AQA Trilogy-Biology key terms - Bioenergetics

Photosynthesis

Word equation

Carbon dioxide + water $\xrightarrow[\text{chlorophyll}]{\text{sunlight}}$ glucose + oxygen

Chemical eqn

$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$

Think all the 6s

Photosynthesis is an **endothermic** reaction. Energy is transferred **from** the environment (sunlight) to the chloroplasts

Plants store excess glucose as **starch** as it is **insoluble,** so does not affect osmosis (turns iodine blue/black).

Glucose (that the plant makes) is used:

- In respiration (which helps release energy for growth)
- Make oil/fats for storage
- Make cellulose- which strengthens cell walls
- Make amino acids – which join to make proteins (for growth)

Nitrate ions- found in the soil. Decomposers break down dead plants/organisms and release them.
-Glucose and nitrate are both **needed to make proteins.**
More **growth**→ bigger **yield**

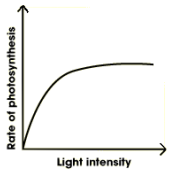
If photosynthesis is prevented, **plant won't grow** as much since less glucose is made, so less protein/respiration/energy for growth

If plants are kept in the **dark**, photosynthesis won't happen as **sunlight** is needed for photosynthesis.

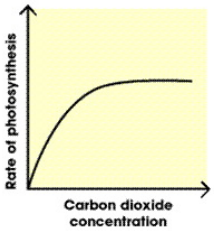
Some plants have white areas (variegated leaves). Photosynthesis will not happen in these bits (only in the green parts), as there is **no chlorophyll**, which is needed for photosynthesis.

Photosynthesis will increase if any factor required increases (**Light, temperature, CO_2**) until there is one factor that is in short supply. This is called the **limiting factor.**

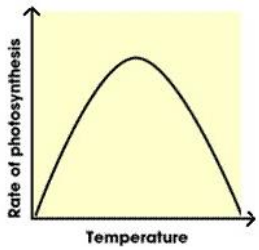
Light intensity



Carbon dioxide

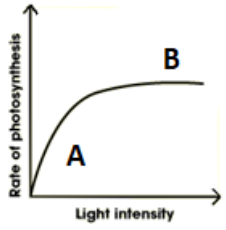


Temperature



Pattern to do with **enzymes**. Increases with temperature as enzymes get more energy they can join with more substrates. But, at high temperatures, enzymes involved in photosynthesis **denature** (i.e. don't work).

On graphs showing limiting factors, at point A (diagonal line), the thing on the **X axis is ALWAYS the limiting factor** (e.g. light intensity in this example). At point B (when it levels out), it is ALWAYs another limiting factor other than this (e.g. temp or CO_2)



Describing graphs- say **what** the pattern is (e.g. it increases up until a light intensity of 20 lux and then levels off)
Words to use: increase, decreases, levels off, rapidly, slowly **+ always quote figures**

Explaining graphs- say **why** something happens (e.g. as the light intensity increases, plants can photosynthesise more, but eventually it levels out **because** something else is the limiting factor (e.g. CO_2)).

REQUIRED PRACTICAL- investigating the effect of light intensity on rate of photosynthesis

How to do experiment:

1. Put pond weed in beaker
2. **Shine light** on it
3. **Vary light intensity** (e.g. by changing distance of lamp from pondweed)
4. **Control** other variables (e.g. same pondweed, use a heat screen or water bath to maintain temperature, same amount of CO_2)

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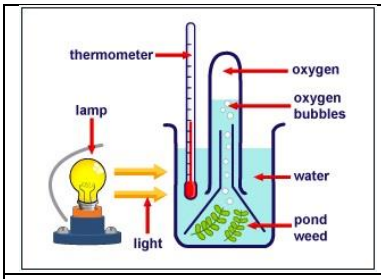
<td> 
</td>
<td>5. Leave enough time at each new light intensity before taking measurement
6. Measure photosynthesis <u>rate</u> (e.g. counting air bubbles or collecting gas and measuring volume in syringe) over a <u>set period of time</u>
7. Repeat</td>
</tr>
<tr>
<td>Better to count bubbles for a shorter time (e.g. every minute for three minutes than to count all the bubbles in three minutes)- less likely to lose count/more reliable</td>
<td>Control variables and rate questions are very common. Info in box above, but make sure you learn these specifically.</td>
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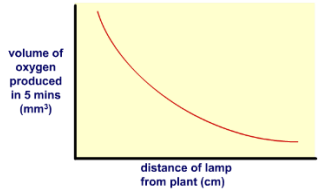
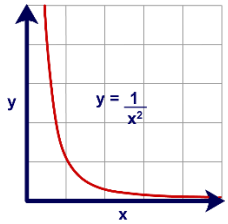
<tr>
<td>Hi<u>gher Tier only- inverse proportion</u>
 

