CHAPTER 10: NUTRITION TYPES AND NUTRIENT COMPOUNDS

Competency: The learner understands that organisms have different nutritional requirements, and that humans have different requirements; depending on age and other factors.

LEARNING OUTCOMES

The learner should be able to:

a) understand the term nutrition (k, u)
b) identify the food nutrients, their sources, and importance to humans (u)
c) perform food tests for various nutrients (only quality testing required) (s)
d) appreciate the importance of a diet containing the different nutrients (u, v)
e) appreciate the concept of balanced diet in relation to age, sex, and an individual's activity (u, v)
f) appreciate the causes and effects of nutrient deficiency in humans including diseases related to malnutrition (u, s)
g) calculate body mass index (BMI) and explain its implication (s, v)
h) identify the major plant mineral nutrients (N, P, K, Mg, Ca, S, Mg), their role, and the symptoms of deficiencies (u)

INTRODUCTION

Nutrition is the process by which living organisms obtain and use food to support their growth, repair of tissues, reproduction, and all other life processes. All living organisms require nutrition but they differ greatly in how they obtain their food and what types of food they need. The study of nutrition types examines how different organisms acquire energy and raw materials from their environment, while the study of nutrient compounds examines the specific chemical substances that organisms need and the roles these substances play in the body. Together these two aspects of nutrition form the foundation of understanding how living things sustain themselves and function.

TYPES OF NUTRITION

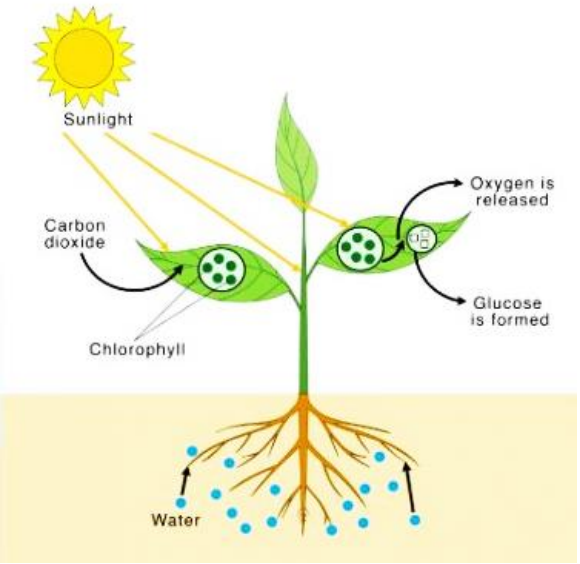
Organisms are classified into two fundamental nutritional types based on whether they can manufacture their own food or must obtain it by consuming other organisms.

Autotrophic Nutrition

Autotrophic nutrition is the type of nutrition in which organisms manufacture their own food from simple inorganic substances such as carbon dioxide and water using an external source of energy. Organisms that carry out this type of nutrition are called autotrophs or producers because they produce food for themselves and form the base of food chains.

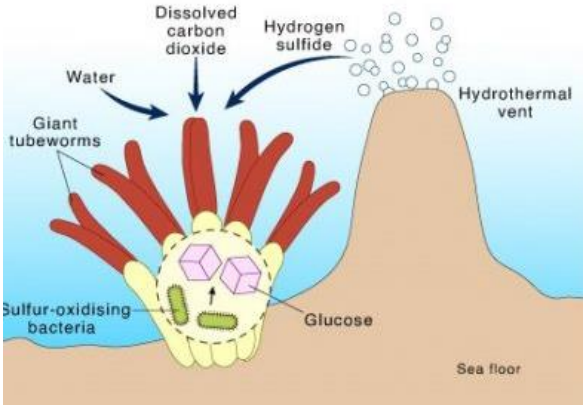
1 Photosynthesis

Photosynthesis is the most common form of autotrophic nutrition. Green plants, algae, and some bacteria use chlorophyll to trap light energy from the sun and convert carbon dioxide and water into glucose, releasing oxygen as a by-product. The glucose formed is used to make other substances such as starch, proteins, fats, and cellulose.



2 Chemosynthesis

Chemosynthesis is a form of autotrophic nutrition carried out by certain bacteria that live in places without sunlight. These organisms obtain energy from chemical reactions involving substances such as ammonia, hydrogen sulphide, or iron compounds and use this energy to manufacture food from carbon dioxide.



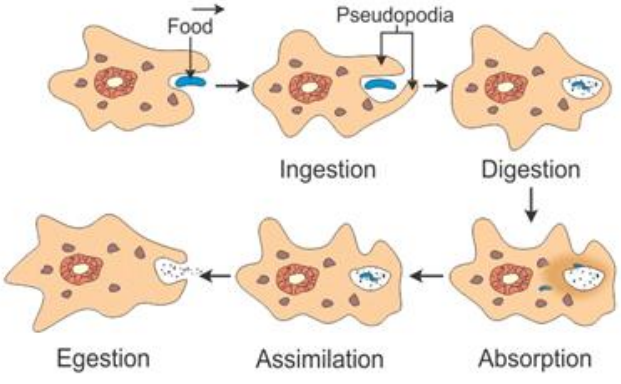
Heterotrophic Nutrition

Heterotrophic nutrition is the type of nutrition in which organisms cannot make their own food and therefore obtain nutrients by feeding on other organisms or their products. Organisms that practise this type of nutrition are called heterotrophs or consumers.

(a) Holozoic Nutrition

Holozoic nutrition is common in animals, including humans. It involves ingestion of food, digestion, absorption of nutrients, assimilation, and egestion of undigested materials. Organisms with holozoic nutrition may be herbivores, carnivores, or omnivores depending on their diet.

Type	Definition	Examples
Herbivores	Animals that feed mainly on plants.	Cow, goat, rabbit, giraffe
Carnivores	Animals that feed mainly on other animals.	Lion, tiger, eagle, snake
Omnivores	Animals that feed on both plants and animals.	Human beings, pigs, bears, chickens



(b) Saprotrophic Nutrition

Saprotrophic nutrition occurs in fungi and some bacteria that feed on dead and decaying organic matter. These organisms secrete digestive enzymes onto the food outside their bodies and absorb the soluble products after digestion. Saprotrophs play an important role in decomposition and nutrient recycling.



