### Photosynthesis

**Objectives**

At the end of this sub section students should be able to:

1. Define the term: photosynthesis.
2. Express photosynthesis as a balanced reaction.
3. State the nature of photosynthesis from the syllabus – what are the main events?
4. State the role & location of chlorophyll.
5. Explain the nature of electron carriage.
6. Identify the sources of light, CO₂ & water for photosynthesis.
7. Explain how human intervention can play a role in photosynthesis.

**Extended Study**

8. Explain the role of ATP
9. Explain the production of ATP from ADP
10. Explain the role NADP+ in trapping & transferring electrons & H ions.
11. Explain the Light Stage/Dark Stage
12. State the two-pathway system of electron carriage.
   - Direct to chlorophyll
   - Trapped by NADP+

**Practical Activity**

*ME - Investigate the influence of light intensity or CO₂ on the rate of photosynthesis*

**Photosynthesis** is the process by which plants make food using carbon dioxide and water in the presence of sunlight and chlorophyll.

\[
6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow{\text{sunlight}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2
\]

**Structure of leaf:**

**Table:**

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<th>2.2.4 Photosynthesis</th>
<th>Objectives</th>
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<td></td>
<td>At the end of this sub section students should be able to:</td>
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**Legend:**

- **C₆H₁₂O₆** glucoses
- **O₂** oxygen
- **CO₂** carbon dioxide
- **H₂O** water
- **sunlight** light
- **chlorophyll** Chlorophyll
Photosynthesis

Leaf adaptations for photosynthesis:

1. **Stomata**
   - for gaseous exchange. Mostly on lower epidermis. Open during day to allow carbon dioxide in for photosynthesis. Closed at night – reduces transpiration.

2. **Air spaces** -
   - between spongy mesophyll cells allow for diffusion of CO\textsubscript{2} and H\textsubscript{2}O within the leaf.

3. **Thin** - for rapid diffusion of CO\textsubscript{2} in and oxygen out. Also allows all cells to capture light.

4. **Cuticle** - prevents excessive water loss, transparent – allows light through for photosynthesis..

5. **Leaf flattened** to give a large surface area for maximum absorption of light and CO\textsubscript{2}.

6. **Xylem vessels** to bring water for photosynthesis and **phloem sieve tubes** to translocate food -sucrose etc.

7. **Petiole** places lamina in best position for light absorption.

8. **Palisade mesophyll** has a high cell density and a large number of chloroplasts per cell for max. photosynthesis.

Factors affecting rate of photosynthesis:

1. Carbon dioxide
2. Light
3. Temperature
4. Water - always available

Rate of photosynthesis is determined by the factor which is in short supply. This factor is called the limiting factor.
Rate can be measured roughly (respiration occurring 24 hours a day) by the amount of CO\textsubscript{2} absorbed or O\textsubscript{2} released by a plant.

1. **Carbon dioxide** - enters through stomata on the lower epidermis and diffuses through the air spaces of the mesophyll.
   - As CO\textsubscript{2} increases so does the rate of photosynthesis until it reaches a plateau (optimum = 0.1%).
   - Increase crop production in a greenhouse by pumping in CO\textsubscript{2}.
   - CO\textsubscript{2} may be a limiting factor when plants are overcrowded on a sunny day.

**Expt.: To investigate the effect of carbon dioxide concentration on the rate of photosynthesis.**
**Graph**
Photosynthesis

2. Light:
Light is necessary because it provides the energy needed to convert carbon dioxide and water into glucose. With an increase in light intensity photosynthesis increases up to light saturation when a plateau is formed. Light may be limiting at dawn, dusk, in a wood or on a warm but dull day. **Compensation point** is the **light intensity** at which the rate of photosynthesis equals the rate of respiration i.e. no change in the amount of food in the plant or in the oxygen or carbon dioxide conc. of the air around the plant.
Expt.: To investigate the effect of light intensity on the rate of photosynthesis

Graph

3. Temperature:
The optimum temp. for most plant enzymes is 25°C (minimum = 0°C). This is why plants grow better in warm climates, indoors, heated glasshouses or in summer. Growth of plants is slower in colder months due to lower light intensity (hence lower photosynthesis).
Temp. may be a limiting factor in early morning when it is bright but cool.

4. Water
Water is freely available - absorbed by plant root hairs and is conducted through the xylem by the transpiration stream.

