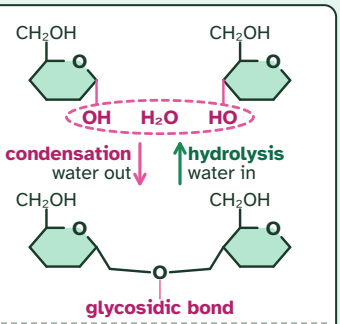
How sugars and fats *fuel* and build cells

What to know, what to draw and what to say. Nothing else.

THE ONE IDEA

Monomers join by condensation and split by hydrolysis. How they join, and how polar they are, decides each molecule's job.



Draw it like this. Other OH groups are left out.

B1.1.2 and 3 START HERE

Water out to *build*, water in to break

- Small **monomers** join into long chains, **polymers**: very large molecules, or macromolecules.
- **Condensation:** an OH from one monomer and an H from the other **leave as water**, and a covalent bond forms. One water per bond.
- **Hydrolysis:** a water molecule is **split**; its H joins one monomer, its OH the other, and the bond breaks. Digestion is hydrolysis.

MONOSACCHARIDES	AMINO ACIDS	NUCLEOTIDES
Polysaccharides	**Polypeptides**	**Nucleic acids**
Joined by glycosidic bonds.	Protein chains (B1.2).	DNA and RNA (A1.2).

B1.1.1

Carbon, the *builder*

- A **covalent bond**: a pair of shared electrons.
- Carbon makes **four covalent bonds**; a double bond counts as two. It bonds to C, H, O, N, P and S.
- Skeletons: an **unbranched or branched chain**, a **single ring** (glucose) or **fused rings** (a steroid).
- **Nature of science:** SI prefixes (kilo, centi, milli, micro, nano) were **agreed internationally**.

B1.1.7

Sugar *name tags* on the cell

- **Glycoprotein**: a protein with sugar chains that **face outwards**.
- Chains vary in sugars, order and branching: **cell-cell recognition**.
- A and B are **antigens**: a body lacking one treats it as foreign.

GROUP O	GROUP A	GROUP B	GROUP AB
Base chain	**+ sugar A**	**+ sugar B**	**Both**

B1.1.4

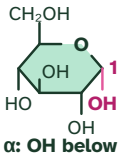
Glucose: small, *soluble*, stable

- **Monosaccharide**: one sugar unit. **Pentose** 5 C (ribose, deoxyribose); **hexose** 6 C (glucose, fructose), CH_2OH included.
- α- and β-glucose are **isomers**, both $C_6H_{12}O_6$: only the OH on carbon 1 differs. *ABBA: Alpha Below, Beta Above.*

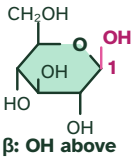
WHY GLUCOSE SUITS ITS JOB

Sweet Treats Stay Energetic

S Soluble: OH groups bond with water	**T** Transportable: in blood plasma	**S** Stable: keeps until an enzyme acts	**E** Energy: oxidised in respiration



α: OH below



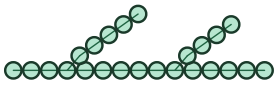
β: OH above

B1.1.5 and 6

Starch and glycogen *store*; cellulose builds



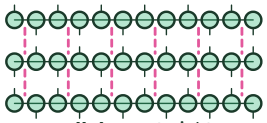
amylose: coiled



amylopectin: branched



glycogen: far more branched



cellulose: straight

- **Starch** (plants) and **glycogen** (animals) are α-glucose polymers, **compact** as they **coil and branch**.
- **Insoluble:** huge molecules stay put and **draw in no water** by osmosis.
- **Easy to use:** glucose is added (condensation) or taken off (hydrolysis) at chain ends; glycogen has many.
- **Cellulose:** an unbranched polymer of **β-glucose**, the main material of plant cell walls.
- Each unit is **turned over** from the last: the chain runs straight.
- Chains lie side by side, **cross-linked by hydrogen bonds** into microfibrils of **high tensile strength**.

