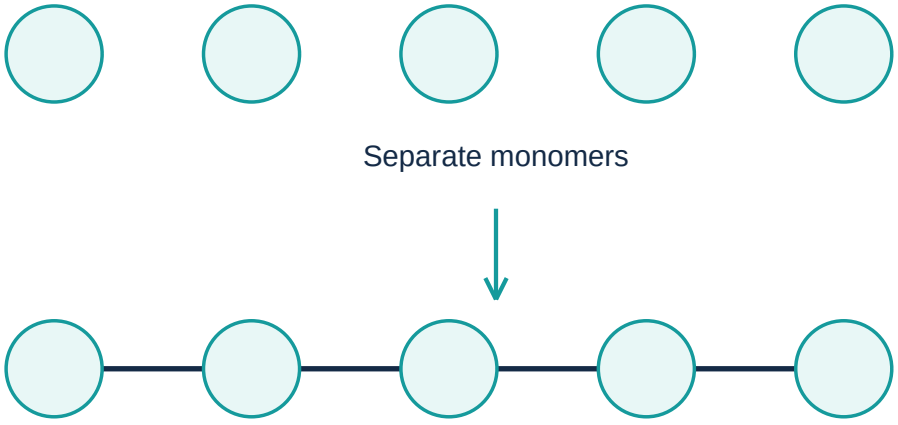
Strong links build a chain

Core idea: covalent bonds join smaller molecules together to form polymers. A polymer is a chemically connected molecule, not a collection of loose monomers.

FROM BUILDING BLOCKS TO ONE CONNECTED MOLECULE



Linked residues within a polymer (a short section is shown)

Circles represent whole subunits, not atoms. Lines represent covalent links. After joining, the incorporated parts of monomers are called residues.

1. WHAT IS A COVALENT BOND?

Covalent bonding involves atoms sharing electron pairs. A single covalent bond has one shared pair. Many covalent bonds already exist inside each monomer; new links between reacting groups connect the smaller molecules.

2. WHY DOES THE LINK MATTER?

Covalent links hold the polymer backbone together under normal cellular conditions. Subunits do not simply drift apart as the molecule moves. Breaking the chain requires a chemical change, not just separating nearby particles.

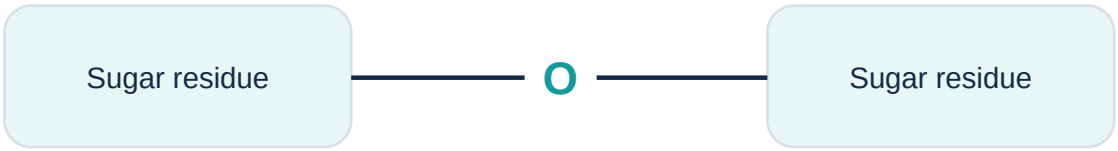
Precision: atoms share electrons; whole monomers do not each become one giant atom. The new bond joins atoms belonging to different reacting molecules.

Scope: Cambridge Biology 9700 syllabus, section 2.2, outcome 3, p. 17.

Carbohydrates: glycosidic links

A glycosidic bond is a covalent linkage between sugar residues. Joining two monosaccharides makes a disaccharide; joining many can build a polysaccharide.

ONE LINK IN A CARBOHYDRATE



Oxygen-containing glycosidic linkage

Schematic only: complete atoms and ring structures are not shown.

1. THE BOND NAME IS NOT THE POLYMER NAME

Glucose residues in starch, glycogen and cellulose are joined by glycosidic bonds. The arrangement of residues and linkages differs between these carbohydrates, producing different structures and functions.

2. CONNECTION TO CONDENSATION AND HYDROLYSIS

In the carbohydrate reactions studied here, condensation forms a glycosidic linkage and releases water. Hydrolysis uses water to break the linkage. The detailed reaction is covered in a later lesson.

3. BACKBONE LINKS AND BETWEEN-CHAIN ATTRACTIONS

Hydrogen bonds can help stabilize the arrangement of carbohydrate chains, but they do not replace the glycosidic links along each chain. Identify whether a question concerns the backbone or interactions between chains.

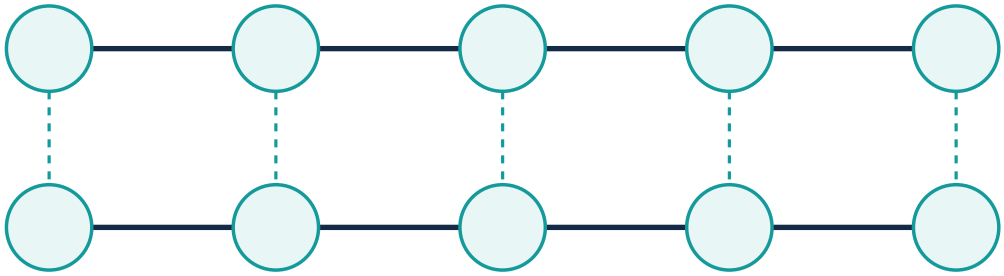
Do not label a glycosidic bond as a hydrogen bond simply because the molecule contains hydrogen.

Supporting reading: OpenStax Biology 2e, 3.1 Macromolecule synthesis.

Backbones, attractions and limits

Use the right level of description: name the subunits, the covalent links joining them, and any separate interactions that help organize the larger structure.

CELLULOSE: TWO DIFFERENT KINDS OF CONNECTION



Solid links along each row: covalent glycosidic links.
Dashed links between rows: hydrogen bonds between chains.

Subunit-level schematic, not a structural formula; dashed links indicate interactions between groups on the chains, not bonds between carbon backbones.

CONNECTIONS TO LATER BIOLOGICAL MOLECULES

CHAIN	BUILDING BLOCKS	COVALENT LINK
Polysaccharide	Monosaccharides	Glycosidic
Polypeptide	Amino acids	Peptide
DNA or RNA chain	Nucleotides	Phosphodiester

IMPORTANT LIMIT: NOT ALL LARGE MOLECULES ARE POLYMERS

A triglyceride has covalent ester bonds joining glycerol to three fatty acids. It is not a polymer of a long repeating sequence of monomers. Covalent bonding alone does not make something a polymer.

Scope: Cambridge Biology 9700 syllabus, section 2.2, outcome 3, p. 17.