Uses of glucose from photosynthesis

4.4.1.3 · Bioenergetics · revision notes

What a plant does with the glucose it makes in photosynthesis: respiration, storage as starch or as fats and oils, cellulose for cell walls, and amino acids for proteins. Mostly short recall and explain questions, often linked to cell structure, transport in plants or food tests.

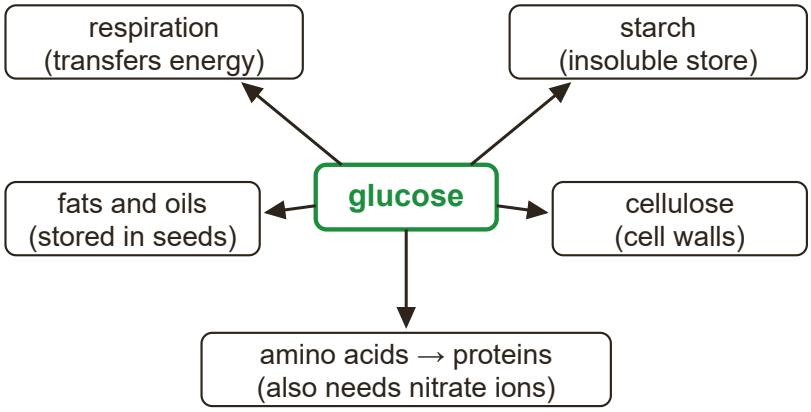
Key facts

- Glucose → respiration (transfers energy)
- Glucose → fats and oils (store, e.g. in seeds)
- Glucose + nitrate ions → amino acids → proteins
- Dissolved sugars move from the leaves in the phloem (translocation)
- Glucose test: Benedict's solution, heated, blue → green, yellow or brick-red
- Glucose → starch (insoluble store)
- Glucose → cellulose (strengthens cell walls)
- Nitrate ions are absorbed from the soil by root hair cells
- Starch test: iodine solution orange-brown → blue-black
- Protein test: Biuret reagent blue → purple

Notes

Five uses of glucose

- **Respiration**: transfers energy for the plant's living processes. Every living plant cell respires, day and night.
- **Starch**: glucose is converted into insoluble starch for storage, for example in potato tubers, roots, leaves and seeds.
- **Fats and oils**: glucose is used to make fats or oils (lipids) for storage, for example in seeds such as sunflower seeds.
- **Cellulose**: glucose is used to make cellulose, which strengthens the cell wall.
- **Amino acids**: glucose is used to make amino acids, which are joined together to make proteins such as enzymes.



The five uses of the glucose made in photosynthesis.

Why plants store starch

- Glucose is soluble; starch is **insoluble**.
- Because it does not dissolve, stored starch does not affect the movement of water into and out of cells by osmosis, and it cannot move out of the cells. Grade 6+ only
- When the plant needs energy, for example at night or when a seed starts to grow, starch is broken back down into glucose for respiration.

Making proteins needs nitrate ions

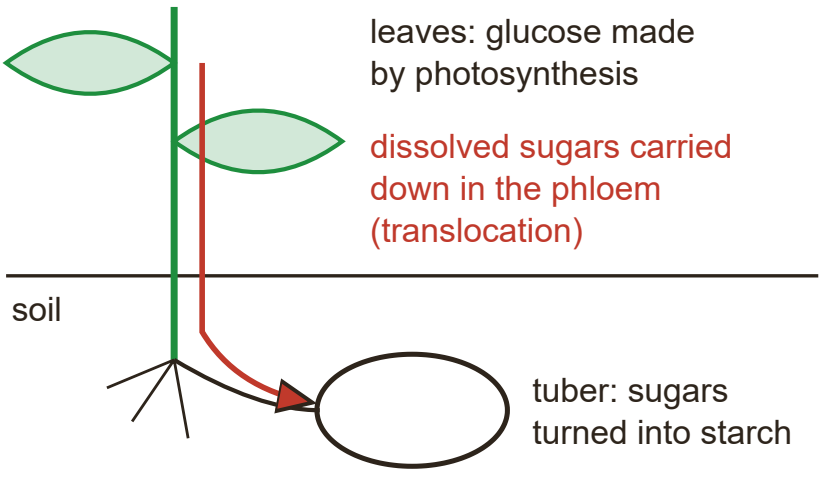
- Amino acids contain nitrogen, but glucose does not.
- Plants absorb **nitrate ions** from the soil through their root hair cells by active transport.
- Glucose and nitrate ions are used to make amino acids, and amino acids are joined to make proteins.
- Without enough nitrate ions a plant cannot make enough protein, so it cannot make new cells and grows poorly. This is why farmers add fertilisers containing nitrates. Grade 7+ only

Testing for starch, glucose and protein

- Starch: add iodine solution. It turns from orange-brown to **blue-black** if starch is present.
- Glucose: add **Benedict's solution** and heat in a hot water bath for a few minutes. It turns from blue to green, yellow or brick-red if glucose is present.
- Protein: add **Biuret reagent**. It turns from blue to purple if protein is present.
- No colour change (the reagent keeps its own colour) means a negative result.