Lipids: the molecules that *avoid* water

B1.1.8 and 9

Lipids keep *away* from water

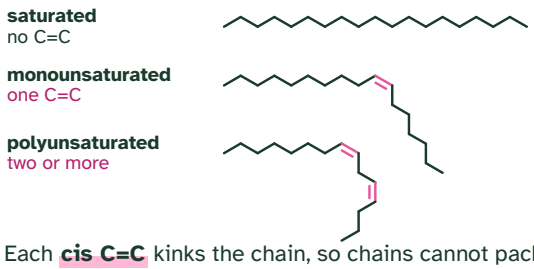
- Lipids **dissolve in non-polar solvents** (hexane) but only sparingly in water: fats, oils, waxes and steroids.
- Mostly C and H, and **C–H bonds are non-polar**, so water pushes them out: **hydrophobic**.
- **Wax:** a fatty acid joined to a long-chain alcohol; it waterproofs a leaf surface.
- **Condensation:** a fatty acid's carboxyl OH and an H from glycerol leave as water: an **ester bond**.

Triglyceride fats and oils
One glycerol, **three fatty acids**: three ester bonds, three waters.

Phospholipid membranes
One glycerol, **two fatty acids** and one **phosphate group**.

B1.1.10

Every double bond *kinks* the tail



- Each **cis C=C** kinks the chain, so chains cannot pack closely: the more C=C, the **lower the melting point**.
- **Plants** store **unsaturated oils**, liquid when cold. **Endotherms** store more saturated fat, soft at body temperature.

Remember it: *Double Kinks Leave Liquids*

B1.1.11

Fat: the *long-term* store and insulator

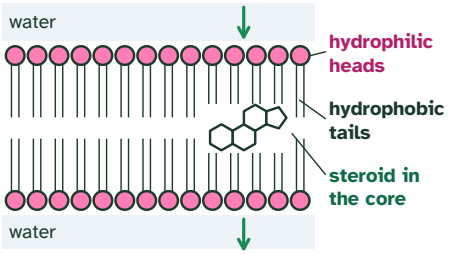
- **Adipose tissue:** cells each holding a large droplet of triglyceride, under the skin and round organs.
- Fat is **energy dense**, stored **without water**, insoluble and stable: a **long-term** store; glycogen, short-term.
- **Insulation:** fat conducts heat about half as well as muscle. Endotherms in polar seas have thick **blubber**; tropical mammals, thin layers.

STORE	GLYCOGEN	TRIGLYCERIDE
Energy	**about 17 kJ g⁻¹**	**about 37 kJ g⁻¹**
Water	about 3 g per gram	none
Release	quick	slower
No oxygen	respired, as glucose	not respired

B1.1.12 and 13

The *bilayer*, and what crosses it

- A phospholipid is **amphipathic**: one part is attracted to water, one is not.
- **Head:** charged phosphate and glycerol, **hydrophilic**. **Tails:** two fatty acids, **hydrophobic**.
- In water they form a **bilayer**: tails in, heads to the water on both sides.



- **Steroid: four fused rings**, three of six carbons, one of five.
- Cholesterol, **oestradiol** and **testosterone** are steroids.
- Non-polar, so they **diffuse through the core** with no protein. Polar glucose and ions cannot.

WATCH OUT

Six mistakes that *cost marks*

- ✕ **Condensation releases water; hydrolysis uses it.** In hydrolysis the water is split.
- ✕ **α- and β-glucose have the same formula.** Only the OH on carbon 1 differs.
- ✕ **Insoluble is not hydrophobic.** Starch is covered in OH groups; it is just huge.
- ✕ **A triglyceride is not a polymer:** one glycerol, three fatty acids.
- ✕ **Melting breaks no covalent bonds:** it separates molecules.
- ✕ **Saturated means saturated with hydrogen,** not with fat.

COVER THE SHEET

Can you *answer these?*

1. State how many bonds a carbon atom forms.
2. Distinguish condensation from hydrolysis.
3. Draw α-glucose and state how β-glucose differs.
4. Compare the structures of glycogen and cellulose.
5. Outline how group A and B red blood cells differ.
6. Describe how a triglyceride is formed.
7. Explain why plant oils are liquid when cold.
8. Compare triglycerides and glycogen as stores.
9. Explain how a bilayer forms and why steroids cross it.

IN THE EXAM

Say where the water goes (OH from one monomer, H from the other), then **link each structure to its job**: branched, so many ends, so glucose comes off fast.

GO FURTHER

Animated figures, a dry lab and a marked Check are in the full guide online.