Biochemistry of photosynthesis
2 phases:
1. **Light phase**: a photochemical reaction in which light energy is converted into chemical energy in the **grana** of the chloroplast

2. **Dark phase** - light independent. Sugar is assembled (‘synthesised’). It occurs in the **stroma**. Reactions are catalysed by enzymes ∴ the rate is affected by temperature.
(Reactions in light stage are so fast that enzymes are needed.)

Diagram of chloroplast
Photosynthesis

**Light phase**
Plants use light to produce ATP – photophosphorylation.
Occurs in two parts:

- **Cyclic photophosphorylation**
Light is absorbed by chlorophyll* and electrons in the chlorophyll molecule are excited. They are picked up by a series of carriers in the electron transport system where ATP is made. The electrons return to the chlorophyll.

  *A variety of pigments, chlorophyll included, absorb light energy of different wavelengths and pass the energy onto the chlorophyll molecule next to the electron acceptor. The energised electrons are passed onto the electron acceptor.

- **Non-cyclic photophosphorylation**
  **Light splits** water into hydrogen ions (H⁺), oxygen and electrons. These electrons are passed to the chlorophyll molecule. The sun’s energy excites electrons from the chlorophyll which are used to combine H⁺ with NADP to form NADPH

  En route the electrons go through a series of carriers and give up their energy to phosphorylate ADP to ATP.

  The electrons do not recycle – they start with water and end up in NADPH.

**Dark phase**
In a series of reactions CO₂ combines with hydrogen (from NADPH) using energy from ATP to form glucose.

**Utilisation of the products of photosynthesis:**
1. Glucose produced is carried away as sucrose in the phloem i.e. translocated.
2. Glucose can be converted to starch and lipids as storage.
3. Glucose can act as a respiratory substrate.
4. Glucose is used to form cellulose for cell walls and proteins for growth (given a supply of N, S etc.).

**Diagram of biochemistry of photosynthesis**
Photosynthesis

2.2.4 Photosynthesis
2004 OL

13. (b) The following equation summarises the process of photosynthesis.

\[ \text{Gas A} + \text{Water} \xrightarrow{\text{Energy}} \text{Glucose} + \text{Gas B} \]

(i) Name Gas A.
(ii) Name Gas B.
(iii) Name the energy source.
(iv) Plants obtain Gas A from the air. Name two processes that release this gas into the air.
(v) Suggest two possible fates for Gas B, following its production in the plant.
(vi) Where in a leaf would you expect to find cells with most chlorophyll?
(vii) What term is used to describe the nutrition of plants? 

(c) The apparatus shown below may be used to investigate the effect of an environmental factor on the rate of photosynthesis.

(i) Name X and Y.
(ii) How would you measure the rate of photosynthesis?
(iii) Name an environmental factor that you would vary in this experiment.
(iv) Explain how you would vary the factor that you have named in (iii).
(v) Other environmental factors should be kept constant during the experiment. Name one of these factors.

2005 OL

11. (a) (i) Complete the following equation, which is a summary of photosynthesis.

\[ 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light} + \text{chlorophyll} \rightarrow \]

(ii) Where in the cells of a leaf is chlorophyll found?

(b) (i) Light energy trapped by chlorophyll is used to split water. List three products that result when water is split.

(ii) Describe what happens to each of the three products that you have listed in (i).

(iii) Carbon dioxide is essential for photosynthesis. Where does it enter the leaf?
Photosynthesis

(iv) From your knowledge of photosynthesis suggest a way to increase the yield of plants such as lettuces in a greenhouse.  (24)

2006 OL

4. The diagram shows part of a section through a leaf.

[Adapted from Livingstone © BIODIDAC]

(c) Use the letter B to show the part of the leaf in which most photosynthesis occurs.

(d) Name the structures in plant cells in which photosynthesis occurs. ........................................

(e) In addition to carbon dioxide another small molecule is needed for photosynthesis.

Name this other molecule ........................................................................................................

2008 OL

12. (a) (i) In what main part of a plant does most photosynthesis take place?

(ii) In what cell structure does photosynthesis take place?  (9)

(b) (i) What is the main source of energy for photosynthesis?

(ii) Suggest two reasons why life on earth might not continue without photosynthesis.

(iii) In photosynthesis water (H₂O) is split into three products.

