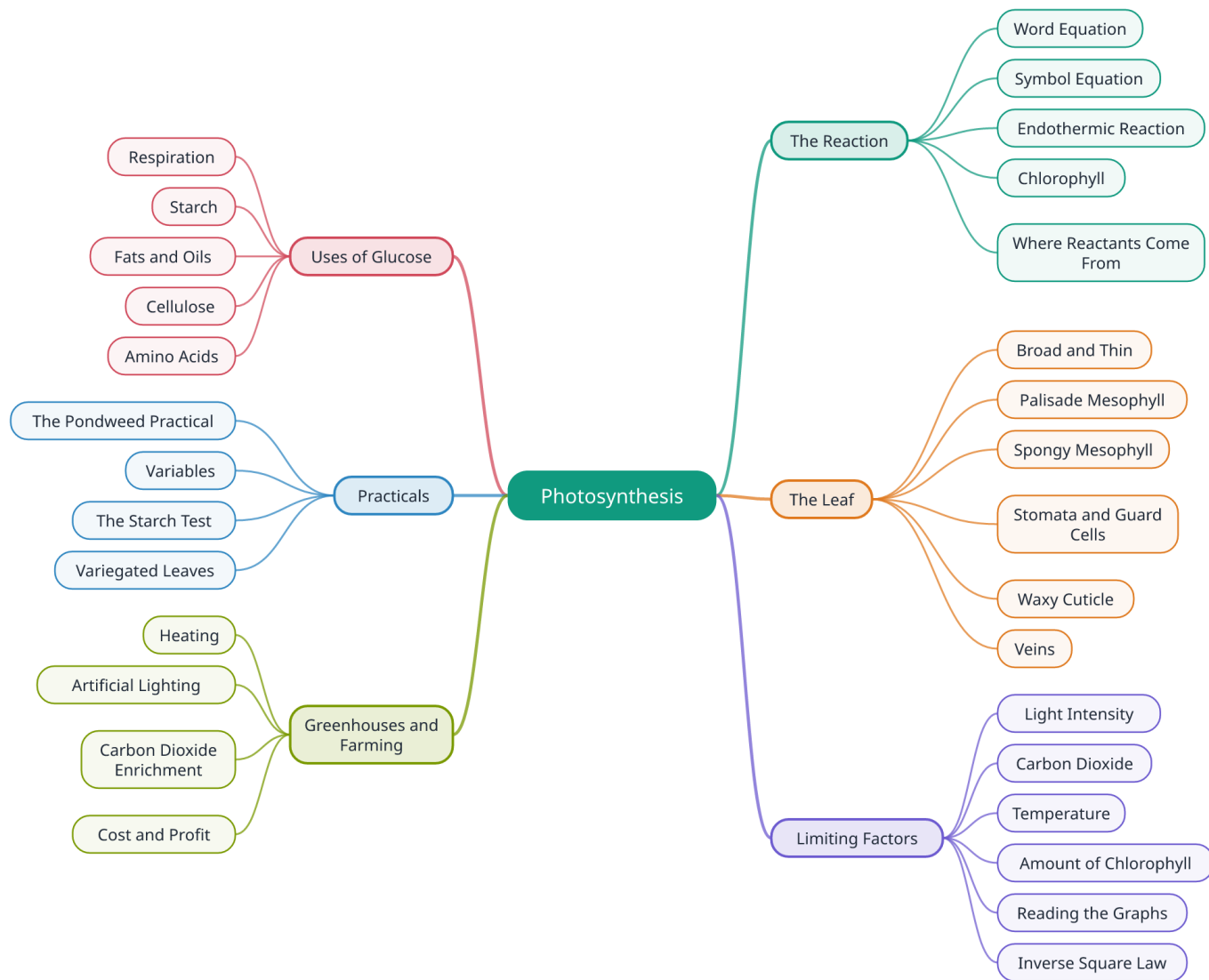


Photosynthesis Mind Map (GCSE)

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Photosynthesis mind map explained

The Reaction

Photosynthesis is how plants and algae make glucose, using energy from light.

Word Equation

carbon dioxide + water → glucose + oxygen, in the presence of light.

Symbol Equation

$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$. Learn it balanced: six of each, except one glucose.

