1. Photosynthesis and Limiting Factors

$$\text{Carbon dioxide + water} \xrightarrow{\text{Sunlight}} \text{glucose + oxygen}$$

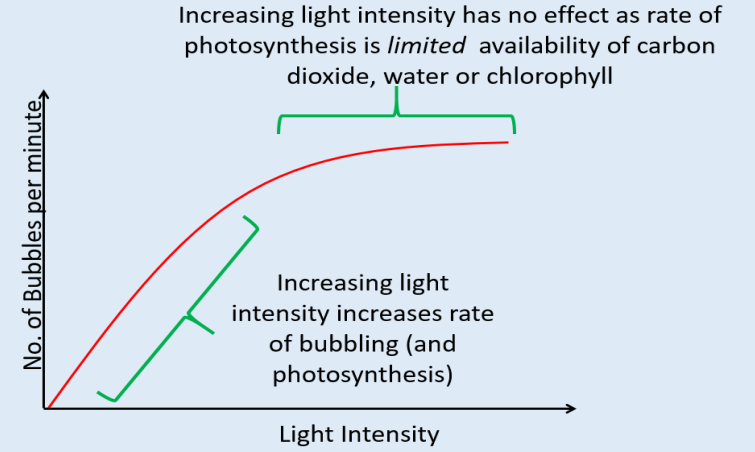
$$6CO_2 + 6H_2O \xrightarrow{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2$$

The Law of Limiting Factors

When a process depends on two or more factors, the *rate* of that process is *limited* by the factor which is in *shortest supply*

The rate of photosynthesis can be limited by:

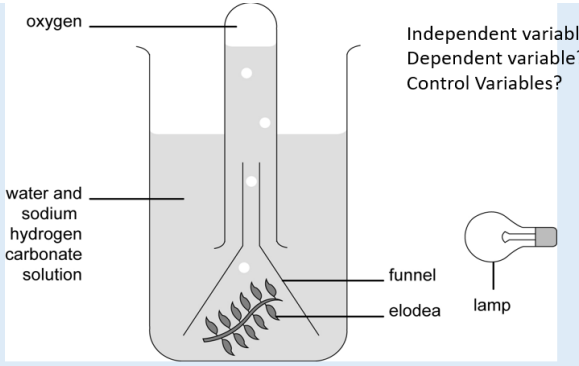
- Light intensity;
- Availability of carbon dioxide;
- Availability of chlorophyll
- Temperature



How could the following experiment be used to measure the rate of photosynthesis?

What do the oxygen Bubbles show?

Why do we add Sodium hydrogen Carbonate?



Independent variable?
Dependent variable?
Control Variables?

Independent variable – distance the lamp is from the elodea (light intensity).
Dependent variable – number of bubbles given off.
Control variables: temperature of water, volume of water, mass of elodea, Wattage of the bulb, concentration of sodium hydrogen carbonate solution.
Oxygen bubbles show that it is photosynthesising.
We add sodium hydrogen carbonate to ensure there is plenty of carbon dioxide in the solution.

2. Use of Glucose by Plants.

- Respiration
- Storage (starch)
- Seeds (lipids and starch)
- Fruit (glucose, sucrose and fructose)
- Cellulose (cell walls)
- Protein synthesis (amino acids, enzymes, organelles)

3. Food Tests

BIOCHEMICAL (FOOD) TESTS

CHEMICAL	TESTS FOR ...?	HOW TO CARRY OUT THE TEST	RESULT	CHEMICAL	TESTS FOR ...?	HOW TO CARRY OUT THE TEST	RESULT
	Starch	1.) Add the iodine solution directly to the substance to be tested (in solid or liquid form) and look for a colour change.	Turns blue black with starch		Protein	1.) Add Biuret's to the solution/ suspension to be tested and look for a colour change.	Turns purple with protein
	Reducing Sugar	1.) Add Benedict's to the solution/ suspension to be tested. 2.) Heat for 2 mins in a water bath at boiling point and look for a colour change.	Turns brick red with reducing sugars (green/ yellow/ orange if less sugar present)		Lipid (known as the Emulsion test)	1.) Add ethanol to the solution/ suspension to be tested and shake thoroughly. 2.) Then add water and look for a colour change.	Turns cloudy/ milky with lipid