(c) Parasitic Nutrition

Parasitic nutrition occurs when an organism called a parasite lives on or inside another organism known as the host and obtains nutrients from it. The parasite benefits while the host is harmed. Examples include tapeworms, Plasmodium, and mistletoe plants.



(d) Mutualistic Nutrition

Mutualistic nutrition involves two organisms living together in a relationship where both benefit nutritionally. Examples include Rhizobium bacteria in legume roots and mycorrhizal fungi associated with plant roots.

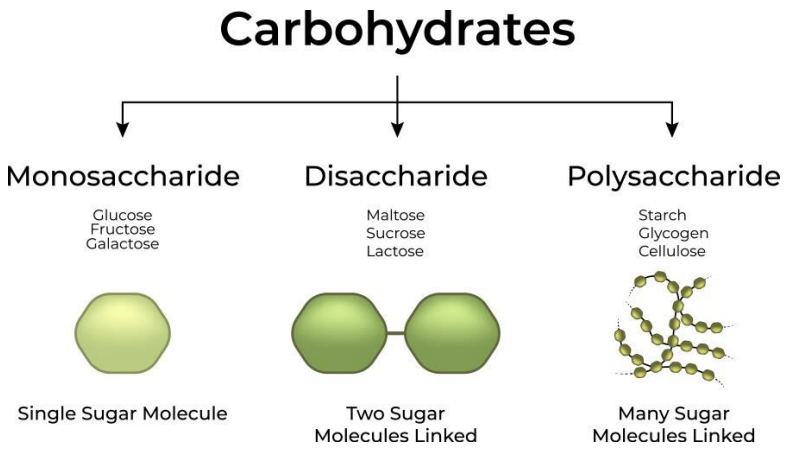


NUTRIENT COMPOUNDS

Nutrient compounds are the specific chemical substances that organisms need to obtain from their food or environment to support growth, energy production, repair, reproduction, and regulation of body processes. In animals and humans the major nutrient compounds are carbohydrates, proteins, lipids, vitamins, mineral salts, and water. Each nutrient has specific chemical properties and performs specific functions in the body, and a deficiency of any essential nutrient causes characteristic health problems.

Carbohydrates

Carbohydrates are organic compounds made up of carbon, hydrogen, and oxygen, with hydrogen and oxygen present in the same ratio as in water. They are the primary source of energy for most living organisms. Carbohydrates are classified into three groups based on the size of their molecules.



Monosaccharides are the simplest carbohydrates, consisting of single sugar units. They are the building blocks from which larger carbohydrates are made. Examples include glucose, fructose, and galactose. Glucose is the most important monosaccharide in biology as it is the primary fuel for cellular respiration in all organisms and the direct product of photosynthesis.

Disaccharides consist of two monosaccharide units joined together by a chemical bond called a glycosidic bond, formed in a condensation reaction that releases a molecule of water. Examples include sucrose, which is table sugar made of glucose and fructose and is the main form in which sugars are transported in plant phloem, maltose which consists of two glucose units and is produced during digestion of starch, and lactose which is milk sugar made of glucose and galactose.

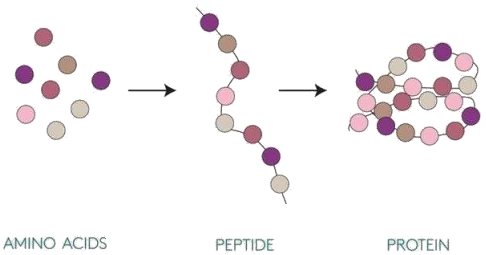
Polysaccharides are large, complex carbohydrates made of many monosaccharide units joined in long chains. Examples include starch, which is the main storage carbohydrate in plants made of many glucose units and is the most important source of dietary carbohydrate for humans, glycogen which is the storage carbohydrate in animals stored mainly in the liver and muscle, and cellulose which forms the structural cell walls of plants and is an important source of dietary fibre in human nutrition even though humans cannot digest it.

Functions of carbohydrates include providing energy through cellular respiration where glucose is broken down to release energy for all metabolic processes, storing energy in the form of starch in plants and glycogen in animals, providing structural support in the form of cellulose in plant cell walls and chitin in the cell walls of fungi and the exoskeletons of insects, and serving as raw materials for the synthesis of other biological molecules.

Dietary sources of carbohydrates include cereals such as maize, rice, wheat, and millet, root crops such as cassava, sweet potato, and Irish potato, sugarcane and sugar, fruits, and legumes.

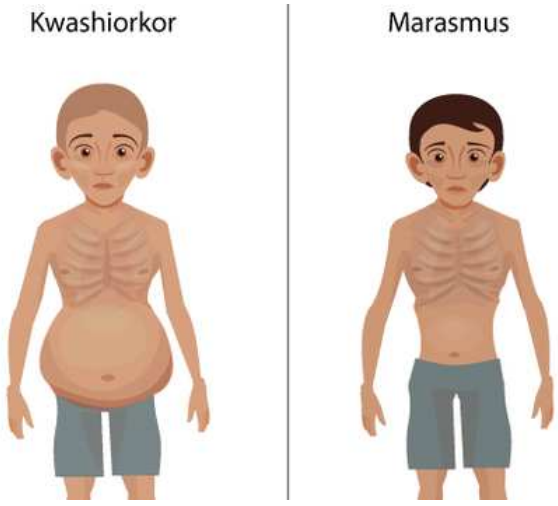
Proteins

Proteins are large, complex organic molecules made up of carbon, hydrogen, oxygen, nitrogen, and often sulphur. They are the most structurally and functionally diverse of all biological molecules. The basic building blocks of proteins are **amino acids**, of which there are 20 different types used in living organisms. Amino acids are joined together by peptide bonds in condensation reactions to form long chains called **polypeptides**, which fold into complex three-dimensional shapes that determine the function of the protein. Humans can synthesise some amino acids in the body, these are called non-essential amino acids, but others called **essential amino acids** must be obtained from food because the body cannot make them.