1. Name these three products.

2. State what happens to each of these products.  (27)

(c) Describe an activity that you carried out to investigate the influence of light intensity or carbon dioxide concentration on the rate of photosynthesis. Include a diagram of the apparatus that you used in your answer.  (24)

2009 OL

15. Answer any two of (a), (b) and (c)  (30, 30)

(a) (i) Write the balanced equation for photosynthesis.

(ii) What is the main source of light for photosynthesis?

(iii) During photosynthesis water molecules are split into three products.

Name each of these products.

(iv) Describe what happens to each of the products referred to in (iii).

(v) Name the structures in which photosynthesis occurs in plant cells.

2010 OL
Photosynthesis

6. The diagram below shows the internal structure of a leaf.

(ii) The cells at W contain many organelles that carry out photosynthesis. Suggest why the cells at W contain more of these organelles than the cells at X.

2010 OL

12. (c) (i) Draw a labelled diagram of the apparatus you used to investigate the effect of light intensity or carbon dioxide concentration on the rate of photosynthesis.

(ii) How did you vary the light intensity or the carbon dioxide concentration?

(iii) How did you measure the rate of photosynthesis?

(iv) What is the relationship between the rate of photosynthesis and either the light intensity or the carbon dioxide concentration

(v) Most Irish tomatoes are grown in greenhouses. State two ways a commercial producer could increase her/his crop yield of tomatoes. (24)

2005 HL

4. The following graph shows how the rate of photosynthesis varied when a plant was subjected to varying levels of light intensity or carbon dioxide concentration.

(a) What is happening at A? .................................................

(b) What is happening at B? .................................................

(c) Suggest a reason for your answer in (b) ..............................

(d) Where in a cell does photosynthesis take place? ...............
Photosynthesis

(e) Give two sources of the carbon dioxide that is found in the atmosphere.

(f) Suggest one way in which the rate of photosynthesis of plants in a greenhouse could be increased…………………………………………………………..

2007HL

7. (b) Answer the following questions in relation to an activity that you carried out to investigate the influence of light intensity OR carbon dioxide concentration on the rate of photosynthesis.

(i) Name the plant that you used. ………………………………………………………………………

(ii) How did you vary light intensity OR carbon dioxide concentration?

(iii) State a factor that you kept constant during the investigation.

(iv) How did you ensure that the factor that you mentioned in (iii) remained constant?

(v) How did you measure the rate of photosynthesis? ……………………………………………..

(vi) Using labelled axes, sketch a graph to show how the rate of photosynthesis varied with the factor mentioned in (ii) above.

2010 HL

8. (b) For which purpose did you use each of the following in the course of your practical studies?

(ii) An aquatic plant such as pondweed rather than a terrestrial plant when investigating the rate of photosynthesis.

S.E.C. Sample Paper HL

12. (a) (i) Write a balanced equation to summarise the process of photosynthesis.

(ii) Name the organelle (component) of the cell in which photosynthesis takes place. (9)

(c) The apparatus in the diagram may be used to investigate the effect of varying an environmental factor on the rate of photosynthesis.

(i) An aquatic plant, such as the pond weed Elodea, is usually used for such an experiment. Explain why an aquatic plant is used in preference to a land plant such as a geranium.

(ii) Explain how you varied the environmental factor that you were investigating in the course of your practical work

(iii) In what units did you express the rate of photosynthesis?

(iv) Using labelled axes sketch a graph to illustrate the results that you obtained. (24)
Photosynthesis

2004 HL

11. (c) The effect of changing light intensity or carbon dioxide concentration on the rate of photosynthesis may be investigated by using the pondweed Elodea. Answer the following in relation to this investigation.
   (i) Why is a water plant rather than a land plant used in this experiment?
   (ii) How is the temperature kept constant in this experiment?
   (iii) If pond water is used in the experiment, it is likely to contain dissolved carbon dioxide. Suggest two possible sources of carbon dioxide in pond water.
   (iv) Explain how light intensity or carbon dioxide concentration may be varied.
   (v) Each time light intensity or carbon dioxide concentration is varied a precaution is necessary. What is this precaution and why is it necessary? (24)

2006 HL

11. (a) (i) What is the primary role of chlorophyll in photosynthesis?
   (ii) Write an equation to summarize photosynthesis. (9)
   (c) (ii) What happens to water molecules when they reach the sites of photosynthesis? (27)

