Three designs for glucose storage

Starch and glycogen are polysaccharides built from alpha-glucose residues. Their chain shapes and branching patterns help cells store a reserve of respiratory substrate.

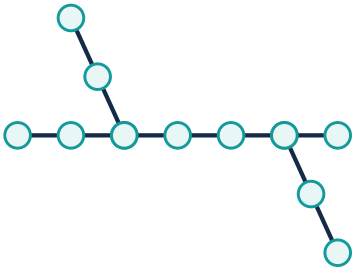
AMYLOSE



One component of starch

Unbranched; coils into a helix.

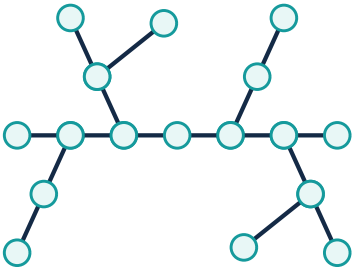
AMYLOPECTIN



The other starch component

Branched chains.

GLYCOGEN



Animal and fungal storage

More highly branched.

Schematic shapes, not atom-level drawings or branch counts. Dots in the branched models represent glucose residues. Amylose is shown as a continuous coiled chain.

SAME BUILDING BLOCK; DIFFERENT ARCHITECTURE

Molecule	Along the chain	At branch points
Amylose	α-1,4	No branch points
Amylopectin	α-1,4	α-1,6
Glycogen	α-1,4	α-1,6

WHERE ARE THEY STORED?

Plants store starch in granules, for example in seeds and storage organs. Animals store glycogen, notably in liver and skeletal muscle. Liver glycogen helps support blood glucose; muscle glycogen provides fuel for that muscle's own activity.

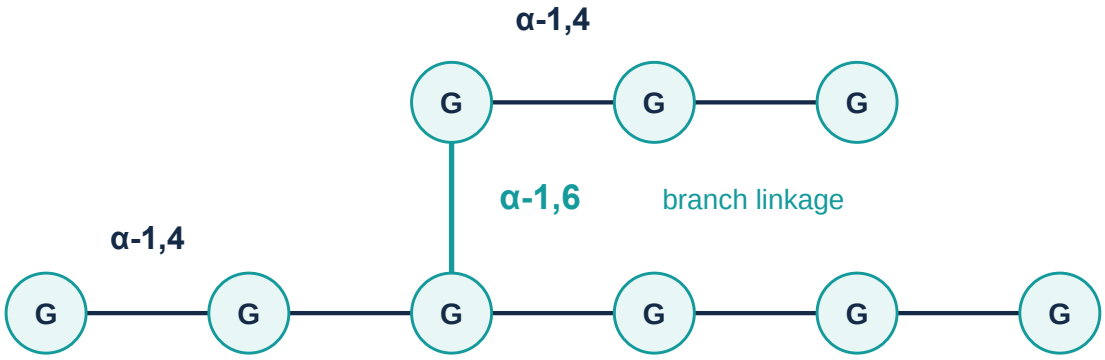
Supporting reading: OpenStax Biology 2e, 3.2 Carbohydrates.

Scope: Cambridge Biology 9700 syllabus, section 2.2, outcome 7, p. 18.

Read the two linkages

The numbers identify the carbons connected through oxygen in a glycosidic bond. An alpha-1,4 linkage extends a chain; an alpha-1,6 linkage connects a branch to another chain.

A BRANCH POINT IN AMYLOPECTIN OR GLYCOGEN



Each G = one glucose residue, not one carbon atom.

1. ALPHA-1,4: EXTEND A CHAIN

Carbon 1 of one glucose unit is linked through an oxygen atom to carbon 4 of another. This linkage occurs along the chains of amylose, amylopectin and glycogen. The alpha arrangement helps chains adopt coiled conformations.

2. ALPHA-1,6: ADD A BRANCH

Carbon 1 of a glucose unit in the branch is linked through oxygen to carbon 6 of a unit in the parent chain. Branching changes the polymer's overall architecture; it does not change its glucose building block.

Do not confuse a coil with a branch. A coiled chain is still one unbranched path. A branch creates an additional chain end. Glycogen has the same two linkage types as amylopectin, but branches more frequently.

Scope: Cambridge Biology 9700 syllabus, section 2.2, outcome 7, p. 18.

Connect structure to function

A good explanation names a structural feature, then shows how it makes a useful storage property. "It is a polysaccharide" alone does not explain why it works well.

1. LARGE POLYMERS: LOWER OSMOTIC IMPACT

Joining many glucose residues into each large molecule creates far fewer dissolved particles than storing the same number of glucose units separately. This reduces the osmotic effect of the glucose reserve and the tendency for excessive water entry.

2. PACKED STRUCTURES: CONCENTRATED RESERVES

Coiling and branching allow many glucose residues to occupy a relatively small volume. Starch forms insoluble granules. Glycogen forms hydrated particles: avoid assuming its behaviour in water is identical to that of starch granules.

3. LARGE SIZE: RETENTION WITHIN THE CELL

These large polymers do not simply diffuse through the cell membrane. Storage keeps carbon and chemical energy available inside the cell until enzyme-controlled breakdown supplies usable substrates.

4. MANY BRANCH ENDS: RAPID MOBILISATION

Branched polymers provide many non-reducing chain ends where enzymes can act. Glycogen's frequent branching gives many accessible ends, supporting rapid mobilisation when demand rises. Branching is not itself an energy-releasing reaction.

ONE-SENTENCE COMPARISON

Both starch and glycogen store alpha-glucose. Starch contains amylose and amylopectin; glycogen is more highly branched than amylopectin, creating more ends for enzyme action.

Supporting detail: NCBI Bookshelf, Biochemistry, Glycogen.

Scope: Cambridge Biology 9700 syllabus, section 2.2, outcome 7, p. 18.