

Photosynthesis

Word equation for photosynthesis

Photosynthesis

Chemical symbols for the four substances in photosynthesis

Photosynthesis

Why is photosynthesis an endothermic reaction?

Photosynthesis

Where does photosynthesis happen in a plant cell?

Photosynthesis

Name four factors that affect the rate of photosynthesis

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How does light intensity affect the rate of photosynthesis?

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How does carbon dioxide concentration affect the rate?

Photosynthesis

How does temperature affect the rate of photosynthesis?

Carbon dioxide CO₂, water H₂O, glucose C₆H₁₂O₆, oxygen O₂.

carbon dioxide + water → glucose + oxygen
(in the presence of light)

In the chloroplasts, which contain chlorophyll.

Energy is transferred from the environment to the chloroplasts by light.

The rate increases as light intensity increases, until another factor becomes limiting and the rate levels off.

Temperature, light intensity, carbon dioxide concentration and the amount of chlorophyll.

Rate rises up to an optimum, then falls because the enzymes are denatured.

The rate increases as concentration increases, until another factor becomes limiting. Carbon dioxide is a reactant.

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How does the amount of chlorophyll affect the rate?

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What is a limiting factor?

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Equation for the rate of photosynthesis from oxygen production

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On a graph of rate against a factor, what does the flat part show?

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Required practical: independent and dependent variables with pondweed

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Required practical: how do you control the temperature of the pondweed?

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Required practical: how do you control carbon dioxide concentration?

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Required practical: what gas do the bubbles contain?

The factor in shortest supply, which stops the rate from increasing even if other factors are increased.

Less chlorophyll means less light is absorbed, so the rate is lower.

The factor on the x-axis is no longer limiting. Another factor is limiting the rate.

rate = volume of oxygen produced ÷ time

Use a water bath, or place a heat shield (a beaker of water) between the lamp and the pondweed. A cool LED lamp also helps.

Independent: distance of lamp (light intensity). Dependent: bubbles, or volume of oxygen, per unit time.

Oxygen, the product of photosynthesis.

Dissolve sodium hydrogencarbonate in the water.

Photosynthesis **Higher tier**

Why is the limiting factor idea important in a greenhouse?

Photosynthesis **Higher tier**

Can any one factor limit photosynthesis?

Photosynthesis **Higher tier**

State the inverse square law for light intensity

Photosynthesis **Higher tier**

Light is 100 units at 10 cm. What is the intensity at 30 cm?

Photosynthesis **Higher tier**

How do you explain a graph with two or three factors?

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Five uses of glucose made in photosynthesis

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Why do plants need nitrate ions?

Photosynthesis

Why is glucose stored as starch?

Yes. The factors interact and any one of them may be the factor that limits photosynthesis.

Growers can add heat, light or carbon dioxide to gain the maximum rate of photosynthesis, but must still maintain a profit.

Distance $\times 3$, so intensity $\div 3^2 = 100 \div 9 = 11.1$ units (to 1 decimal place).

Light intensity is inversely proportional to the square of the distance ($\propto 1 \div \text{distance}^2$). Double the distance and intensity falls to one quarter.

Respiration, starch (storage), fat or oil (storage), cellulose (cell walls) and amino acids (protein synthesis).

Find which factor is limiting in each part: the x-axis factor where the line rises, another factor where it is flat.

Starch is insoluble, so it is suitable for storage.

To produce proteins: nitrate ions from the soil are used with glucose to make amino acids.

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What does cellulose do for plant cells?

It strengthens the cell wall.