4. Aerobic Respiration (with oxygen)

Glucose + oxygen → carbon dioxide + water + energy

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

Systems involved in aerobic respiration:

- Breathing system
- Digestive system
- Circulatory system

Uses of Energy:

- Movement (muscles contracting)
- Thermoregulation (keeping warm)
- Biosynthesis (making new molecules)
- Active transport (movement against a gradient)

5. Anaerobic Respiration (without oxygen)

Glucose → lactic acid + energy (mammals)

$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + ATP$

Glucose → carbon dioxide + ethanol + energy (plants and micro-organisms)

Lactic Acid:

- Made by incomplete breakdown of glucose.
- Builds up in muscles (fatigue, cramp, pain)
- Needs to be broken down after exercise

Oxygen Debt:

Oxygen needed to breakdown lactic acid to water and carbon dioxide.

Keep breathing and heart rate high to help remove oxygen debt.

6. Micro-organisms in Industry

Used to make bread and alcohol (fermentation).

Yeast respires aerobically at first in bread production, then anaerobically so gives off carbon dioxide which makes the bread rise.

In alcohol production, the yeast turns glucose to ethanol, however before long, the concentration of alcohol increases so that it kills the yeast.

7. Cardiovascular System

- Heart – pumps blood
- Blood vessels – carry blood
- Blood – delivers food and oxygen, removes waste

8. Baseline Data

Measurements can be taken such as:
Weight
Height
Breathing rate
Pulse

9. Respiration Rate

Measuring the rate of oxygen consumption can give an estimate of the **metabolic rate**. This measure indicates how quickly the body is using energy from respiration.

10. Metabolic Rate

- Metabolic rate is the sum of all of the chemical reaction in a cell or the body.
- Energy from respiration is used in enzyme controlled reaction to make new molecules.

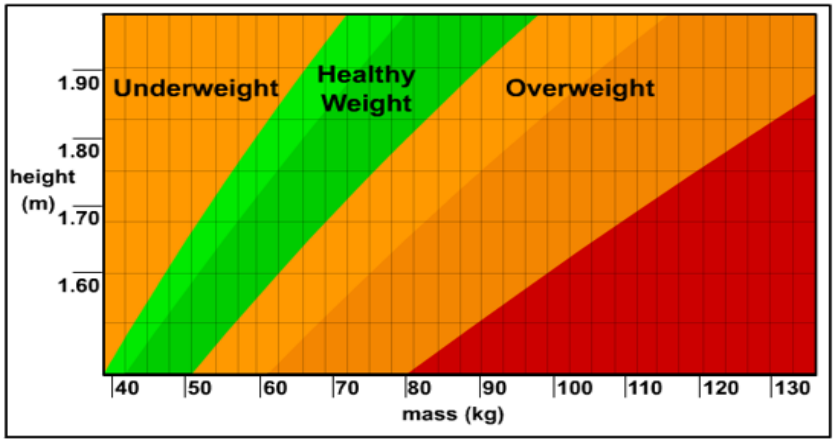
E.g. of reactions that contribute towards metabolism:

- Converting glucose to starch, glycogen and cellulose.
- Making fat (lipid) molecules from fatty acids and glycerol.
- Using glucose and nitrate ions to form amino acids which are in turn made into proteins.
- Respiration.
- Breakdown excess amino acids into urea for excretion.

Factors affecting it: age, fitness, genetics

Low versus High Metabolic Rate:

- People with low metabolic rates are likely to store energy as fat (and therefore possibly be heavier).
- People with high metabolic rates are likely to use this energy rather than store as fat (and therefore likely to be lighter).
- BMI is a useful measure of mass compared to height.



BMI = Mass (Kg) / Height^2 (m)

Under 18 = underweight

Over 25 = overweight. (Not always accurate E.g. England rugby team are not obese!)