Point of Comparison	Compare the structure and function of starch, glycogen and cellulose.		
	Starch	**Glycogen**	**Cellulose**
Monomer	**α-glucose** monomers.	**α-glucose** monomers.	**β-glucose** monomers.
Bonds between monomers	**α(1-4)** glycosidic bonds in **amylose**. **α(1-4)** glycosidic bonds **within a branch** and **α(1-6)** glycosidic bonds **at a branch point** in **amylopectin**.	**α(1-4)** glycosidic bonds **within a branch** and **α(1-6)** glycosidic bonds **at a branch point**.	**β(1-4)** glycosidic bonds
Orientation of monomers	All glucose units have the **same orientation**.	All glucose units have the **same orientation**.	**Alternate** glucose units are rotated **180^{o}** with respect to each other.
Structure of molecule	**Amylose** is **helical**. **Amylopectin** is **helical** and **branched**.	Glycogen is **helical** and **more extensively branched** than amylopectin.	Cellulose is a **long straight** chain.
Bonds between molecules	**No interchain** hydrogen bonding.	**No interchain** hydrogen bonding.	**-OH groups projecting outwards** in both directions allow **interchain hydrogen bonding** leading to **microfibril formation**.
Function	Starch is a compact energy **storage** molecule in **plants**.	Starch is a compact energy **storage** molecule in **animals**.	Cellulose is a **structural** molecule that provides **high tensile strength** to the cell wall of plants.

How do the structures of starch and glycogen make then good storage molecules?	
Structure	**Function**
They are **large molecules** made up of **many α-glucose monomers** linked by **α(1-4)** glycosidic bonds.	It is a large **energy store** that can be hydrolyzed to yield many glucose molecules that can be used as a **respiratory substrate** to yield **ATP**. **Enzymes** like amylase that hydrolyze these bonds are **commonly available**. Glucose units readily released for **respiration** to yield **energy**.
They comprise of helices.	Helices can pack many glucose subunits **per unit volume**, allowing for more **compact** storage. Most –OH groups in the helix are involved in **intramolecular** hydrogen bonding and hence **few –OH groups are available** for hydrogen bonding with water. Hence, they are **insoluble in water** and do not affect the water potential of cells.
Amylopectin and glycogen are branched with α(1-6) glycosidic bonds at branch points.	Branching presents **multiple branch ends** for hydrolytic action by **amylases**. Thus, more **glucose** molecules can be released and more ATP can be generated by respiration **per unit time**. Branching optimizes the packing of many glucose subunits **per unit volume** allowing for more **compact** storage. Branching reduces the accessibility of water and thus **reduces the solubility** of the molecule in water. Hence, they do not affect the water potential of cells.

How does the structure of cellulose make it a good structural molecule?	
Structure	**Function**
Alternate β-glucose units are **rotated 180º** with respect to its neighbors forming a **straight chain**.	There are free –OH groups projecting out in both directions which can hydrogen bond with –OH groups of **adjacent parallel cellulose molecules**, forming **microfibrils** which have **high tensile strength** and confer strength to the cell wall. Most –OH groups are involved in **interchain hydrogen bonding** and only the surface of the microfibril has –OH groups that can form hydrogen bonds with water. Hence, cellulose is **insoluble in water** and does not affect the water potential of cells.
The meshwork of microfibrils that form the cell wall have a porous structure.	The cell wall is **freely permeable** to water and solutes, allowing the movement of substances in and out of cells. The cell wall is **strong** and **rigid** and prevents the plant cells from bursting due to **osmotic stress**.
Cellulose contains β-glucose residues linked together by β(1-4) glycosidic bonds.	**Cellulases** that recognize and hydrolyze **β(1-4)** glycosidic bonds are found in very few organisms. Hence, cellulose **cannot be hydrolyzed** and used as a respiratory substrate.