2008 HL

14. (a) (ii) During photosynthesis oxygen is produced.
   1. From what substance is oxygen produced?
   2. In which stage of photosynthesis is oxygen produced?
   3. Give two possible fates of oxygen following its production

2009 HL

12. (c) One laboratory activity that you carried out demonstrated the influence of light intensity or carbon dioxide concentration on the rate of photosynthesis. Answer the following in relation to this activity:
   (i) Explain how you measured the rate of photosynthesis.
   (ii) Explain how you varied light intensity or carbon dioxide concentration.
   (iii) State how you kept another named factor constant.
   (iv) Draw a graph with labelled axes to show the results that you obtained.
   (v) Briefly explain the trend in your graph. (24)

2010 HL

14. (a) (i) Where in a plant cell does photosynthesis take place?
   (ii) Give the alternative name of the first stage of photosynthesis.
   (iii) During the first stage of photosynthesis energised electrons enter two pathways.
      1. Where do the energised electrons come from?
      2. Briefly describe the main events of each of these pathways.
   (iv) 1. In the second stage of photosynthesis compounds of the general formula \( C_x(H_2O)_y \) are formed. What name is given to this group of compounds?
      2. From which simple compound does the plant obtain the H used to make compounds of general formula \( C_x(H_2O)_y \)?
   (v) Name the simple compound that supplies the necessary energy for the second stage reactions.

2004 OL

13. (b) (i) carbon dioxide or \( CO_2 \) 3
   (ii) oxygen or \( O_2 \) 3
   (iii) stated source or light 3
   (iv) respiration or breathing/combustion 2(3)
   (v) used in respiration or inhaled/released (into environment) 2(3)
   (vi) near upper surface or other correct answer 3
Photosynthesis

(vii) autotrophic (photosynthesis) 3
(c) (i) X = water Y = pondweed or aquatic plant – do not allow ‘plant’ on its own. 2(3)
(ii) number of bubbles or volume / in a fixed time 2(3)
(iii) carbon dioxide or light or other factor any one 3
(iv) addition of sodium hydrogen carbonate or changing distance of light source (must correspond to (iii)) any one 6
(v) light or carbon dioxide or temperature (not mentioned in (iii)) 3

2005 OL

11. (a) (i) \(C_6H_{12}O_6 + (6)O_2 \) 2(3)
(ii) chloroplast 3
(b) (i) hydrogen (proton) / oxygen/ electron or energy or ATP 3(3)
(ii) Hydrogen / protons (released into pool & combine with CO\(_2\)) to form glucose) / oxygen used in respiration OR released / electrons are passed to chlorophyll/ 3(3)
(iii) stoma / guard cells 3
(iv) increase day length / artificial light/ increase carbon dioxide level / increase in temperature level 3
Photosynthesis

4. 2(6) + 4(2)(a) A on stoma and Stoma
(b) Oxygen/ water (vapour) / carbon dioxide / nitrogen
(c) B on palisade layer
(d) Chloroplasts
(e) Water [allow chlorophyll]

2008 OL

12 (a) 6, 3

(i) leaf
(ii) Chloroplast / granum / Stroma

(b) 9(3)

(i) Light / sun
(ii) Lack of oxygen/ lack of food (energy)/ plants die /
excess CO₂ / animals die

Two pts

(iii) 1. protons (Hydrogen (ions)) / electrons/ oxygen / OH-
(Water splits into H⁺ & OH⁻ merits 3(3))
2. electrons pass to chlorophyll / ATP
protons stored / NADPH / used in dark phase
oxygen released into air/ respiration
OH⁻ to water & O₂

Three pts

(c) 6 + 6(3)

Diagram of Apparatus
(Plant, variable, container)
type of plant or named plant/ control/ factor kept
constant/ how variable altered/ how rate was
measured / time / thermometer / water bath / adjust
/ bubbles / lamp / ruler/ result /conclusion / record /
repeat / average

6, 3, 0

Six pts – written
or labelled

2009 OL

15 (a) 6 +11 + 6(2) +1

(i) 6 CO₂ + 6 H₂O □ C₆H₁₂O₆ + 6 O₂ Perfect – 6
1 mistake – 3
2 mistakes- 0

6, 3, 0

(This ‘6,3,0’ is
affixed to Part)

2009 OL

15(a) (i) exclusively
(ii) The sun
(iii) Electrons, Protons or H (ions) / Oxygen, accept OH-
Photosynthesis

