Explanation of Photosynthesis

Photosynthesis is a process used by plants, algae, and some bacteria to convert light energy, typically from the sun, into chemical energy stored in glucose (a type of sugar). This process is vital because it is the primary source of energy for nearly all life on Earth. Photosynthesis occurs in the **chloroplasts** of plant cells, which contain a green pigment called **chlorophyll**.

The overall equation for photosynthesis is:

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

This equation shows that six molecules of carbon dioxide (CO_2) and six molecules of water (H_2O) react, using light energy, to produce one molecule of glucose ($C_6H_{12}O_6$) and six molecules of oxygen (O_2).

Key Steps of Photosynthesis:

1. **Light-dependent Reactions**: These occur in the **thylakoid membranes** of the chloroplasts and require sunlight. The energy from sunlight is absorbed by chlorophyll and used to produce **ATP** and **NADPH**, energy-rich molecules that will power the next stage of photosynthesis. During this stage, water molecules are split into oxygen and hydrogen ions, releasing oxygen as a byproduct.
2. **Calvin Cycle (Light-independent Reactions)**: This occurs in the **stroma** of the chloroplasts and does not require direct sunlight. The ATP and NADPH produced in the light-dependent reactions are used to convert carbon dioxide into glucose through a series of chemical reactions.

Worksheet: Photosynthesis

Part A: Multiple Choice Questions

1. **Which of the following is the primary pigment involved in photosynthesis?**

   a. Haemoglobin
   b. Chlorophyll
   c. Carotene
   d. Xanthophyll

2. **What are the products of photosynthesis?**

   a. Oxygen and glucose
   b. Carbon dioxide and water
   c. Oxygen and ATP
   d. Water and glucose

3. **In which part of the plant cell does photosynthesis occur?**

   a. Nucleus
   b. Mitochondria
   c. Chloroplast
   d. Cytoplasm

4. **Which of the following is not necessary for photosynthesis?**

   a. Sunlight
   b. Oxygen
   c. Carbon dioxide
   d. Water

5. **What molecule carries energy from the light-dependent reactions to the Calvin cycle?**

   a. ATP
   b. NADPH
   c. Chlorophyll
   d. Glucose

Part B: Fill in the Blanks

1. The main pigment in plants that captures light energy is……...
2. The light-independent reactions of photosynthesis are also known as the **……**
3. During photosynthesis, plants release **…….** as a byproduct.
4. The process of photosynthesis converts light energy into **…….. ……**stored in glucose.
5. Carbon dioxide enters the plant through small openings called…….

Part C: True or False

1. **Photosynthesis takes place in the mitochondria.**
2. **Chlorophyll absorbs all colours of light equally.**
3. **The oxygen produced during photosynthesis comes from carbon dioxide.**
4. **The Calvin cycle is part of the light-dependent reactions.**
5. **Photosynthesis occurs only in green plants.**

Part D: Short Answer

1. **Explain why photosynthesis is important for life on Earth.** Photosynthesis is crucial for life on Earth because it is the process by which plants produce glucose, which is a vital source of energy for all living organisms. Additionally, photosynthesis releases oxygen into the atmosphere, which is essential for the respiration of most living organisms.
2. **What is the role of water in photosynthesis?** Water provides electrons and protons in the light-dependent reactions of photosynthesis. It is split into oxygen, protons, and electrons during photolysis, releasing oxygen as a byproduct.
3. **Describe the relationship between the light-dependent reactions and the Calvin cycle.** The light-dependent reactions produce ATP and NADPH, which are used as energy sources in the Calvin cycle to convert carbon dioxide into glucose.

Answer Key for Worksheet

- **Part A:**
    1. b
    2. a
    3. c
    4. b
    5. a
- **Part B:**
    1. chlorophyll
    2. Calvin cycle
    3. oxygen
    4. chemical energy
    5. stomata
- **Part C:**
    1. False(It takes place in the chloroplasts.)
    2. False(Chlorophyll absorbs mostly blue and red light, reflecting green.)
    3. False(The oxygen comes from water molecules.)
    4. False(The Calvin cycle is part of the light-independent reactions.)
    5. False(Photosynthesis also occurs in algae and some bacteria.)
- **Part D:**
    1. Photosynthesis is essential for producing food (glucose) for plants, which supports most life on Earth by providing the foundation of food chains. It also produces oxygen. **Or** Photosynthesis is crucial for life on Earth because it is the process by which plants produce glucose, which is a vital source of energy for all living organisms. Additionally, photosynthesis releases oxygen into the atmosphere, which is essential for the respiration of most living organisms.
    2. Water is split into oxygen and hydrogen during photosynthesis, and the hydrogen is used to help produce glucose. **Or** Water provides electrons and protons in the light-dependent reactions of photosynthesis. It is split into oxygen, protons, and electrons during photolysis, releasing oxygen as a byproduct.
    3. The light-dependent reactions provide the energy molecules (ATP and NADPH) necessary to power the Calvin cycle, which synthesises glucose from carbon dioxide **or** The light-dependent reactions produce ATP and NADPH, which are used as energy sources in the Calvin cycle to convert carbon dioxide into glucose.