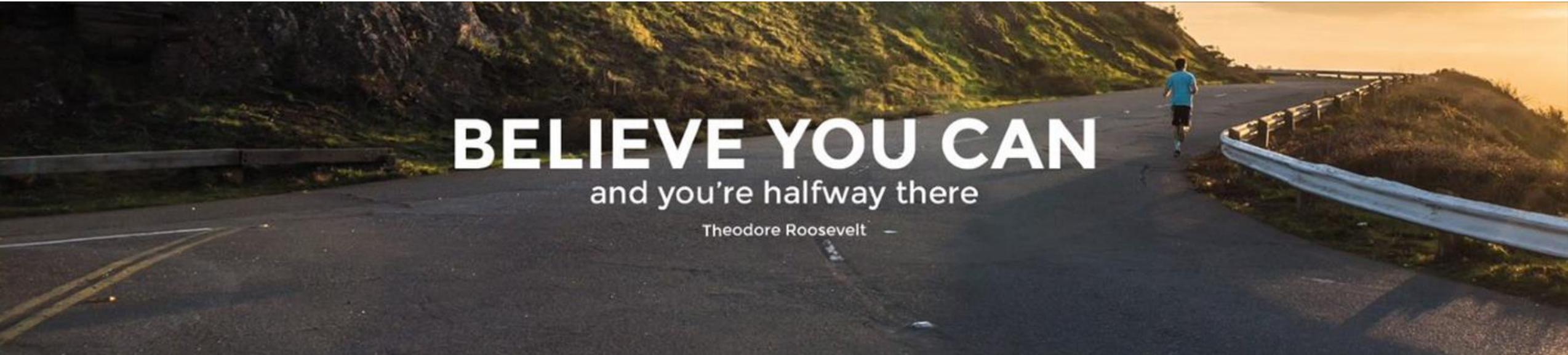


EB Education Revision Guide



How to work with Photosynthesis: Part 1

Photosynthesis

What is it?

Plants make their own food by photosynthesis. It is where energy enters most of the food chains on Earth. The process is a chemical reaction that uses light energy.

It just means “putting together with light”. It is an endothermic reaction, as energy is taken in.

Glucose is made during photosynthesis.

What do plants need?

Sunlight –source of energy for the plant.

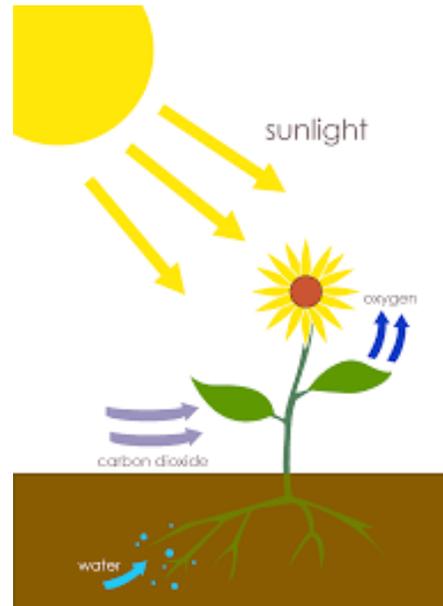
Chlorophyll – the green pigment which makes plants look green, found in chloroplasts.

Water – travels up from the roots.

Carbon dioxide – diffuses in through the stomata in the leaves.

Photosynthesis

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



What happens to the glucose made?

Some is used to make larger, complex molecules like starch. These make up the biomass of the organism.

Sugars can also be stored as fats and oils.

Glucose can be converted into sucrose and stored in fruits, seeds and roots. It can also be used to form amino acids, which combine to make proteins.

Some is used during respiration.