Endothermic Reaction

Energy is transferred from the environment to the chloroplasts by light, so photosynthesis takes in energy.

Chlorophyll

The green pigment in chloroplasts that absorbs the light energy.

Where Reactants Come From

Carbon dioxide diffuses into the leaf from the air through the stomata. Water is absorbed by the roots and carried up to the leaves in the xylem.

The Leaf

Leaves are adapted to absorb light and exchange gases efficiently.

Broad and Thin

A large surface area to absorb light, and a short distance for gases to diffuse.

Palisade Mesophyll

Tightly packed cells near the top surface with many chloroplasts. Most photosynthesis happens here.

Spongy Mesophyll

Air spaces that let carbon dioxide and oxygen diffuse through the leaf.

Stomata and Guard Cells

Pores, mostly on the underside, that let carbon dioxide in and oxygen out. Guard cells open and close them.

Waxy Cuticle

A waterproof layer that reduces water loss while still letting light through.

Veins

Xylem brings water into the leaf, and phloem carries sugars away.

Limiting Factors

A limiting factor is whatever is in shortest supply, so it stops the rate of photosynthesis increasing.

Light Intensity

More light increases the rate, until another factor becomes limiting.

Carbon Dioxide

A higher carbon dioxide concentration increases the rate, until another factor becomes limiting.

Temperature

The rate increases as temperature rises, but above the optimum the enzymes are denatured and the rate falls sharply.

Amount of Chlorophyll

Less chlorophyll, for example from disease or a lack of magnesium, lowers the rate.

Reading the Graphs

The rate rises, then levels off. Where it is rising, the factor on the x-axis is limiting. Where it levels off, a different

factor has become the limiting one.

Inverse Square Law

Higher tier. Light intensity is proportional to $1 / \text{distance}^2$. Doubling the distance from a light source cuts the light intensity to a quarter.

Uses of Glucose

Plants use the glucose they make in five main ways.

Respiration

Glucose is broken down to release energy for the plant's cells.

Starch

Converted to insoluble starch for storage in roots, stems and leaves. Being insoluble, it does not affect water movement by osmosis.

Fats and Oils

Made for long-term energy storage, especially in seeds.

Cellulose

Used to strengthen the cell wall.

Amino Acids

Made by combining glucose with nitrate ions absorbed from the soil, then used to make proteins.

Practicals

The light intensity investigation is a required practical for AQA and a core practical for Edexcel.

The Pondweed Practical

Place pondweed in water at different distances from a light source. Count the oxygen bubbles, or measure the volume of oxygen given off, in a set time.

Variables

- Independent: distance from the light (light intensity)
- Dependent: rate of oxygen production
- Control: temperature and carbon dioxide concentration

The Starch Test

Boil the leaf in water, warm it in ethanol in a water bath to remove the chlorophyll, rinse it, then add iodine solution. It turns blue-black where starch is present.

Variegated Leaves

A leaf with green and white parts only turns blue-black where it was green, showing that chlorophyll is needed for photosynthesis.

Greenhouses and Farming

Higher tier, mainly AQA. Farmers control limiting factors to grow more crops, faster.

Heating

Keeps the temperature near the optimum for photosynthesis.

Artificial Lighting

Lets photosynthesis continue beyond daylight hours.

Carbon Dioxide Enrichment

Paraffin heaters or added carbon dioxide raise the carbon dioxide concentration.

Cost and Profit

Farmers must balance the extra cost of heating, lighting and carbon dioxide against the extra profit from a bigger,

faster yield.

How to revise with this mind map

1. Learn both equations. Be ready to write the word equation and the balanced symbol equation from memory: they come up every year.
2. Practise reading limiting factor graphs. For each graph, say which factor is limiting where the line is rising, and why the line levels off. This is where most marks are lost.
3. Know the practical inside out. For the pondweed practical, be able to describe the method, name the independent, dependent and control variables, and explain how to keep temperature constant.
4. Explain, don't just state. Higher marks need the reason: the rate falls at high temperatures because the enzymes are denatured, not just because it is too hot.
5. Make it yours. Build your own photosynthesis map in Mindmapi from your class notes, and ask the AI about any branch you are unsure of. The answer is saved into that branch's notes for next time.