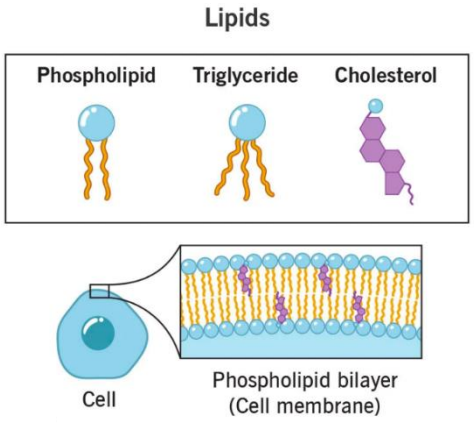
Functions of proteins are enormously diverse. Structural proteins such as collagen provide strength and support to tissues including skin, tendons, and bone. Contractile proteins such as actin and myosin enable muscle contraction and movement. Enzymes are protein catalysts that speed up all chemical reactions in the body including digestion, respiration, and photosynthesis. Transport proteins such as haemoglobin carry oxygen in the blood. Antibodies are proteins produced by the immune system to fight infection. Hormones such as insulin are proteins that regulate body processes. Receptor proteins in cell membranes detect signals from hormones and other molecules. Proteins also provide energy when carbohydrates and fats are insufficient.
Dietary sources of proteins include animal products such as meat, fish, eggs, milk, and cheese, and plant sources such as beans, groundnuts, soybeans, and lentils. Animal proteins are generally considered complete proteins because they contain all essential amino acids, while most plant proteins lack one or more essential amino acids.

Protein deficiency causes a serious condition called **kwashiorkor** in children, characterised by swelling of the abdomen, stunted growth, muscle wasting, skin and hair changes, and weakened immunity. Severe combined deficiency of both protein and calories causes **marasmus**, characterised by extreme wasting and emaciation.



Lipids (Fats and Oils)

Lipids are a diverse group of organic compounds made up of carbon, hydrogen, and oxygen, but with a much lower proportion of oxygen than carbohydrates. They are insoluble in water but soluble in organic solvents. The main types of lipids in nutrition are **triglycerides** (fats and oils), **phospholipids**, and **sterols** such as cholesterol. Triglycerides consist of a glycerol molecule joined to three fatty acid chains. Fats are solid at room temperature and come mainly from animal sources, while oils are liquid at room temperature and come mainly from plant sources. Fatty acids can be saturated, meaning they have no double bonds between carbon atoms and are generally solid, or unsaturated, meaning they have one or more double bonds and are generally liquid.



Functions of lipids include providing energy, fat contains more than twice as much energy per gram as carbohydrates making it the most concentrated energy store in the body. Subcutaneous fat insulates the body against heat loss and cushions organs against physical shock. Phospholipids form the bilayer membrane of all cells, controlling what enters and leaves the cell. Fat-soluble vitamins A, D, E, and K are dissolved and transported in dietary fat. Steroid hormones such as oestrogen, testosterone, and cortisol are manufactured from cholesterol. Myelin, the insulating sheath around nerve fibres, is largely composed of lipids.
Dietary sources of lipids include animal fats from meat, butter, and cheese, plant oils from groundnuts, sunflower seeds, avocado, coconut, and palm, and fish oils from oily fish such as sardines and mackerel.
Excess fat consumption, particularly of saturated fats and trans fats, is associated with obesity, cardiovascular disease, and type 2 diabetes.

Vitamins

Vitamins are organic compounds required by the body in very small amounts but that are essential for specific metabolic processes. Unlike carbohydrates, proteins,

and fats, vitamins are not used as energy sources or structural materials but function mainly as **coenzymes**, molecules that assist enzymes in catalysing chemical reactions. The body either cannot synthesise vitamins at all or cannot synthesise them in sufficient quantities, so they must be obtained from food.
Vitamins are divided into two groups based on their solubility.
Fat-soluble vitamins, A, D, E, and K, are dissolved and stored in body fat and the liver. Because they can be stored, deficiency develops slowly but excess intake can lead to toxicity. **Vitamin A** is essential for the production of the light-sensitive pigment in the cells of the eye needed for vision in dim light. Deficiency causes night blindness and eventually complete blindness. Sources include liver, eggs, dairy products, and yellow and orange vegetables such as carrots and pumpkin. **Vitamin D** is essential for the absorption of calcium and phosphorus from the intestine and for the mineralisation of bones and teeth. Deficiency causes rickets in children, soft, deformed bones, and osteomalacia in adults. It is produced in the skin on exposure to sunlight and found in fish liver oils and eggs. **Vitamin K** is essential for the production of blood clotting proteins and deficiency causes excessive bleeding.

Water-soluble vitamins, the B vitamins and vitamin C. are not stored in the body and must be consumed regularly. **Vitamin C** is essential for the synthesis of collagen, the structural protein of connective tissue, skin, and blood vessels. Deficiency causes **scurvy**, characterised by bleeding gums, slow wound healing, and weakening of blood vessels. Sources include fresh fruits and vegetables particularly citrus fruits, guavas, and green vegetables. **Vitamin B1 (thiamine)** is essential for carbohydrate metabolism and nerve function. Deficiency causes **beriberi**, affecting the nervous system and heart. **Vitamin B3 (niacin)** deficiency causes **pellagra**, characterised by dermatitis, diarrhoea, and dementia. **Folic acid** is essential for DNA synthesis and cell division and is particularly important during pregnancy for the development of the foetal nervous system. Deficiency causes anaemia and neural tube defects in newborns. **Vitamin B12** is essential for the formation of red blood cells and maintenance of nerve function.

Mineral Salts

Mineral salts are inorganic elements and compounds required by the body in small amounts for structural, regulatory, and enzymatic functions. They are absorbed from food dissolved in water as ions. The major minerals needed in relatively large amounts include calcium, phosphorus, potassium, sodium, magnesium, chlorine, and sulphur. Trace minerals needed in very small amounts include iron, zinc, iodine, fluorine, copper, manganese, and selenium.