Temperature

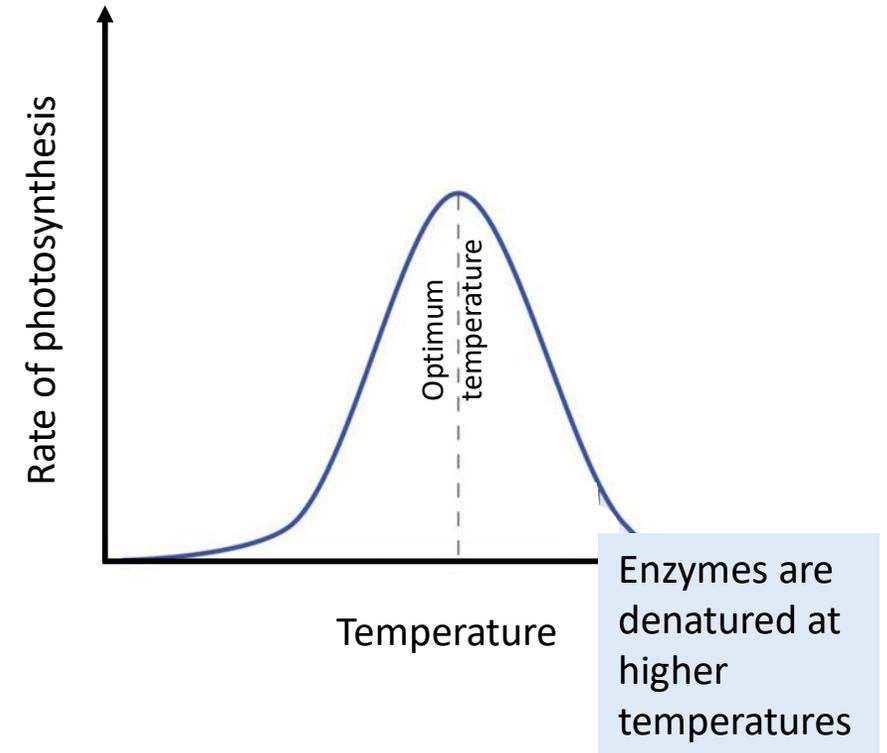
Temperature affects the rate of photosynthesis, because enzymes are involved in the reaction.

If the temperature is too low this can be a limiting factor. The enzymes are working slowly due to low kinetic energy.

As temperature increases, the enzymes have more energy, collide with substrate molecules more and the rate of photosynthesis increases.

If the temperature is too high, enzymes are denatured, meaning the reaction cannot happen as the active site has changed shape, so the substrate can no longer combine with the enzyme.

Limiting Factors



Limiting Factors

TOP TIP:

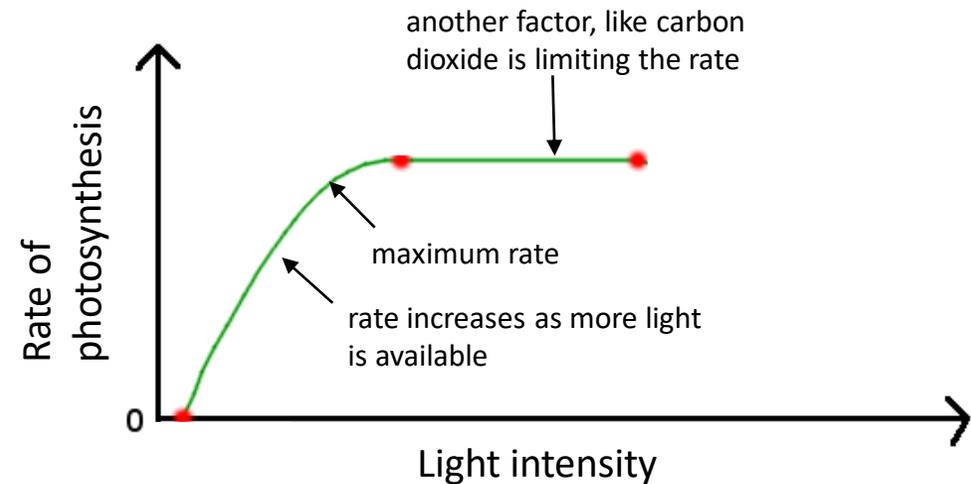
Respiration happens all the time, day and night – oxygen is taken in by the plant and carbon dioxide released. Photosynthesis will only take place during the day.

Light

As light transfers the energy needed for photosynthesis it can be a limiting factor.

As light levels increase, the rate of photosynthesis also increases. For a while the rate is directly proportional to light intensity.

Once a certain light intensity is reached, the rate of photosynthesis remains the same. This is because another factor (such as temperature or carbon dioxide concentration) is the limiting factor.

