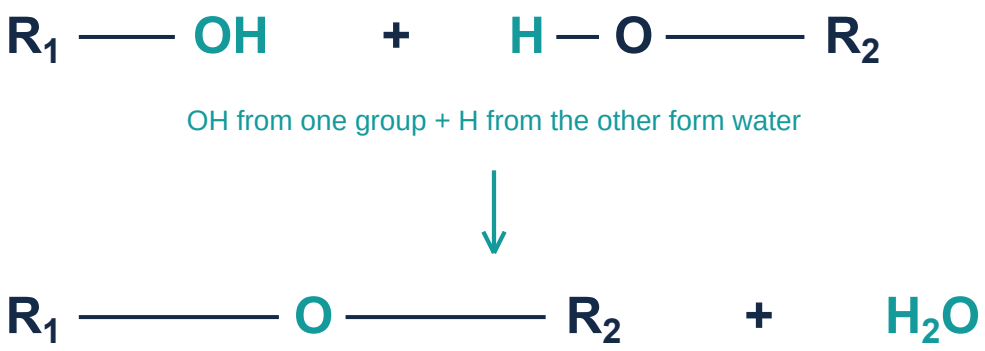
Join sugars, release water

A glycosidic bond is a covalent linkage joining sugar residues. In the condensation model, two monosaccharides join and one water molecule is released for each new linkage.

THE NET CHANGE AT THE REACTING GROUPS



The remaining oxygen forms the bridge between sugar residues.

R_1 and R_2 stand for the rest of the sugar structures. This is an atom-accounting schematic, not a full ring drawing or a detailed reaction mechanism. At least one reacting group is at an anomeric carbon.

1. CONDENSATION IS A CHEMICAL REACTION

New covalent connectivity forms between sugar residues as water is eliminated overall. The sugars do not simply sit next to each other, and removing water by evaporation alone does not explain bond formation.

2. NAME BOTH THE BOND AND THE REACTION

Bond: glycosidic. Reaction: condensation. Two monosaccharides produce one disaccharide and one water molecule. The original sugar units become residues incorporated into the larger molecule.

Reverse connection: hydrolysis uses water to break a glycosidic linkage. Condensation releases water; hydrolysis consumes it.

Scope: Cambridge Biology 9700 syllabus, section 2.2, outcome 5, p. 17.

Two examples: maltose and sucrose

A disaccharide contains two monosaccharide residues. The identity of those sugars and the carbon positions joined determine which disaccharide is formed.

1. MALTOSE: TWO GLUCOSE MOLECULES

glucose + glucose

↓

maltose + water

An α-1,4 glycosidic linkage joins C1 of one glucose residue to C4 of the other. The second residue retains a free reducing end, so maltose is a reducing sugar.

2. SUCROSE: GLUCOSE AND FRUCTOSE

glucose + fructose

↓

sucrose + water

The linkage connects C1 of glucose to C2 of fructose. Both anomeric carbons are involved, leaving no free reducing end. Intact sucrose is therefore non-reducing.

THE SAME MOLECULAR-FORMULA BALANCE

$$C_6H_{12}O_6 + C_6H_{12}O_6$$

$$\rightarrow C_{12}H_{22}O_{11} + H_2O$$

Both examples release one water molecule. A formula alone does not distinguish maltose from sucrose: connectivity matters.

Supporting chemistry: OpenStax Organic Chemistry, 25.8 Disaccharides.

Repeat the joining reaction

Many monosaccharides can be linked into a polysaccharide by repeated condensation. Each new glycosidic linkage contributes to the covalent backbone of the carbohydrate.

COUNTING MODEL: SIX UNITS IN ONE OPEN CHAIN



6 initially separate sugars → 5 new links + 5 water molecules

Circles represent sugar residues, not atoms. Six units form only a short oligosaccharide model; a polysaccharide contains many more. Count the connections, not the circles, to find the water released.

1. ONE CONNECTED CHAIN: n UNITS NEED n - 1 LINKS

For n separate monosaccharides joined into one open chain, n - 1 condensation linkages form and n - 1 water molecules are released. Complete hydrolysis of those same links requires n - 1 water molecules.

2. LINK POSITIONS SHAPE THE POLYSACCHARIDE

Connections to later lessons: starch and glycogen contain α-1,4 links, with α-1,6 links at branch points in amylopectin and glycogen. Cellulose contains β-1,4 links. These arrangements lead to different structures.

3. KEEP THE BIOLOGICAL MODEL PRECISE

The diagrams summarize the net condensation chemistry. In cells, specific enzymes and activated sugar donors control carbohydrate synthesis; free sugars do not spontaneously assemble into polymers just because they are mixed.

Summary: identify the sugar units, name the glycosidic linkage, and account for water. A hydrogen bond between chains is not a new glycosidic linkage.

Supporting reading: OpenStax Biology 2e, 3.2 Carbohydrates.