Read the descriptions of the photosynthesis experiments from history and write what each scientist could conclude from their experiment.

Weighing Soil - Jan Baptista van Helmont (1580-1644)

Flemish chemist, biologist and doctor, Jan Baptista van Helmont, investigated what materials plants need to grow by planting a willow tree in a pot.

Firstly, he dried and weighed the soil in the pot and weighed the willow tree. He then planted the willow tree in the dry soil and covered the soil with an iron grate to prevent dust and air mixing with the soil.

Finally, he watered it. He continued to only water the tree for five years. After the five years, he dried and weighed the soil and weighed the willow tree.

	Start	5 years later
Mass of willow tree	2.2 kg	77.2 kg
Mass of dry soil	91.2 kg	91.2 kg

Conclusion

Mint in a bell jar - Joseph Priestley (1733-1804)

English chemist and minister Joseph Priestly investigated the effect plants had on the air.

He place a lit candle in a bell jar with a sprig of mint. The flame quickly extinguished. The bell jar was then left in direct sunlight. After 27 days he used a lens to focus sunlight on the wick and relit the candle. *NB: oxygen was discovered a year later.*

Conclusion

Read the descriptions of the photosynthesis experiments from history and write what each scientist could conclude from their experiment.

Plants in light and dark - Jan Ingenhousz (1730-1799)

Dutch physiologist, biologist and chemist, Jan Ingenhousz, investigated the effect sunlight had on an aquatic plant. Ingenhousz placed a freshly cut sprig of an aquatic plant into a test tube. When the tube was placed in direct sunlight, bubbles formed on the green parts of the plant and the cut end of the stem. Ingenhousz then placed the plant in a dark cupboard and the plant no longer produced bubbles.

Conclusion:

Plants in carbonic acid– Jean Senebier (1742-1809)

Swiss naturalist and pastor, Jean Senebier, investigated the effect carbonic acid had on aquatic plants. Carbonic acid disassociates (splits) into carbon dioxide and water when dissolved in water.

Senebier placed an aquatic plant under a glass funnel and test tube filled with distilled water (pure water). When this was placed in direct sunlight, nothing happened.

Senebier repeated this, having dissolved carbonic acid in the distilled water. This resulted in the aquatic plant producing a gas, which collected in the top of the test tube.

Senebier then doubled the amount of carbonic acid; this in turn doubled the amount of gas produced by the plant.

Conclusion:

Model photosynthesis

1. Write the word equation for photosynthesis:

_____ + _____ → _____ + _____

2. Describe the conditions needed for photosynthesis to occur.

_____

_____

_____

_____

3. Write the symbol equation for photosynthesis:

_____ + _____ → _____ + _____

4. Look at the symbol equation for photosynthesis. Record how many atoms of each element are at the start and end of the reaction.

Start:		End:	
Carbon (C)	_____	Carbon (C)	_____
Hydrogen (H)	_____	Hydrogen (H)	_____
Oxygen (O)	_____	Oxygen (O)	_____

5. Produce a model that shows the photosynthesis reaction. Your model should show how the atoms in the molecules rearrange to form new compounds. You can draw this or build a 3D model.

Challenge: All living things respire to extract energy from food. The chemical reaction for respiration is: Glucose + Oxygen → Carbon Dioxide + Water

Compare the reaction of photosynthesis to the reaction of respiration.

_____

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Read the descriptions of the photosynthesis experiments from history and write what each scientist could conclude from their experiment.

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Firstly, he dried and weighed the soil in the pot and weighed the willow tree. He then planted the willow tree in the dry soil and covered the soil with an iron grate to prevent dust and air mixing with the soil.

Finally, he watered it. He continued to only water the tree for five years. After the five years, he dried and weighed the soil and weighed the willow tree.

	Start	5 years later
Mass of willow tree	2.2 kg	77.2 kg
Mass of dry soil	91.2 kg	91.2 kg

Conclusion

The mass of the willow tree increased by 75kg (77.2-2.2) over the 5 years of the experiment. The mass of the dry soil stayed the same over the 5 years of the experiment. The only thing added to the soil was water and the only other source of reactants was the air around the tree, so the change in mass must have come from these things.

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He place a lit candle in a bell jar with a sprig of mint. The flame quickly extinguished. The bell jar was then left in direct sunlight. After 27 days he used a lens to focus sunlight on the wick and relit the candle. *NB: oxygen was discovered a year later.*

Conclusion

The candle could not burn in the first experiment but could after it had been left in the sunlight for 27 days. The mint was the only other thing in the bell jar, therefore, the gas needed for the candle to burn came from the mint (oxygen).

Read the descriptions of the photosynthesis experiments from history and write what each scientist could conclude from their experiment.

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Conclusion:

Bubbles formed when the plant had sunlight and did not form when the plant was placed in the dark. Therefore, light is needed for the reaction to happen.

Plants in carbonic acid– Jean Senebier (1742-1809)

Swiss naturalist and pastor, Jean Senebier, investigated the effect carbonic acid had on aquatic plants. Carbonic acid disassociates (splits) into carbon dioxide and water when dissolved in water.

Senebier placed an aquatic plant under a glass funnel and test tube filled with distilled water (pure water). When this was placed in direct sunlight, nothing happened.

Senebier repeated this, having dissolved carbonic acid in the distilled water. This resulted in the aquatic plant producing a gas, which collected in the top of the test tube.

Senebier then doubled the amount of carbonic acid; this in turn doubled the amount of gas produced by the plant.

Conclusion:

When the plant was placed in sunlight, it did not produce bubbles. Therefore, another reactant alongside sunlight is needed for the reaction. When carbonic acid was added to the water, a source of carbon dioxide, the plant produced bubbles. Therefore, plants need sunlight AND carbon dioxide to photosynthesise. Doubling the amount of carbon dioxide doubles the rate of reaction.

Model photosynthesis

1. Write the word equation for photosynthesis:

carbon dioxide + water → glucose + oxygen

2. Describe the conditions needed for photosynthesis to occur.

Plants need a supply of: carbon dioxide (from the air) and water (from the ground). They also need sunlight and chlorophyll. Increasing the temperature will help the plant enzymes work faster.

3. Write the symbol equation for photosynthesis:

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

4. Look at the symbol equation for photosynthesis. Record how many atoms of each element are at the start and end of the reaction.

Start:		End:	
Carbon (C)		Carbon (C)	
Hydrogen (H)		Hydrogen (H)	
Oxygen (O)		Oxygen (O)	

5. Produce a model that shows the photosynthesis reaction. Your model should show how the atoms in the molecules rearrange to form new compounds. You can draw this or build a 3D model.

Challenge: All living things respire to extract energy from food. The chemical reaction for respiration is: Glucose + Oxygen → Carbon Dioxide + Water

Compare the reaction of photosynthesis to the reaction of respiration.

Similarities: The same chemical elements and compounds appear in both respiration and photosynthesis. Both reactions are driven by enzymes.

Differences: The reactants of photosynthesis are the products of respiration. The reactants of respiration are the products of photosynthesis. Respiration does not require light or chlorophyll.