- **Calcium** is the most abundant mineral in the body and is essential for building strong bones and teeth, muscle contraction, nerve impulse transmission, and blood clotting. Deficiency causes rickets in children and osteoporosis in adults. Sources include milk, cheese, fish with edible bones, and green leafy vegetables.
- **Iron** is essential for the production of haemoglobin, the protein in red blood cells that carries oxygen. Deficiency causes **anaemia**, characterised by fatigue, pallor, breathlessness, and reduced immunity. Sources include red meat, liver, dark green leafy vegetables, beans, and fortified foods.
- **Iodine** is essential for the production of thyroid hormones that regulate metabolic rate and growth. Deficiency causes **goitre**, an enlargement of the thyroid gland in the neck, and in pregnant women can cause cretinism, severe mental and physical retardation in the child. Sources include seafood, iodised salt, and dairy products.
- **Phosphorus** works with calcium in building bones and teeth and is essential for energy transfer in cells as a component of ATP. Sources include meat, fish, dairy, and legumes.

Water

Water is the most essential of all nutrients and makes up approximately 60 to 70 percent of the human body. Every metabolic reaction in the body takes place in a watery solution.
Water is not an energy source but is indispensable for all life processes. It is the solvent in which all biochemical reactions occur, the medium through which nutrients are transported to cells and waste products are removed, the lubricant for joints and digestive tract, and the medium for temperature regulation through sweating.
Water is lost continuously from the body through urine, sweat, breathing, and faeces and must be replaced by drinking water and consuming water-containing foods. Dehydration, even mild water loss of 2% of body weight, causes significant reduction in physical and mental performance, and severe dehydration is rapidly life-threatening.

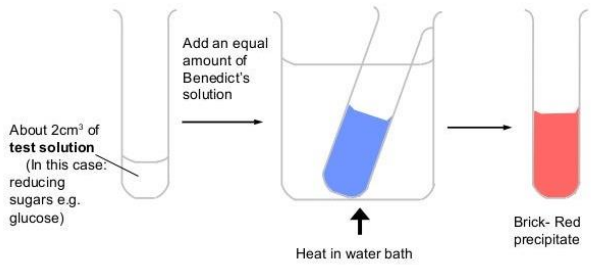
LABORATORY TESTING OF NUTRIENTS

In biology, it is important to be able to identify which nutrients are present in a food sample. This is done through a series of chemical tests carried out in the laboratory, each of which uses a specific reagent that reacts with a particular nutrient to produce a characteristic colour change. These tests are qualitative, meaning they show whether a nutrient is present or absent, though some can also be made quantitative to show how much of a nutrient is present.
Before testing, solid food samples are usually ground up and dissolved or suspended in water to make a solution or suspension that can be tested. The main nutrients tested for in the laboratory are carbohydrates, proteins, and lipids, as well as vitamin C.

Testing for Carbohydrates

Test for Reducing Sugars, Benedict's Test
Reducing sugars are sugars that can donate electrons to reduce other compounds. All monosaccharides such as glucose and fructose and some disaccharides such as maltose and lactose are reducing sugars. Sucrose is a non-reducing sugar and gives a negative Benedict's test.

Reagent used: Benedict's solution, which is an alkaline solution containing copper sulphate that is clear blue in colour.
Procedure: A small amount of the food sample is placed in a test tube and dissolved in a little distilled water. Approximately 2 cm^3 of Benedict's solution is added to the sample. The mixture is then placed in a water bath and heated at approximately 80 to 100 degrees Celsius for about 5 minutes.
Results: If a reducing sugar is present, the blue Benedict's solution changes colour progressively as the concentration of sugar increases. A small amount of reducing sugar produces a green colour, a moderate amount produces a yellow or orange colour, and a large amount produces a brick red precipitate. If no reducing sugar is present the solution remains blue.



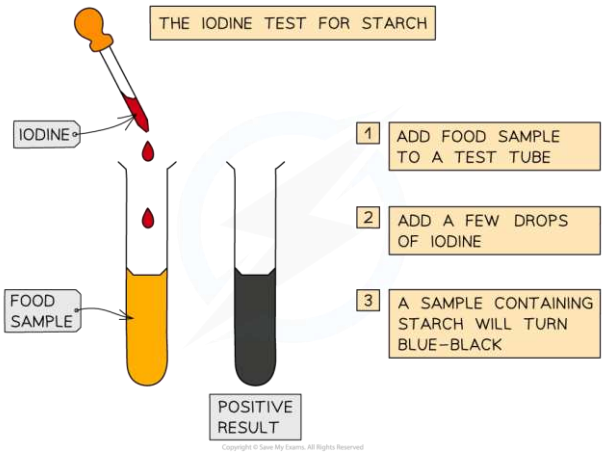
Explanation: The copper ions in Benedict's solution are reduced by the reducing sugar from blue copper sulphate to red copper oxide, which is the brick red precipitate seen when a large amount of reducing sugar is present.

Test for Non-Reducing Sugars

Since sucrose does not reduce Benedict's solution directly, an additional step is needed to test for its presence.
Procedure: First carry out a Benedict's test on the sample. If the result is negative, the sample is boiled with dilute hydrochloric acid for about 5 minutes to hydrolyse the sucrose into its component monosaccharides, glucose and fructose. The solution is then neutralised by adding sodium hydrogen carbonate and then Benedict's solution is added and the mixture is heated again as before.
Results: If sucrose was present, the hydrolysis will have produced reducing sugars, glucose and fructose, that will now give a positive Benedict's test, producing a colour change from blue to green, yellow, orange, or brick red depending on the amount present.

Test for Starch, Iodine Test

Reagent used: Iodine solution, which is brown or yellow-brown in colour.
Procedure: A few drops of iodine solution are added directly to the food sample or to a solution of the food sample on a white tile or in a test tube.
Results: If starch is present the iodine solution changes from its natural brown colour to a deep blue-black colour. If no starch is present the iodine solution remains brown.