This decrease isn't linear, it is closer to an inverse square relationship (i.e. doubling the distance of the lamp would quarter the light intensity).
- The inverse square law states that light intensity is inversely proportional to the square of the distance from the light source
 
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<td><u>Higher tier only-</u>
-In greenhouses we must consider limiting factors to gain maximum rate of photosynthesis, whilst also maintaining profit.
Limiting factors can interact and any one may be the factor that limits photosynthesis.</td>
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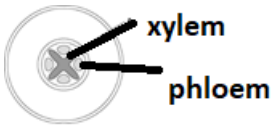
<tr>
<td><u>Cells</u>= building blocks of all living <u>organisms. Tissues</u> = groups of cells with a similar structure and function. <u>Organs</u>= groups of tissues performing specific jobs. <u>Organ systems</u>- organs working together to form organisms.</td>
<td>Tissues
 

<u>Xylem</u>- carries water from roots to leaves. Made of dead, hollow cells, which allow a tube to carry the water. Strengthened by lignin. 1 direction.
<u>Phloem</u>- carries dissolved sugars and minerals from leaves to rest of plant- called <u>translocation (</u>details on transport key terms sheet). Sugars can move in both directions. Made of elongated cells. Cell sap can move from 1 phloem to next through tiny pores in end walls.</td>
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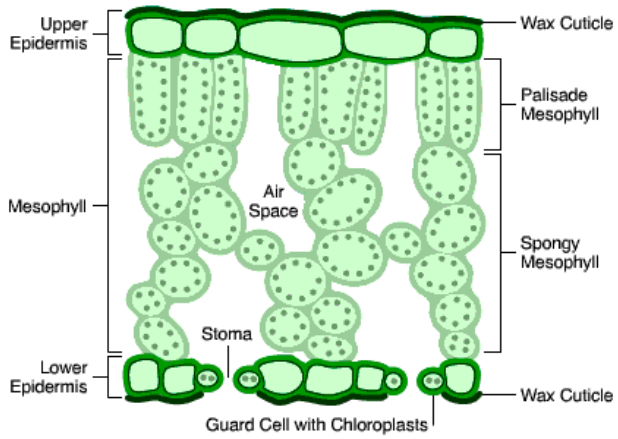

The leaf is a plant **organ** (as are stem and roots)

In leaves- Palisade layer- cells on upper surface of leaf with lots of chloroplasts for photosynthesis. Block shaped so can tightly fit onto top layer of leaf (more sunlight)
Spongy mesophyll layer- lots of air spaces to allow for gas exchange. Few chloroplasts as not needed.
Stomata- openings on bottom of plant (so less evaporation from sun)- let CO_2 into plant (and water out). Opening of these is controlled by **guard cells.**
Upper epidermis- very thin to let light through. Covered by a waxy cuticle to stop water loss.
Meristem tissue- in the tips of roots and shoots. Contains undifferentiated cells in zones where plant growth can take place.

Root hair cells- help absorb water (by osmosis) and minerals from the soil (by active transport). Have an elongated shape which allows a **large surface area.**

Respiration

Respiration is a reaction that happens in the mitochondria of all cells. **Releases energy (not made!)** used for:
-chemical reactions to build larger molecules
-movement
-keeping warm
-used for continual enzyme controlled processes of metabolism

Respiration is an **exothermic** reaction (energy is released)

Aerobic respiration

$6O_2 + C_6H_{12}O_6$ ~~$6H_2O+6CO_2$~~ (+ Energy)

Oxygen + glucose → water + carbon dioxide (+energy)

Mitochondria have a **large surface area** for the **enzymes** needed for the **respiration** reaction. Cells that need lots of energy often have lots of mitochondria (e.g. muscle cells), as they release lots of energy in respiration.

Metabolism includes:
-Conversion of starch to glucose, glycogen and cellulose
-formation of lipid molecules from 1 glycerol and 3 fatty acids
-Use glucose and nitrate ions to make amino acids (which then make proteins)
-respiration
-breakdown of excess proteins to form urea for excretion

Exercise causes **heart and breathing rate** to **increase** to provide extra **O_2** and **glucose** to the cells for respiration and remove CO_2.

Anaerobic respiration occurs when there is a lack of **oxygen** (e.g. start of exercise).

Anaerobic respiration in humans:

-Glucose→ lactic acid (+ energy)

H tier only → Lactic acid (painful) is produced instead of CO_2 and water (due to the incomplete oxidation of glucose). Anaerobic respiration releases less energy than aerobic (as the oxidation of glucose is incomplete)

H tier only →Blood carries the lactic acid to the liver where it is converted back into glucose. **Oxygen debt**= amount of extra oxygen needed to react with the built up lactic acid and remove it from cells.

If you run in a short sprint, you will respire anaerobically. Longer race= aerobically.

Plants/yeast anaerobic respiration:

Glucose → ethanol and carbon dioxide

Anaerobic respiration in yeast cells= **fermentation**. Used to make bread and alcohol