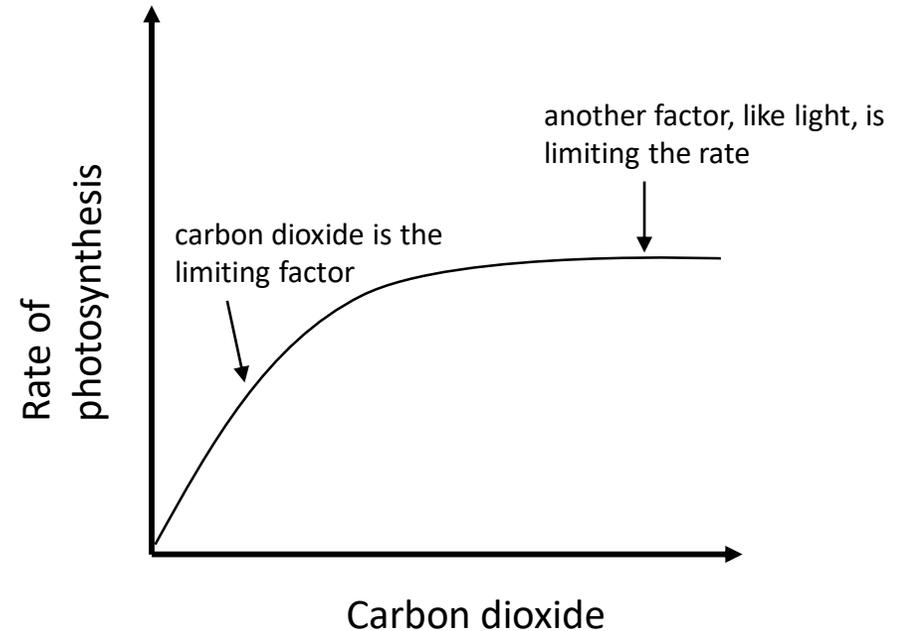


Carbon dioxide

Increasing the carbon dioxide concentration increases the rate of photosynthesis up to a point.

After this, the rate of photosynthesis remains the same, and carbon dioxide is no longer the limiting factor.

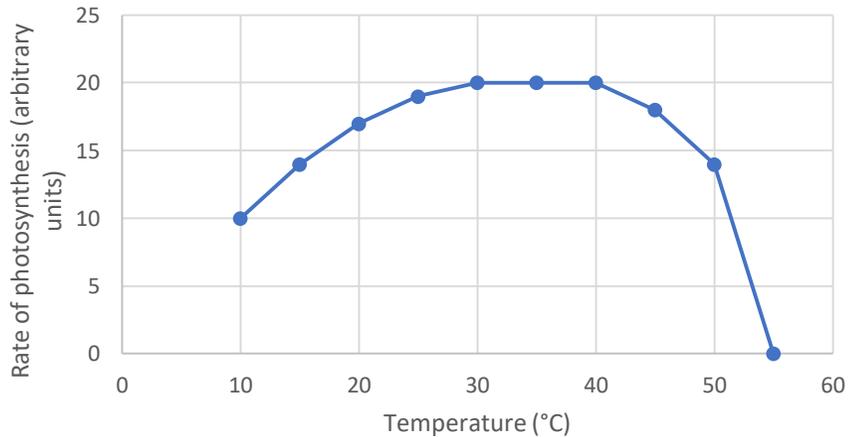
Limiting Factors



Your turn:

1. Rosie is growing some tomatoes in a greenhouse. A bigger crop of tomatoes is produced the more the plants photosynthesise. As temperature can change the rate of photosynthesis, Rosie wants to use heaters to make the tomato plants photosynthesise at a faster rate.

Rosie needs to find out the optimum temperature for her greenhouse.



- a) Describe what the graph shows. You should include data from the graph in your answer.

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.....

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.....

.....

- b) Explain the shape of the graph.

.....

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.....

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- c) Explain what the optimum temperature is for the greenhouse.

.....

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Your turn:

d) Rosie is not sure whether to use heaters in her greenhouse. What other factors should she consider apart from increasing the rate of photosynthesis.

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.....
.....
.....

2a) Use the words below to fill in the gaps.

chlorophyll light nitrogen oxygen
carbon cytoplasm sound water starch

During photosynthesis dioxide and are converted into and glucose. energy is required to do this, and is trapped by a green pigment called in the chloroplasts.

The plant changes some of the glucose into This is insoluble so it can be stored.

b) Where does photosynthesis take place in a plant?

.....

c) How do the two raw materials required for photosynthesis get into the plant?

1:.....

.....

2:.....

.....

Your turn:

3a) Write the word equation for photosynthesis.

.....

b) Scientists grew some geraniums in a greenhouse to investigate the rate of photosynthesis. They cut discs from the leaves of the geraniums. They measured the rate of photosynthesis by using the rate of oxygen production.

No oxygen was produced by the leaf discs in the dark.

Explain why.

.....

c) The leaves took in oxygen when it was dark.