Explanation: Iodine molecules fit inside the helical coils of starch molecules, forming a complex that absorbs

light differently from free iodine, producing the characteristic blue-black colour. This colour change is reversed on heating because the starch helix uncoils, releasing the iodine and restoring the brown colour.

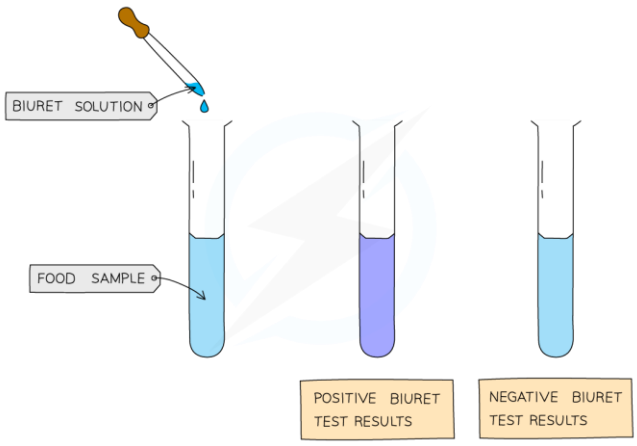
Testing for Proteins, Biuret Test

The Biuret test detects the presence of peptide bonds, which are the bonds linking amino acids together in proteins and polypeptides. The test therefore detects all proteins and polypeptides regardless of their specific amino acid composition.

Reagents used: Sodium hydroxide solution (NaOH) and dilute copper sulphate solution ($CuSO_4$), or a pre-made Biuret reagent that combines both.

Procedure: A small amount of the food sample is dissolved in distilled water in a test tube. A few drops of sodium hydroxide solution are added first to make the solution alkaline. Then a few drops of very dilute copper sulphate solution are added. The mixture is gently shaken and observed for a colour change. The mixture should not be heated.

Results: If protein is present a purple or violet colour develops. A faint pink or lilac colour indicates the presence of short peptides with few peptide bonds. If no protein is present the solution remains blue from the copper sulphate.



Explanation: In an alkaline solution, copper ions form a complex with the nitrogen atoms in the peptide bonds of proteins, producing the characteristic purple colour. The intensity of the purple colour is proportional to the number of peptide bonds present, which is related to the amount and length of protein molecules in the sample.

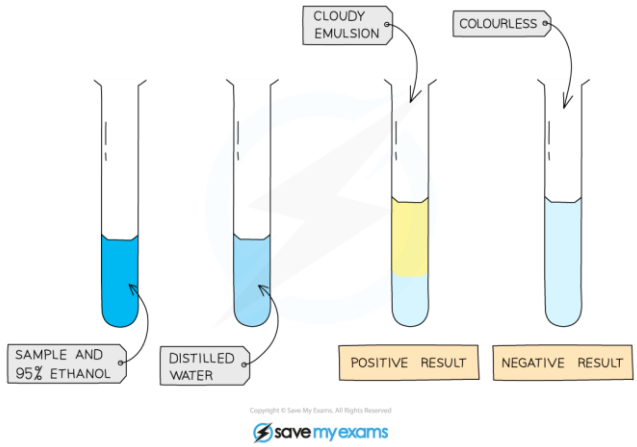
Testing for Lipids

The most common laboratory test for detecting the presence of fats and oils in a food sample is the **Emulsion Test (Ethanol Test)**

Reagents used: Absolute ethanol (alcohol) and distilled water.

Procedure: A small amount of the food sample is placed in a test tube and shaken vigorously with approximately 2 cm^3 of absolute ethanol until the fat or oil in the sample dissolves in the ethanol. The ethanol solution is then poured into a second test tube containing approximately 2 cm^3 of distilled water and observed.

Results: If fat or oil is present a milky white emulsion forms in the water. This happens because the fat dissolved in ethanol comes out of solution when mixed with water and forms tiny droplets that scatter light, giving the milky white cloudy appearance. If no fat is present the solution remains clear.



Explanation: Fats are soluble in ethanol but insoluble in water. When the ethanolic solution is mixed with water, the fat comes out of solution as microscopic droplets suspended in the water, forming an emulsion that appears milky white.

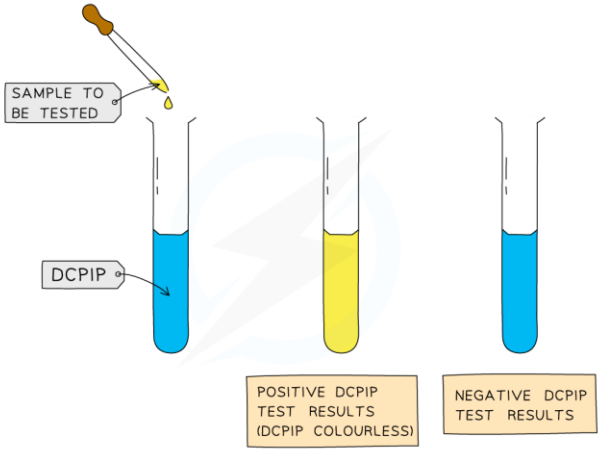
Testing for Vitamin C, DCPIP Test

Vitamin C (ascorbic acid) is a reducing agent and can be detected using the dye DCPIP (dichlorophenolindophenol), which is blue in its oxidised form and colourless in its reduced form.

Reagent used: DCPIP solution, which is blue in colour.

Procedure: A small volume of DCPIP solution is placed in a test tube. The food sample, which should be a liquid such as fruit juice or a solution of the food in distilled water, is added drop by drop from a syringe

or dropper to the DCPIP solution, shaking gently after each drop, until a colour change is observed.
Results: If vitamin C is present the blue DCPIP solution is decolourised and becomes colourless. The volume of food sample needed to decolourise the DCPIP can be used to estimate the concentration of vitamin C, a smaller volume needed indicates a higher concentration of vitamin C. If no vitamin C is present the DCPIP remains blue regardless of how much sample is added.