(iv) □ Electrons – to chlorophyll / reference to energy / ATP
□ Protons / H (ions) - Pathway 2 / Dark Stage /
gerenal proton pool
□ Oxygen – Respiration / Excreted
□ OH. - forms water, releases electrons, releases oxygen
(v) Chloroplasts

2010 OL

6. (i) (Epi)dermal 5(4)
(ii) W is usually closer to the light
(iii) Air or water (vapour) or O₂ or CO₂ or N₂ or chemicals in or out
(iv) To allow gas exchange or Transpiration or Temperature control
(v) Guard cells

12(c) 2010 OL

(c) (i) Diagram – (Test tube + water + Plant)
Labels - (Any three labels)
[3+3(1)]
(ii) Vary light: lamp at different distances from plant OR
Vary CO₂ conc.: different concs of NaHCO₃ solution
3(5)+3(1)
(iii) (Counted number of ) bubbles / per time (Two points)
(iv) As either light intensity or CO₂ conc. increases, the rate of photosynthesis increases.
(v) Extra CO₂/increase temperature / growth promoters / increase light / add fertilizer (Two points)

2005 HL

4. 5(2) + 2(5)
(a) Rate (or photosynthesis) is increasing
(b) Rate (or photosynthesis) is levelling off (is not increasing)
(c) (Light or carbon dioxide) saturated or explained
(d) Chloroplast or chlorophyll
(e) Respiration / combustion or burning
(f) Increased (artificial) lighting/ increased carbon dioxide / heating

2007 HL

Q 9. (a) (i) supplies carbon or correct comment related to CO₂ 3
(ii) supplies hydrogen or protons (H⁺) or electrons or photolysis or described 3
[allow formation of carbohydrate or named once]
(b) (i) Elodea or other correctly named aquatic plant 3
(ii) lamp distance or wattage or quantity of NaHCO₃ 3
(iii) carbon dioxide or light or temperature 3
(iv) water bath or described or lamp distance or wattage or NaHCO₃ 3
(v) bubbles or volume / time
or data logger / sensor named 2(3)
(vi) vertical axis labelled rate + horizontal axis labelled [light or CO₂] 3
curve matching axes labels 39b
2004 HL

11 (c) (i) **Why Elodea?** ease of measurement of rate or explained 3
(ii) **How temp constant:** water bath or described 3
(iii) **Sources of CO₂:** animal respiration / plant respiration / from air / bacterial respiration or decomposition / 2(3)

[Note: respiration alone = 1 point]
(iv) **How varied:** lamp / different distances (or different wattage) OR sodium hydrogen carbonate / different amounts 3 + 3
(v) **Precaution at each change:**
Allow time (before counting bubbles) 3

**Reason:**
Plant adjusting or equilibration or explained 3

2006 HL

11. (a) (i) traps or uses light or explained 3
(ii) balanced equation (**one error = 3**) 6, 3, 0
© (ii) photolysis or split 3
Protons or H² / electrons / oxygen 2(3)

2008 HL

14 (a) (i) Stomata
light or CO₂ or potassium ions (K⁺) or wind or turgidity of guard cells or water availability or high temperature 3
3
(ii) 1. water
2. light (dependent) stage
3. respiration
3. (diffuses) to atmosphere
3
3
3
3
3
3
3
(iii) 1. provides or stores energy / reduction of CO₂ or glucose formation or for dark stage
2. accepts electrons / hydrogen carrier / for the dark stage or glucose formation or for dark stage 2(3)
2(3)
2(3)

2009 HL

12

(c) (i) Counted bubbles (or measure volume) per unit time or use a (datalogging) sensor 3
(ii) Light source at different distances (from plant) or different wattages or different concentrations of NaHCO₃ solution 3
(iii) Temperature / how OR light (if not given in (c) (ii)) / how
Photosynthesis

OR CO₂ concentration (if not given in (c) (ii)) / how 2(3)
(iv) Axes labelled correctly
Curve matching axes given 3
3
(v) Increasing (or decreasing) / (more or less) light (energy) for light phase or (more or less) CO₂ for dark phase
OR
Levels off / saturation (or explained) 2(3)