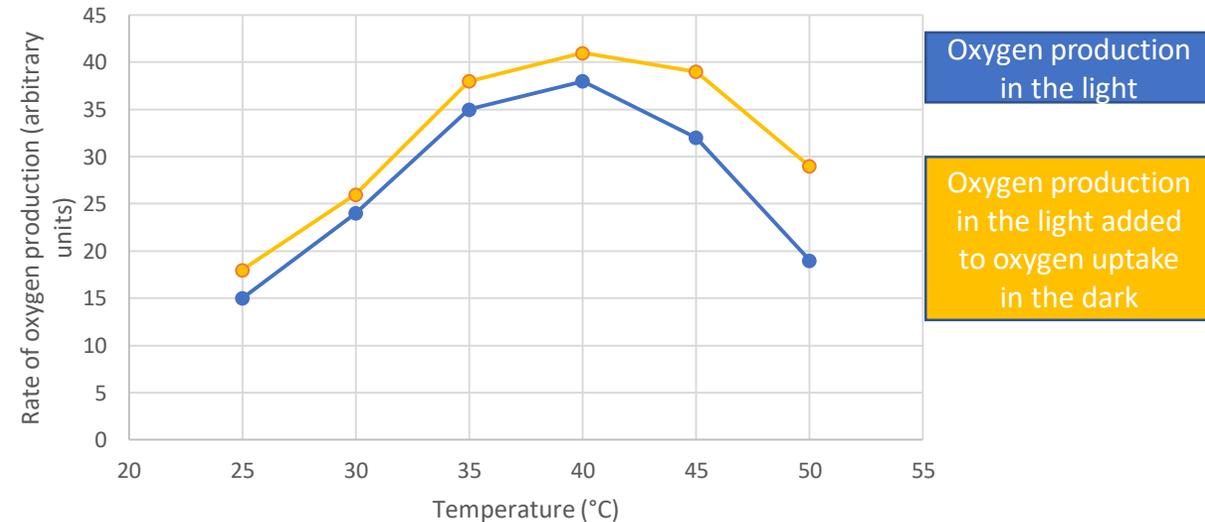
Explain why.

.....

d) The scientists measured the rate of oxygen uptake by leaves in the dark. They also measured the rate of oxygen release by the leaf discs in the light.

The graph below shows the effect of temperature on:

- Oxygen production in the light
- Oxygen production in the light added to oxygen uptake in the dark.





Your turn:

Use the graph to answer the questions below:

i) Describe what effect temperature has on the production of oxygen in the light.

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ii) Explain what effect temperature has on oxygen production in the light, when temperature increases from:
25°C to 35°C.

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45°C to 50°C

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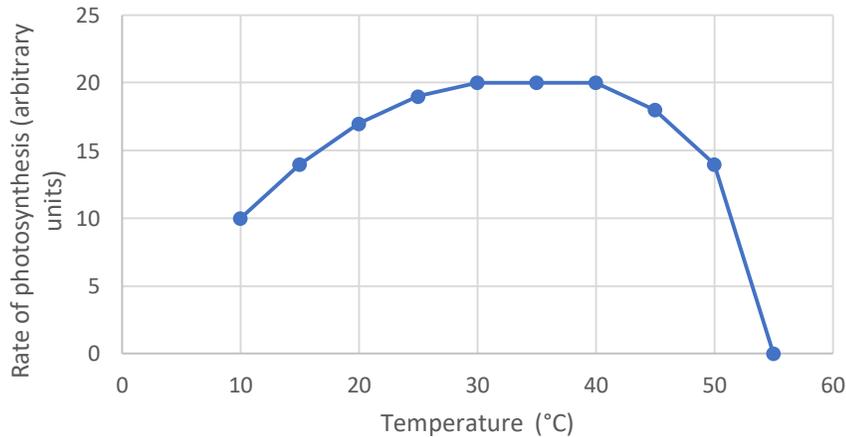
iii) Explain why temperatures in a greenhouse should not be higher than 35°C.

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Answers:

1. Rosie is growing some tomatoes in a greenhouse. A bigger crop of tomatoes is produced the more the plants photosynthesise. As temperature can change the rate of photosynthesis, Rosie wants to use heaters to make the tomato plants photosynthesise at a faster rate.

Rosie needs to find out the optimum temperature for her greenhouse.



- a) Describe what the graph shows. You should include data from the graph in your answer.

