

Photosynthesis and limiting factors

**Which organisms are the main producers of food and biomass?**

Photosynthesis and limiting factors

**What is biomass?**

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**What does endothermic mean?**

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**Word equation for photosynthesis**

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**Symbol equation for photosynthesis**

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**What is the energy source for photosynthesis?**

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**What is a limiting factor?**

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**Name the three limiting factors of photosynthesis.**

The mass of living material. Plants build it from the glucose made in photosynthesis.

Photosynthetic organisms: plants and algae.

carbon dioxide + water → glucose + oxygen, using light energy.

A reaction that takes in energy from the surroundings.

Light energy, absorbed by chlorophyll in the chloroplasts.



Temperature, light intensity and carbon dioxide concentration.

A factor in short supply that stops the rate of a process from increasing.

Photosynthesis and limiting factors

**Why does the rate of photosynthesis fall at high temperatures?**

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**What does a flat part of a rate graph tell you?**

Photosynthesis and limiting factors **Higher tier**

**How can you tell which factor limits a plateau when two factors interact?**

Photosynthesis and limiting factors **Higher tier**

**Two light intensity curves have different plateaus. What does the higher plateau show?**

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**Core practical: how is light intensity changed?**

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**Core practical: how is the rate of photosynthesis measured?**

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**Core practical: name three variables to control.**

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**Core practical: why is a heat shield or water bath used?**

The factor being changed is no longer limiting. Another factor is.

The enzymes are denatured, because their active site changes shape, so substrates cannot bind.

The other factor, such as carbon dioxide concentration or temperature, was higher and was limiting the lower curve.

It is the factor that is in shortest supply. Increasing it raises the plateau.

Count the bubbles of oxygen released per minute, or measure the volume of gas collected.

By changing the distance between the lamp and the pondweed.

To keep the temperature constant, because the lamp warms the water.

Temperature, carbon dioxide concentration (sodium hydrogencarbonate) and the plant used.

Photosynthesis and limiting factors **Higher tier**

**How is the rate of photosynthesis related to light intensity when light is limiting?**

Photosynthesis and limiting factors **Higher tier**

**State the inverse square law for light intensity.**

Photosynthesis and limiting factors **Higher tier**

**A lamp is moved to three times the distance. What happens to light intensity?**

Transport in plants

**Give three adaptations of a root hair cell.**

Transport in plants

**How do root hair cells take in mineral ions?**

Transport in plants

**How does water enter a root hair cell?**

Transport in plants

**What does xylem carry?**

Transport in plants

**Why are xylem cells lignified and dead?**

Light intensity is proportional to  $1 \div \text{distance}^2$  from the light source.

Directly proportional.

Long thin projection for a large surface area, thin wall, and many mitochondria for active transport.

It falls to one ninth ( $1 \div 3^2$ ).

By osmosis, because the cell sap is more concentrated than the soil water.

By active transport, using energy from respiration.

Dead cells with no end walls form a hollow tube for water, and lignin strengthens the walls.

Water and mineral ions, from the roots to the rest of the plant.

Transport in plants

**What does phloem carry?**

Transport in plants

**Why are phloem cells living?**

Transport in plants

**What is the role of companion cells?**

Transport in plants

**What is transpiration?**

Transport in plants

**Put the path of water in order.**

Transport in plants

**What are stomata?**

Transport in plants

**How do guard cells close a stoma?**

Transport in plants

**What is translocation?**

They use energy from respiration to transport sucrose.

Sucrose, dissolved in water, around the plant.

The loss of water vapour from the leaves, which pulls water and mineral ions up through the plant.

They have many mitochondria and release the energy needed for the transport of sucrose in the phloem.

Pores in the leaf surface, each surrounded by two guard cells, which let gases in and out.

Root hair cell → xylem → leaf cells (evaporation) → air spaces → out through the stomata.

The transport of sucrose around the plant in the phloem.

They lose water and become limp, which reduces water loss.

Transport in plants

**Where does sucrose move to and from in translocation?**

Transport in plants

**Does translocation need energy?**

Leaves, water uptake and extreme environments

Triple only

**Why is the palisade mesophyll near the top of the leaf?**

Leaves, water uptake and extreme environments

Triple only

**What is the function of the air spaces in the spongy mesophyll?**

Leaves, water uptake and extreme environments

Triple only

**What does the waxy cuticle do?**

Leaves, water uptake and extreme environments

Triple only

**Why is a leaf broad, flat and thin?**

Leaves, water uptake and extreme environments

Triple only

**Why is the upper epidermis transparent?**

Leaves, water uptake and extreme environments

**How does increasing light intensity affect water uptake?**

Yes. It is carried out by the living cells of the phloem, using energy from respiration.

From the leaves to the parts of the plant that use or store it, such as roots, shoots and fruits.

They allow carbon dioxide to diffuse through the leaf to the cells, and oxygen to diffuse out.

It has many chloroplasts and most photosynthesis happens here, close to the light.

A large surface area absorbs light, and a thin leaf gives a short diffusion distance for gases.

It is waterproof, so it reduces water loss by evaporation from the leaf surface.

It increases it, because the stomata open and more water vapour diffuses out.

To let light pass through to the palisade cells below.

Leaves, water uptake and extreme environments

**How does increasing air movement affect water uptake?**

Leaves, water uptake and extreme environments

**How does increasing temperature affect water uptake?**

Leaves, water uptake and extreme environments

**What does a potometer measure?**

Leaves, water uptake and extreme environments

**How do you calculate a rate of water uptake?**

Leaves, water uptake and extreme environments

**How do you calculate percentage change in mass?**

Leaves, water uptake and extreme environments

Triple only

**How does leaf size and shape help plants in dry places?**

Leaves, water uptake and extreme environments

Triple only

**How does a thick cuticle help plants in extreme environments?**

Leaves, water uptake and extreme environments

Triple only

**How can stomata be adapted to reduce water loss?**

It increases it, because water evaporates faster and water vapour diffuses out faster.

It increases it, because water vapour is carried away, keeping a steep concentration gradient.

Rate = change in quantity (such as distance moved or volume) ÷ time.

The rate of water uptake of a leafy shoot, from the movement of an air bubble in a capillary tube.

Small, narrow or rolled leaves, or spines, have a small surface area so less water evaporates.

$(\text{change in mass} \div \text{original mass}) \times 100.$

Fewer stomata, stomata in pits, or stomata that are closed during the day.

It is waterproof, so less water evaporates from the leaf surface.

Plant hormones **Triple only**

**What is a tropism?**

Plant hormones **Triple only**

**Where is auxin made in a shoot?**

Plant hormones **Triple only**

**How does auxin cause phototropism in a shoot?**

Plant hormones **Triple only**

**How does a root respond to gravity?**

Plant hormones **Triple only**

**How does a shoot respond to gravity?**

Plant hormones **Triple only** **Higher tier**

**Two commercial uses of auxins**

Plant hormones **Triple only** **Higher tier**

**Three commercial uses of gibberellins**

Plant hormones **Triple only** **Higher tier**

**Commercial use of ethene**

In the tip of the shoot.

A growth response of a plant to a stimulus.

It grows downwards (positive gravitropism).  
Auxin on the lower side slows the growth of  
the cells there.

Auxin moves to the shaded side and makes  
cells elongate there, so the shoot bends  
towards light.

Weedkillers and rooting powders.

It grows upwards (negative gravitropism).

Ripening fruit.

Germination of seeds, fruit and flower  
formation, and production of seedless fruit.