Explanation: Vitamin C reduces the blue oxidised form of DCPIP to its colourless reduced form. The reaction is specific enough that a positive result strongly indicates the presence of vitamin C, though other strong reducing agents can also decolourise DCPIP.

BALANCED DIET AND EFFECTS OF IMBALANCED DIET

A balanced diet is a diet that contains all the essential nutrients, including carbohydrates, proteins, fats, vitamins, mineral salts, water, and fibre, in the correct proportions required by the body. Nutritional needs vary depending on age, sex, activity level, and health condition. A balanced diet promotes proper growth, energy supply, tissue repair, and good health.

Balanced Diet for Different Groups of People

Balanced Diet for a Baby
Babies require a highly nutritious diet because they grow very rapidly during the first year of life. Breast milk is the best food for babies during the first six months because it provides all nutrients, water, and protective antibodies in the correct amounts. After six months, soft complementary foods such as porridge, mashed fruits, beans, eggs, fish, and vegetables should be introduced while breastfeeding continues.

Effects of Imbalanced Diet in a Baby
Poor nutrition in babies causes serious health problems. Protein and energy deficiency may lead to marasmus or kwashiorkor. Iron deficiency causes anaemia, while vitamin A deficiency affects vision and immunity. Lack of calcium and vitamin D causes rickets, and long-term underfeeding results in stunting and poor brain development.

Balanced Diet for a Child
Children need a balanced diet to support growth, physical activity, and brain development. Their diet should contain carbohydrates for energy, proteins for growth and repair, fats for energy and brain development, vitamins and minerals for body functions, and adequate water. Foods such as cereals, milk, beans, fish, eggs, fruits, and vegetables are important.

Effects of Imbalanced Diet in a Child
An imbalanced diet in children can cause stunted growth, wasting, anaemia, poor learning ability, weak bones, and vitamin deficiencies. Excessive sugary foods may cause dental decay and childhood obesity, increasing the risk of diseases later in life.

Balanced Diet for an Adult Woman
Adult women require a balanced diet rich in iron, calcium, proteins, vitamins, and folic acid. Iron is important because women lose blood during menstruation. Pregnant and breastfeeding women need extra nutrients to support the growth of the baby and milk production. Foods such as leafy vegetables, milk, beans, meat, fruits, and cereals are important.

Effects of Imbalanced Diet in an Adult Woman
Poor nutrition in women may cause iron deficiency anaemia, weakness, poor immunity, osteoporosis, infertility, and complications during pregnancy. Lack of folic acid during pregnancy may cause birth defects, while excessive intake of fatty and sugary foods may lead to obesity and cardiovascular diseases.

Balanced Diet for an Adult Man
Adult men require adequate carbohydrates, proteins, healthy fats, vitamins, minerals, and fibre to maintain energy, muscle mass, and overall health. Fibre-rich foods, fruits, vegetables, and balanced calorie intake help reduce the risk of chronic diseases.

Effects of Imbalanced Diet in an Adult Man
An imbalanced diet in men may cause obesity, hypertension, diabetes, heart disease, and high cholesterol. Lack of protein causes muscle weakness, while excessive alcohol consumption may lead to liver disease and nutritional deficiencies.

Balanced Diet for an Athlete
Athletes require large amounts of carbohydrates for energy, proteins for muscle repair and growth, and sufficient water for hydration. Vitamins and minerals such as iron, calcium, and zinc are also important. Their diet must support intense physical activity and recovery after exercise.

Effects of Imbalanced Diet in an Athlete
Poor nutrition in athletes causes fatigue, poor performance, dehydration, muscle loss, slow recovery, and increased risk of injury. Iron deficiency reduces oxygen transport, while severe calorie restriction may weaken bones and affect overall health.

Balanced Diet for an Inactive Person
Inactive people require fewer calories because they use less energy. Their diet should contain moderate carbohydrates, adequate proteins, healthy fats, vitamins, minerals, and plenty of fibre. Nutrient-rich foods such as fruits, vegetables, legumes, and whole grains are recommended.

Effects of Imbalanced Diet in an Inactive Person
Excessive calorie intake combined with inactivity commonly leads to obesity. This increases the risk of diabetes, hypertension, heart disease, joint problems, and some cancers. Low fibre intake may cause constipation and poor digestive health.

DANGERS OF OBESITY, BULIMIA, ANOREXIA, AND DRUG USE IN HUMANS

Obesity

Obesity is a condition in which excessive body fat accumulates in the body due to taking in more energy than is used. It is commonly caused by overeating, lack of physical activity, genetic factors, and unhealthy lifestyles.



Dangers of Obesity
Obesity increases the risk of serious diseases such as hypertension, heart disease, stroke, and type 2 diabetes. Excess body weight also causes joint problems, breathing difficulties, and sleep apnoea. Obesity may increase the risk of certain cancers and fatty liver disease. It can also lead to low self-esteem, depression, and social isolation.

Bulimia Nervosa

Bulimia nervosa is an eating disorder in which a person repeatedly eats very large amounts of food and then attempts to remove the food from the body through vomiting, excessive exercise, or misuse of laxatives because of fear of gaining weight.



Dangers of Bulimia
Repeated vomiting damages the teeth because stomach acid erodes the enamel. Bulimia also causes dehydration and dangerous loss of body salts such as potassium, which may lead to abnormal heart rhythms. Damage to the oesophagus, swollen salivary glands, digestive problems, anxiety, depression, and poor mental health are also common.

Anorexia Nervosa

Anorexia nervosa is an eating disorder in which a person severely restricts food intake because of an intense fear of gaining weight, even when extremely thin. The person usually has a distorted body image and believes they are overweight.



Dangers of Anorexia

Anorexia causes severe malnutrition, extreme weight loss, muscle wasting, and weakness. The heart becomes weak, leading to dangerous heart problems and even death. Bone loss, hormonal imbalance, infertility, poor immunity, depression, and brain function problems may also occur. In severe cases, starvation can cause organ failure.

Diet Pills

Diet pills are substances used to reduce body weight by suppressing appetite, increasing metabolism, or reducing fat absorption. Some are used without medical supervision.