Moving glucose around the plant

- Glucose is made in the leaves but used or stored all over the plant.
- Dissolved sugars are carried from the leaves to the rest of the plant in the **phloem**. This is called **translocation**.
- In a storage organ such as a potato tuber, the sugars are converted into starch.



Sugars move from the leaves to a potato tuber, where they are stored as starch.

How to answer each type of question

Give uses of the glucose made in photosynthesis

1 to 3 marks | Grade 3

1. Count how many uses are asked for and give exactly that many.
2. Make each use specific: 'to make cellulose for cell walls', not just 'for growth'.
3. Check you have not given a use the question has ruled out.

Example. A potato plant makes glucose in its leaves.
Give **three** ways the plant uses this glucose, other than storing it as starch.

Model answer. Any three from: for respiration (1); to make cellulose for cell walls (1); to make amino acids / proteins (1); to make fats or oils for storage (1).

Explain how glucose ends up stored in another part of the plant

3 marks | Grade 5

1. Start where the glucose is made: in the leaves, by photosynthesis.
2. Say how it moves: dissolved sugars are carried in the phloem.
3. Finish with what happens in the storage organ: it is converted into starch.

Example. Potato tubers grow underground and contain a lot of starch.
Explain how the starch in a tuber is made from carbon dioxide taken in by the leaves.

Model answer. The leaves use carbon dioxide to make glucose by photosynthesis (1). Dissolved sugars are transported from the leaves to the tuber in the phloem (1). In the tuber the sugar is converted into starch for storage (1).

Explain why starch is stored instead of glucose

2 marks | Grade 6

1. Use the key word: starch is insoluble.
2. Link it to water: it does not affect osmosis, and it stays in the cells.

Example. Plant cells convert glucose into starch for storage.
Explain the advantage of storing starch rather than glucose.

Model answer. Starch is insoluble (1), so it does not affect the movement of water into or out of the cells by osmosis / it cannot move out of the cells (1).

Explain the effect of a shortage of nitrate ions

3 marks | Grade 5

1. Say what nitrate ions are used for: with glucose, to make amino acids.
2. Say that amino acids are joined to make proteins.
3. Link less protein to less growth (fewer new cells).

Example. Wheat plants grown in soil that is low in nitrate ions grow poorly, even when they have plenty of light and water.
Explain why.

Model answer. Plants use nitrate ions and glucose to make amino acids (1). Amino acids are joined to make proteins (1). With fewer proteins the plant cannot make as many new cells, so it grows less (1).

Don't lose marks

- Saying plants store glucose as glycogen. Glycogen is the storage carbohydrate in animals; plants store starch.
- Saying cellulose is an energy store or part of the cell membrane. It strengthens the cell wall.
- Saying plants get glucose or proteins from the soil. Only water and mineral ions, such as nitrate, come from the soil.
- Forgetting that respiration is a use of glucose: plants respire the glucose they make.
- Writing that starch is stored because it is 'small'. Starch is a large, insoluble molecule.

More tips

Memory tricks

- Five uses: 'Really Smart Plants Can Feast': Respiration, Starch, Proteins (via amino acids), Cellulose, Fats and oils.
- Cellulose → cell wall: both start with 'cell'.
- See 'nitrate' in a question? Think nitrogen → amino acids → proteins → growth.
- Starch is Stored and Stays put, because it is insoluble.

Exam technique

- Give specific uses, each with a purpose: 'converted into starch for storage', 'used to make cellulose to strengthen cell walls'.
- In starch storage questions, the key word examiners look for is 'insoluble', linked to osmosis.
- For nitrate questions, give the full chain: nitrate ions + glucose → amino acids → proteins → growth.
- Be ready to link this topic to others: phloem (transport), iodine test (food tests) and active transport (root hair cells).

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

List the five uses of glucose

Respiration, starch for storage, fats or oils for storage, cellulose for cell walls, and amino acids for proteins.

Grade 4

State what cellulose is used for

Cellulose strengthens the cell wall of plant cells.

Grade 4

Name where plants store starch and oils

Starch is stored in leaves, roots and tubers such as potatoes; many seeds store oils.

Grade 5

Describe how glucose reaches storage organs

Sugars made in the leaves are carried in solution in the phloem to where they are used or stored.

Grade 5

Explain why plants need nitrate ions

Plants use glucose and nitrate ions to make amino acids, which are joined to make proteins.

Grade 5

Explain how nitrate shortage reduces growth

Less nitrate means fewer amino acids and less protein, so fewer new cells are made and the plant grows less.

Grade 6

Explain why plants store starch, not glucose

Starch is insoluble, so it does not affect the movement of water by osmosis and it stays inside the cells.

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