.....
 ..As the temperature increases, the rate of photosynthesis
 ..increases, levels off, then decreases. It rises to a maximum rate
 ..of 20 units at 30°C, decreases after 40 °C, and rate is zero at 55
 ..°C.
 ..

- b) Explain the shape of the graph.

.....
 ..As the temperature increases, the rate of photosynthesis increases
 ..because the enzymes have more energy, so collide more frequently.
 ..It levels off due to another limiting factor (like light). It decreases
 ..because the enzymes denature.
 ..

- c) Explain what the optimum temperature is for the greenhouse.

.....
 ..Around 28 °C to 30 °C is the maximum rate of photosynthesis,
 ..and heating any more would be wasteful.
 ..



Your turn:

d) Rosie is not sure whether to use heaters in her greenhouse. What other factors should she consider apart from increasing the rate of photosynthesis.

.....
The cost of heaters and heating
.....
Impact on pollution/carbon footprint/global warming
.....
.....
.....

2a) Use the words below to fill in the gaps.

chlorophyll light nitrogen oxygen
carbon cytoplasm sound water starch

During photosynthesiscarbon..... dioxide andwater..... are converted intooxygen..... and glucose.Light..... energy is required to do this and is trapped by a green pigment called chlorophyll... in the chloroplasts.

The plant changes some of the glucose intostarch..... This is insoluble so it can be stored.

b) Where does photosynthesis take place in a plant?

.....the leaf.....

c) How do the two raw materials required for photosynthesis get into the plant?

1:.....Carbon dioxide diffuses through the stomata into.....

.....the leaf.....

2:.....Water – enters through the roots by osmosis.....

.....

Answers:

3a) Write the word equation for photosynthesis.

.....
 Carbon dioxide + water \longrightarrow glucose + oxygen

b) Scientists grew some geraniums in a greenhouse to investigate the rate of photosynthesis. They cut discs from the leaves of the geraniums. They measured the rate of photosynthesis by using the rate of oxygen production.

No oxygen was produced by the leaf discs in the dark.

Explain why.

.....
 Photosynthesis cannot take place without light

c) The leaves took in oxygen when it was dark.

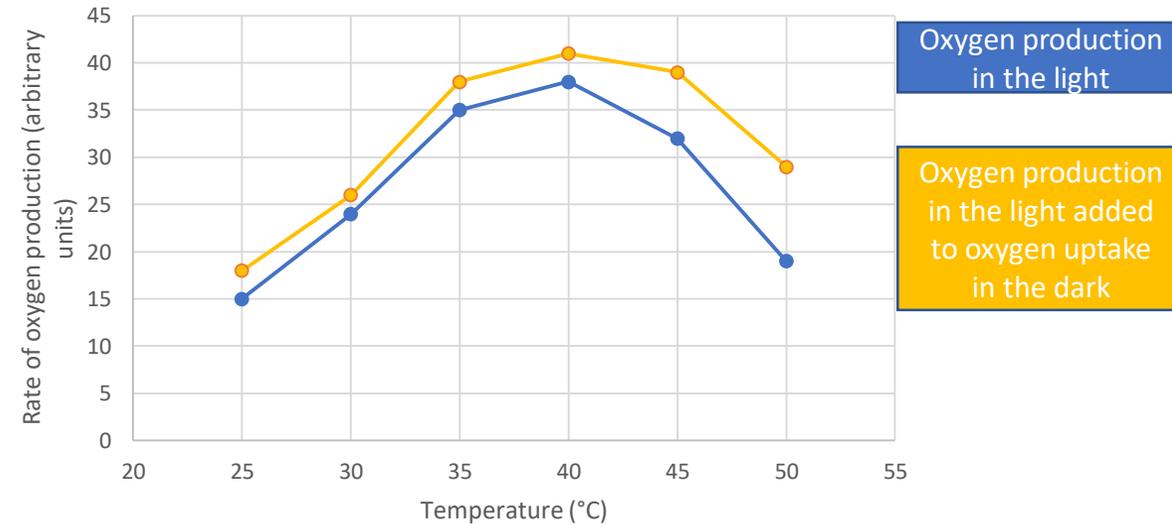
Explain why.

.....
 Respiration is happening day and night.

d) The scientists measured the rate of oxygen uptake by leaves in the dark. They also measured the rate of oxygen release by the leaf discs in the light.

The graph below shows the effect of temperature on:

- Oxygen production in the light
- Oxygen production in the light added to oxygen uptake in the dark.



For more help and resources, or
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