Dangers of Diet Pills

Diet pills may increase heart rate and blood pressure, leading to heart attacks or strokes. Some cause addiction, anxiety, insomnia, and mood changes. They may also damage the liver, cause dehydration, digestive problems, and dangerous electrolyte imbalances. Reliance on diet pills may prevent healthy lifestyle changes.

Anabolic Steroids

Anabolic steroids are artificial forms of testosterone used to increase muscle size and athletic performance. Although sometimes used medically, they are often abused by athletes and bodybuilders.

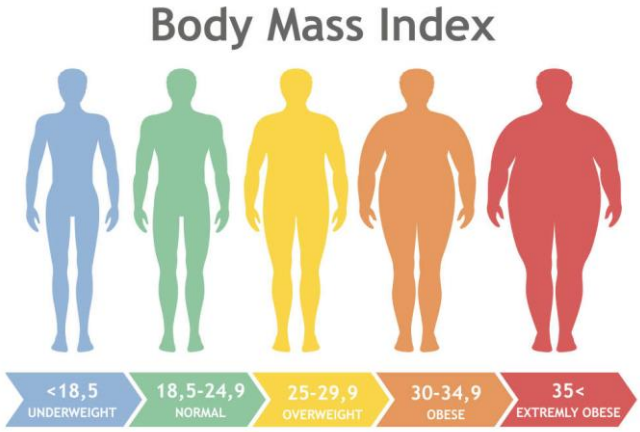


Dangers of Anabolic Steroids

Steroid misuse causes serious heart and liver damage. It may lead to high blood pressure, heart attack, stroke, infertility, and hormonal imbalance. In males, steroids may cause shrinking of the testes and breast enlargement, while in females they may cause deepening of the voice and growth of facial hair. Steroids may also cause aggressive behaviour, depression, acne, and stunted growth in adolescents.

BODY MASS INDEX (BMI)

Body Mass Index (BMI) is a simple numerical measure that relates a person's body weight to their height. It was developed in the 19th century by Belgian mathematician Adolphe Quetelet and has since been adopted worldwide as a quick screening tool to assess whether a person's weight might pose a health risk. It is important to understand from the outset that BMI is a screening tool, not a diagnostic one, it flags potential concerns but does not directly measure body fat or overall health.



How is it Calculated?

The formula differs slightly depending on the unit system. In the metric system, you divide a person's weight in kilograms by the square of their height in metres. In the imperial system, you divide weight in

pounds by the square of height in inches, then multiply the result by 703 to convert the units correctly.

$$\textbf{BMI} = \textbf{weight (kg)} \div \textbf{height}^2\ (\textbf{m}^2)$$

Worked Example

Suppose we have a 35-year-old woman named Sarah. She weighs **70 kg** and is **1.65 metres** tall. To find her BMI, we first square her height: $1.65 \times 1.65 = \mathbf{2.7225\ m^2}$. We then divide her weight by this figure: $70 \div 2.7225 = \mathbf{25.7}$.
Sarah's BMI is therefore **25.7**, which places her in the Overweight category (25.0–29.9) according to WHO classifications.

However, this single number tells us nothing about where Sarah carries her weight, how much of it is muscle versus fat, her fitness level, her diet, or her family history. A physically active Sarah with good metabolic markers may be at no greater health risk than someone with a BMI of 23. This is precisely why BMI must be interpreted with context.

What the Categories Mean

Once a BMI is calculated, it is compared against standard ranges. A BMI below 18.5 is considered underweight, which can indicate malnutrition or other health concerns. The range of 18.5 to 24.9 is classified as normal or healthy weight. From 25.0 to 29.9 is overweight, and anything at 30 or above falls into the obese range, which is further subdivided into Class I (30–34.9), Class II (35–39.9), and Class III (40 and above), each associated with progressively higher health risks such as type 2 diabetes, hypertension, and cardiovascular disease.

THE EFFECTS AND SOLUTIONS OF ABNORMAL BODY WEIGHT

Being Underweight

Being underweight occurs when a person has a body mass index (BMI) below 18.5. It may result from poor nutrition, illness, eating disorders, high metabolism, or lack of enough food.

Effects of Being Underweight

Underweight individuals often suffer from nutritional deficiencies that weaken the immune system and increase the risk of infections. Muscle wasting, weakness, fatigue, and poor physical performance are common. Bone density may decrease, increasing the risk of fractures and osteoporosis. In women, hormonal imbalance may cause irregular menstruation and infertility. Severe undernutrition may also affect heart function, mental health, growth, and brain development in children.

Solutions to Being Underweight

Treatment involves increasing intake of nutritious foods rich in proteins, healthy fats, vitamins, and carbohydrates. Foods such as eggs, milk, fish, beans, nuts, and whole grains are recommended. Strength training exercises help build muscle mass. Medical treatment and counselling may also be necessary, especially when eating disorders or illnesses are involved.

Being Overweight or Obese

Overweight and obesity occur when a person has excessive body fat due to consuming more energy than the body uses. Causes include unhealthy diets, physical inactivity, stress, genetic factors, and some medical conditions.

Effects of Being Overweight or Obese

Excess body weight increases the risk of cardiovascular diseases, hypertension, stroke, and type 2 diabetes. It also causes joint problems, sleep apnoea, breathing difficulties, and fatty liver disease. Obesity increases the risk of certain cancers and may negatively affect mental health, leading to low self-esteem, depression, and social isolation.

Solutions to Being Overweight or Obese

Management involves adopting healthy eating habits and regular physical activity. A balanced diet rich in fruits, vegetables, fibre, and whole grains while reducing fatty and sugary foods is important. Regular exercise such as walking, running, swimming, or cycling helps burn excess calories. Counselling and behavioural support may help individuals develop healthy habits. In severe cases, medical treatment or surgery may be required.

SELF-ESTEEM AND BODY WEIGHT

Self-esteem is the way a person values and feels about themselves. It influences confidence, behaviour, and emotional wellbeing. Body weight and physical appearance can strongly affect self-esteem.