2010 HL
14. (a) (i) Chloroplast 3
(ii) *Light (stage) 3
(iii) 1. Chlorophyll
2. Pathway :
Pathway :
(Energised electrons) release energy / ATP formed / 
(electrons) return to chlorophyll
Any two
Electrons taken up by NADP / photolysis (or water splits) / NADPH (formed) / electrons from water to chlorophyll / ATP formed
Any two
3
2(3)
2(3)
(iv) 1. *Carbohydrates
2. *Water (or H₂O)
3
3
(v) *Adenosine Triphosphate (or ATP) 3

2006 HL
11. (a) (i) traps or uses light or explained 3
(ii) balanced equation (one error = 3) 6, 3, 0
(b) (i) light not required 3
(ii) CO₂ 3
(iii) NADPH _{(2)} 3

   ATP 3

(iv) NADPH _{(2)} : supplies hydrogen or mention of reduction or e⁻ 3
ATP: supplies energy 3
(v) monosaccharides or polysaccharides or carbohydrates 6
(c) (i) concentration gradient / root hair / osmosis / cell to cell / root pressure/ xylem / cohesion or explained / adhesion or capillarity or explained / Dixon and Joly / transpiration or evaporation [accept water loss] / tension any six 6(3)
(ii) photolysis or split 3
Protons or H⁺ / electrons / oxygen 2(3)
Photosynthesis

Q 11.
(a) Adenosine triphosphate 3
Role: P – P bond / holds or stores (energy) / passes on or releases (energy)
or ATP ------ ADP + P / + energy (or the reverse reaction)
any two 2(3)
(b) (i) Pathway 1.
Light energising electrons or light into chlorophyll / (e-) from chlorophyll / ATP formed / (e-) returned to chlorophyll
Pathway 2.
(e-) to NADP / photolysis (or H₂O split) / H+ (protons) to NADP / NADPH formed / ATP formed / O₂ formed / different electrons / (e-) back to chlorophyll / 6(3) [maximum 4 points from either pathway]
(ii) Product Fate
ATP for dark phase or explained or any metabolic reaction
NADPH for dark phase or explained
O₂ respired or released (into atmosphere) any three 3(3)
Page 5 of 8
(c) (i) Why Elodea?: ease of measurement of rate or explained 3
(ii) How temp constant: water bath or described 3
(iii) Sources of CO₂: animal respiration / plant respiration / from air / bacterial respiration or decomposition / 2(3) [Note: respiration alone = 1 point]
(iv) How varied: lamp / different distances (or different wattage) OR sodium hydrogen carbonate / different amounts 3 + 3
(v) Precaution at each change:
Allow time (before counting bubbles) 3
Reason:
Plant adjusting or equilibration or explained 3
### Photosynthesis: Where is your learning at?

**Green**: I know it all  
**Orange**: I have some idea – study the sections in more detail  
**Red**: I need to start studying this section

<table>
<thead>
<tr>
<th></th>
<th>Green</th>
<th>Orange</th>
<th>Red</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Define the term photosynthesis</td>
<td></td>
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<tr>
<td>2</td>
<td>Can you write the balanced equation for photosynthesis?</td>
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</tr>
<tr>
<td>3</td>
<td>Where is chlorophyll found in the cell?</td>
<td></td>
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<tr>
<td>4</td>
<td>What is the function of chlorophyll?</td>
<td></td>
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<tr>
<td>5</td>
<td>Where does the supply of electrons come from and what are they used for?</td>
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<tr>
<td>6</td>
<td>Where do plants get 1Light, 2 Carbon Dioxide and 3 Water from?</td>
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<tr>
<td>7</td>
<td>How can humans increase or decrease the rate of photosynthesis?</td>
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<tr>
<td>8</td>
<td>What is ATP, what is its role in the cell?</td>
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<tr>
<td>9</td>
<td>How does ADP become ATP and gain more energy?</td>
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<tr>
<td>10</td>
<td>What is NAD+ reduced to? What function does this molecule then have?</td>
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<tr>
<td>11</td>
<td>Describe accurately what happens in the Light Stage and Dark Stage of photosynthesis</td>
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<tr>
<td>12</td>
<td>Electrons can take two possible pathways in the light stage of photosynthesis describe these pathways, what are the products of each pathway and what are the products used for?</td>
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</tbody>
</table>
| 13 | Practical: To Investigate the influence of light intensity or carbon dioxide on the rate of photosynthesis  
Draw a labelled diagram to show how you would carry out this investigation |       |     |