Effects of Body Weight on Self-Esteem
People who are underweight or overweight may feel dissatisfied with their appearance because of social pressure and unrealistic body standards. This may lead to embarrassment, anxiety, depression, social withdrawal, and low confidence. Children and adolescents are especially vulnerable to teasing and bullying related to body weight.
Self-Esteem in Underweight Individuals
Underweight individuals may feel weak, unattractive, or unhealthy. Those with eating disorders may develop a distorted body image and fear gaining weight. Poor nutrition can also affect brain function and emotional stability, worsening low self-esteem.
Self-Esteem in Overweight and Obese Individuals
Overweight and obese individuals may experience discrimination, bullying, and social stigma. These experiences can lower confidence and increase stress, depression, and emotional eating, creating a cycle of further weight gain and poor self-image.
Building Healthy Self-Esteem
Healthy self-esteem can be improved through counselling, positive social support, self-compassion, and setting realistic health goals. Focusing on healthy habits rather than appearance alone helps individuals develop confidence and better emotional wellbeing.

PLANT MINERAL NUTRIENTS

Plants manufacture carbohydrates through photosynthesis using carbon dioxide and water. However, for proper growth and development, plants also require mineral nutrients absorbed from the soil. These nutrients dissolve in soil water and are absorbed by plant roots in the form of mineral ions. Mineral nutrients are essential for growth, metabolism, reproduction, and the completion of the plant life cycle.

Nitrogen

Plants absorb nitrogen mainly as nitrate ions (NO_3^-) from the soil. Nitrogen is required for the formation of amino acids and proteins. Proteins are important because they form enzymes, growth hormones, and chlorophyll used in photosynthesis. Nitrogen is also needed for the formation of nucleic acids such as DNA and RNA which control inheritance and growth.
A deficiency of nitrogen causes stunted growth and yellowing of older leaves, a condition called chlorosis. This occurs because chlorophyll cannot be produced adequately.

Phosphorus

Plants absorb phosphorus in the form of phosphate ions (PO_4^{3-}). Phosphorus is important for energy transfer, protein synthesis, and the formation of nucleic acids. It also promotes root growth, flowering, fruit formation, and cell division.
Plants lacking phosphorus develop weak root systems, stunted growth, reddish or purple leaves, and premature dropping of leaves and fruits.

Magnesium

Magnesium is absorbed as magnesium ions (Mg^{2+}). It is an essential component of chlorophyll and is also important in activating enzymes involved in plant metabolism.
Magnesium deficiency causes poor growth, poor fruit development, and yellowing between the veins of leaves, known as interveinal chlorosis. Severe deficiency may lead to premature death of the plant.

Potassium

Potassium is required for many plant processes including enzyme activation, energy production, and regulation of stomatal opening and closing. It helps plants resist diseases, improves root development, and prevents wilting during dry conditions.
Deficiency of potassium causes yellowing between leaf veins, scorching and curling of leaf tips, weak growth, and poor seed and fruit development. Purple spots may also appear on the lower side of leaves.

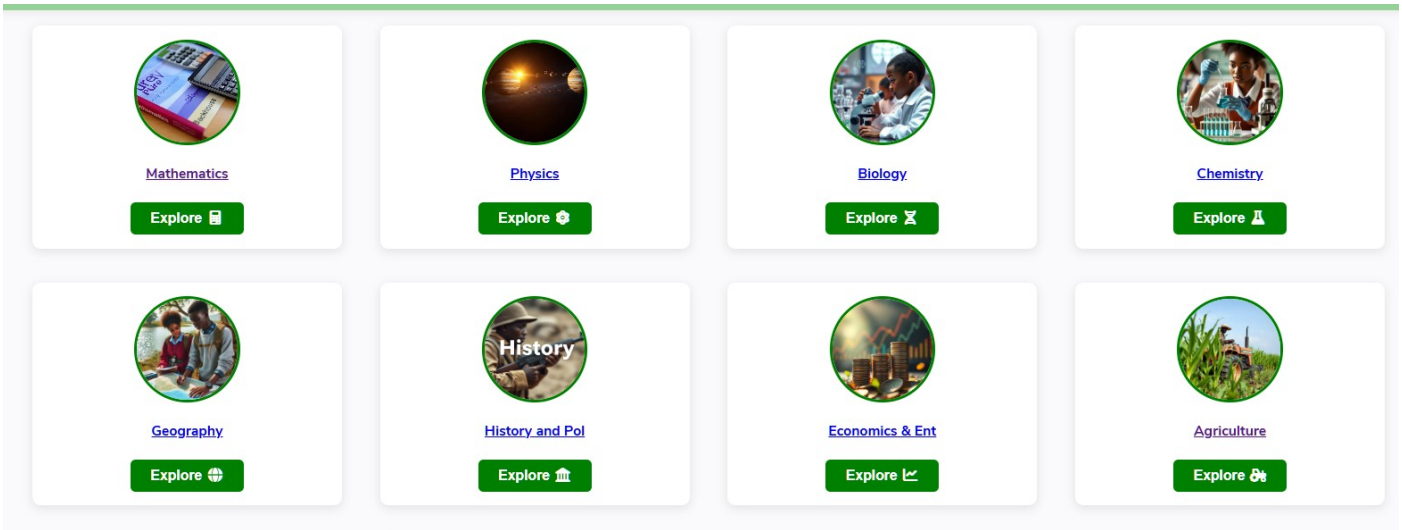
Sulphur

Plants absorb sulphur in the form of sulphate ions (SO_4^{2-}). Sulphur is needed for the formation of proteins, amino acids, and vitamins. It also helps in seed and fruit development and acts as a natural fungicide.
Sulphur deficiency causes yellowing of leaves and weak, slender stems.

Calcium

Calcium is absorbed as calcium ions (Ca^{2+}). It is important for the formation of cell walls and cell membranes. Calcium also helps maintain healthy growth and increases resistance to diseases.
Plants lacking calcium show poor root growth and stunted development of young leaves and tissues. Young leaves may develop small brown spots along the margins which later spread across the leaf.

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